Appendix 4-1: Supplemental Information for the Everglades Construction Project Basins in the Southern Everglades

Edited by Carlos Adorisio, Doug Pescatore
and Youchao Wang

Contributors: Jonathan Madden, Thomas Davison,
Lacramioara Ursu and Cordella Miessau

INTRODUCTION

The Everglades Forever Act (EFA), Section 373.4592, Florida Statutes (F.S.), mandates permittees to implement best management practices (BMPs) in the Everglades Agricultural Area (EAA) and C-139 basins to achieve specified total phosphorus (TP) loads. A monitoring network is maintained to assess program performance and make adjustments when necessary to assure compliance [Paragraph 373.4592(4)(f), F.S.] This appendix summarizes required monitoring and supplemental data evaluations for these basins during Water Year 2015 (WY2015) (May 1, 2014–April 30, 2015). It provides the underlying data employed in the overall load performance and compliance determination for both the EAA and C-139 basins. Upstream permit-level data in the EAA Basin and subbasin data in the C-139 Basin used for secondary compliance determination in the event of basin-level noncompliance are presented. Supplemental evaluations of the rainfall, flow, and TP load distribution among the EAA subbasins are included.

This appendix provides the following:

- EAA Basin compliance calculation details
- EAA Basin basin-level water quality summaries
- EAA Basin water quality summaries by subbasin
- EAA Basin short-term and long-term variations in rainfall and runoff
- EAA Basin permit-level water quality monitoring data
- C-139 Basin compliance calculation details
- C-139 Basin basin-level water quality summaries
- C-139 Basin short-term and long-term variations in rainfall and runoff
- C-139 Basin water quality summaries by subbasin

EAA BASIN SUPPLEMENTAL EVALUATION

EAA BASIN COMPLIANCE CALCULATION DETAILS

Compliance with statutory mandates for phosphorus levels in the EAA Basin runoff is based on the South Florida Water Management District (District or SFWMD) applying mathematical equations and the methodology outlined in Chapter 40E-63, Florida Administrative Code (F.A.C.). **Figure 1** provides the monthly rainfall totals for the EAA Basin during WY2015 and related coefficients used to calculate the target load per the equations. The target load is based upon a 25 percent reduction of the predicted load. The predicted load is the pre-BMP baseline period load adjusted for the hydrologic variability associated with rainfall as well as accounting for a reduction in the EAA Basin area by a factor equal to the current acreage divided by the baseline acreage. The limit load is the upper 90 percent confidence limit for the target load. The calculated limit is not considered for the compliance determination in WY2015 because the basin runoff load was less than the target load. For the purposes of this methodology, runoff load refers to the permittee's offsite discharges impacted by BMPs. It is computed as TP load discharged from the EAA Basin boundary as a whole, less external loads crossing into the basin boundary: (1) based on the basin boundary established for the baseline period of WY1980–WY1988 and (2) for pass-through operation delivering water to areas south or east of the EAA.

EAA BASIN-LEVEL MONITORING

Chapter 40E-63, F.A.C. requires the District to report on the status of the EAA Basin's compliance with TP load mandates based on required water quality monitoring. Appendices A3 and B2 of Chapter 40E-63, F.A.C., outline monitoring and data collection requirements.

Basin-level compliance determination is based on water year monitoring at various inflow and outflow points defining the boundary of four major EAA subbasins (S-5A, S-2/S-6, S-2/S-7, and S-3/S-8) and at conveyance canals serving these subbasins. **Table 1** provides TP sampling statistics for all District-monitored locations in the EAA Basin during WY2015. The locations of the EAA boundary structures represented as inflows and outflows in **Table 1** are depicted in Figure 4-3 in Chapter 4 of this volume.

During WY2015, 17 structures comprised the model compliance boundary of the EAA Basin, and 19 monitored sampling points represented the water quality in discharges through those structures. Some structures are designed to move water in two directions, with water quality samples being collected on the upstream side for flow in either direction.

EAA BASIN-LEVEL WATER QUALITY SUMMARY

TP loads from the surface water runoff attributable to the lands within the EAA Basin are evaluated on an annual basis taking into account the basin boundary changes from lands converted to the Everglades Stormwater Treatment Areas (STAs), quantification of inflows crossing the EAA Basin boundaries from external sources, and addition of new EAA Basin boundary water control structures. A map showing 2009 land use in the EAA Basin is presented in **Figure 2**.

To interpret TP measurements taken at inflow and outflow water control structures defining the boundary of the EAA Basin, it is important to recognize that water leaving the EAA Basin through these structures is a combination of EAA farm- and urban-generated runoff as well as water passing through the EAA Basin canals from external sources. Therefore, EAA Basin discharge monitoring data includes pass-through from Lake Okeechobee as well as runoff from areas that historically discharged to Lake Okeechobee (regulated under Chapter 40E-61, F.A.C., Permit Number 50-00001-Q, addressing source control activities for runoff to Lake Okeechobee) but were diverted south for treatment through the STAs (a.k.a. 298 Diversion Project). Once diverted to the

STAs, these diversion project areas were also subject to existing requirements (BMP implementation) and anticipated amendments (25 percent TP load reduction) under Chapter 40E-63, F.A.C. Because the original rule-adopted baseline period did not include data representative of these discharges to Lake Okeechobee, these diversion areas are considered external sources crossing into the EAA Basin boundary and are not currently evaluated for the 25 percent TP load reduction requirement adopted under Chapter 40E-63, F.A.C. As such, inflows from these EAA 298 and 715 Farms Diversion Basin areas to the EAA must be separated from the EAA Basin runoff until an appropriate performance measure method is adopted by regulations (see *EAA Permit-level Monitoring* section of this appendix). The EAA 298 and 715 Farms Diversion Basins depicted in Figures 4-3 and 4-4 in Chapter 4 of this volume include the South Florida Conservancy District, South Shore Drainage District, East Beach Water Control District, East Shore Water Control District, and 715 Farms (Closter Farms). The runoff from lands within the diversion areas enters the EAA through four pump stations: East Beach Water Control District (pump station EBPS3), the combined area of East Shore Water Control District and Closter Farms (pump station ESPS2), South Shore Drainage District (pump station SSDDMC), and South Florida Conservancy District (pump station SFCD5E).

Table 2 summarizes the annual flow, TP load, and TP flow-weighted mean concentration (FWMC) for every structure used during WY2015 to determine overall compliance with EAA Basin load reduction requirements. The structure summaries present the annual flow and TP load at each structure representing an EAA subbasin inflow or outflow. Annual individual summaries are not intended to be aggregated to mass balance the flows and loads for a reported EAA Basin TP runoff load. The runoff determination procedures outlined in Chapter 40E-63, F.A.C., for deriving the annual water year TP load values within the EAA Basin are accomplished through considering daily inflows to the EAA, excluding irrigation flow, subtracted from the outflow results for the entire EAA Basin.

WY2015 EAA basin estimate TP load calculation

See 40E-63 Appendix A for "Target" equation

Month	Rainfall	(in)			
May	3.12	in	m_1 =	3.70	
June	7.14	in	m_2 =	8.03	
July	7.98	in	m_3 =	14.91	
August	5.87	in	X =	3.794	
September	8.89	in	C =	0.800	
October	2.12	in	S =	0.714	
November	1.87	in	SE =	0.2011	
December	0.79	in			
January	0.47	in	Target[1] TP Load =	139.0	mt
February	2.23	in	Limit[2] TP Load =	187.0	mt
March	1.12	in	Runoff TP Load =	38.7	mt
April	2.82	in	Predicted =	185.3	mt
Total Rainfall	44.42	in	% Reduction =	79%	

Notes:

[1] Target load is adjusted for reduction in EAA land area (463030 ac./ 523721 ac.)
Target load calculation accounts for 25% reduction of baseline period loads

[2] Limit load is upper 90% confidence limit for Target

[3] Predicted load = Target load / (1 - 0.25)

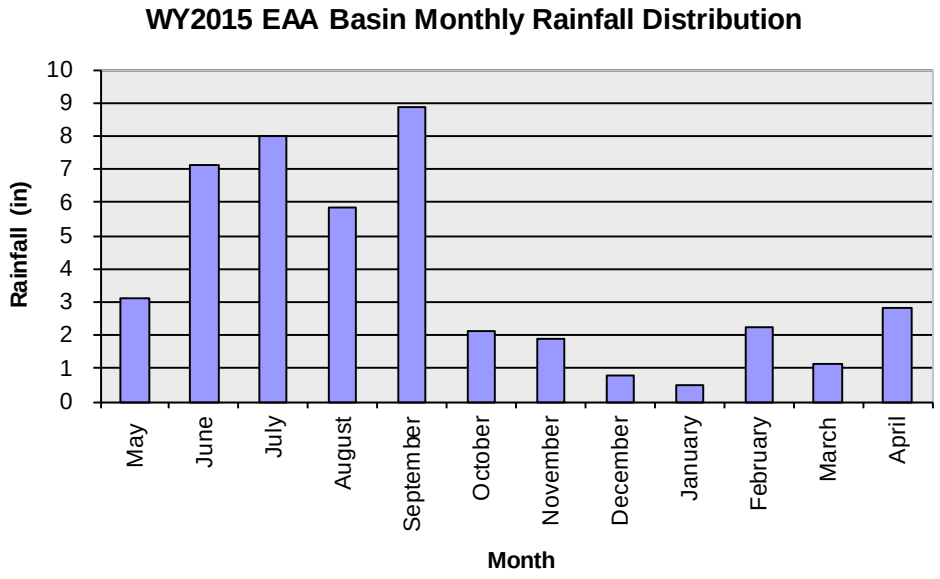

Figure 1. WY2015 EAA Basin monthly rainfall totals, compliance calculation coefficients, and target TP load calculation.
[Note: ac. – acres; in – inches; and mt – metric tons.]

Table 1. Summary statistics for WY2015 TP monitoring data for the EAA Basin.

Subbasin (canal)	Structure	Sampling Point	Sample Type	Number of Samples	Number Used in Load Calculation	Minimum Observed (µg/L)	Maximum Observed (µg/L)	Number Flagged	Flow Curve Rating[a]
S-5A (West Palm Beach Canal)	S-352	S-352	Grab	79	60	99	596	0	Excellent
			Composite[c]	42	42	92	334	0	
	S-5A Complex	S-5A	Grab[d]	232	192	74	295	0	Excellent
			Composite[c, e]	44	44	103	146	0	
	EBPS	EBEACH	Grab	36	14	88	1,061	0	Good[f]
			Composite[c]	28	27	118	962	0	
S-2/S-6 (Hillsboro Canal)	S-2 Complex	S2	Grab	14	1	55	129	0	Good
			Composite[c]	3	1	137	204	0	
		S351	Grab	51	39	50	159	0	Fair
			Composite[c]	42	42	39	759	0	
	S-6	S-6	Grab	52	15	18	176	0	Fair
			Composite[c]	47	45	26	141	1	
	G-328	G328	Grab	52	20	9	174	0	Fair
			Composite[c]	28	28	17	84	0	
	ESPS	ESHORE2	Grab	52	11	37	387	0	Good[f]
			Composite[c]	24	23	43	156	0	
S-2/S-7 (North New River Canal)	S-2 Complex	S2	Grab	14	1	55	129	0	Good
			Composite[c]	3	1	137	204	0	
		S351	Grab	51	39	50	159	0	Fair
			Composite[c]	42	42	39	759	0	
	G-370	G-370	Grab	52	7	13	106	0	Excellent
			Composite[c]	26	26	18	89	0	
	G-371	G-371	Grab	52	0	13	88	0	Fair
			Composite[c]	0	0			0	
	G-434	G434	Grab	52	36	18	114	0	Good
			Composite[c]	42	42	16	109	0	
	G-435	G435	Grab	52	13	14	67	0	N/A[g]
			Composite[c]	25	25	13	45	0	

Table 1. Continued.

Subbasin (canal)	Structure	Sampling Point	Sample Type	Number of Samples	Number Used in Load Calculation	Minimum Observed (µg/L)[a]	Maximum Observed (µg/L)	Number Flagged	Flow Curve Rating[b]
S-3/S-8 (Miami Canal)	S-3 Complex	S3	Grab	15	0	51	181	0	Excellent
			Composite[c]	2	0	123	131	0	
		S354	Grab	51	40	52	151	0	Good
			Composite[c]	45	45	30	166	0	
	G-136	G136	Grab	22	19	21	519	0	Poor[h]
			Composite[c]	21	21	32	403	0	
	SSDDMC	SSDDMC	Grab	52	10	32	135	0	Good
			Composite[c]	26	23	29	150	0	
	SFCD5E	SFCD5E	Grab	52	20	33	156	0	Excellent
			Composite[c]	24	31	45	227	0	
	G-372	G-372	Grab	52	44	30	156	0	Good
			Composite[c]	50	50	34	129	0	
	G-373	G-373	Grab	52	3	24	196	0	Good
			Composite[c]	2	2	50	69	0	

a. Notes: µg/L = microgram per liter; 1 µg/L = 1 part per billion (ppb).

b. Flow curve ratings – discharge estimates derived from theoretical equations are within a range of expected values based on streamflow measurements used to calibrate the theoretical equations and are classified as excellent (< 5%), good (< 10%), fair (< 15%), or poor (> 15%).

c. Composite samples could be time-proportional, flow-proportional, or a combination of the two.

d. Represents discrete daily samples.

e. Represents the 39 sampling periods containing 151 discrete daily samples.

f. Good, based on experience with theoretical ratings based on pump manufacturers' performance curves, but streamflow measurements are not sufficient to calibrate theoretical equations and the flow curve rating cannot adequately be determined.

g. N/A – not available due to lack of field measurements.

h. Streamflow measurements are not sufficient to calibrate theoretical equations and the flow curve rating cannot adequately be determined.

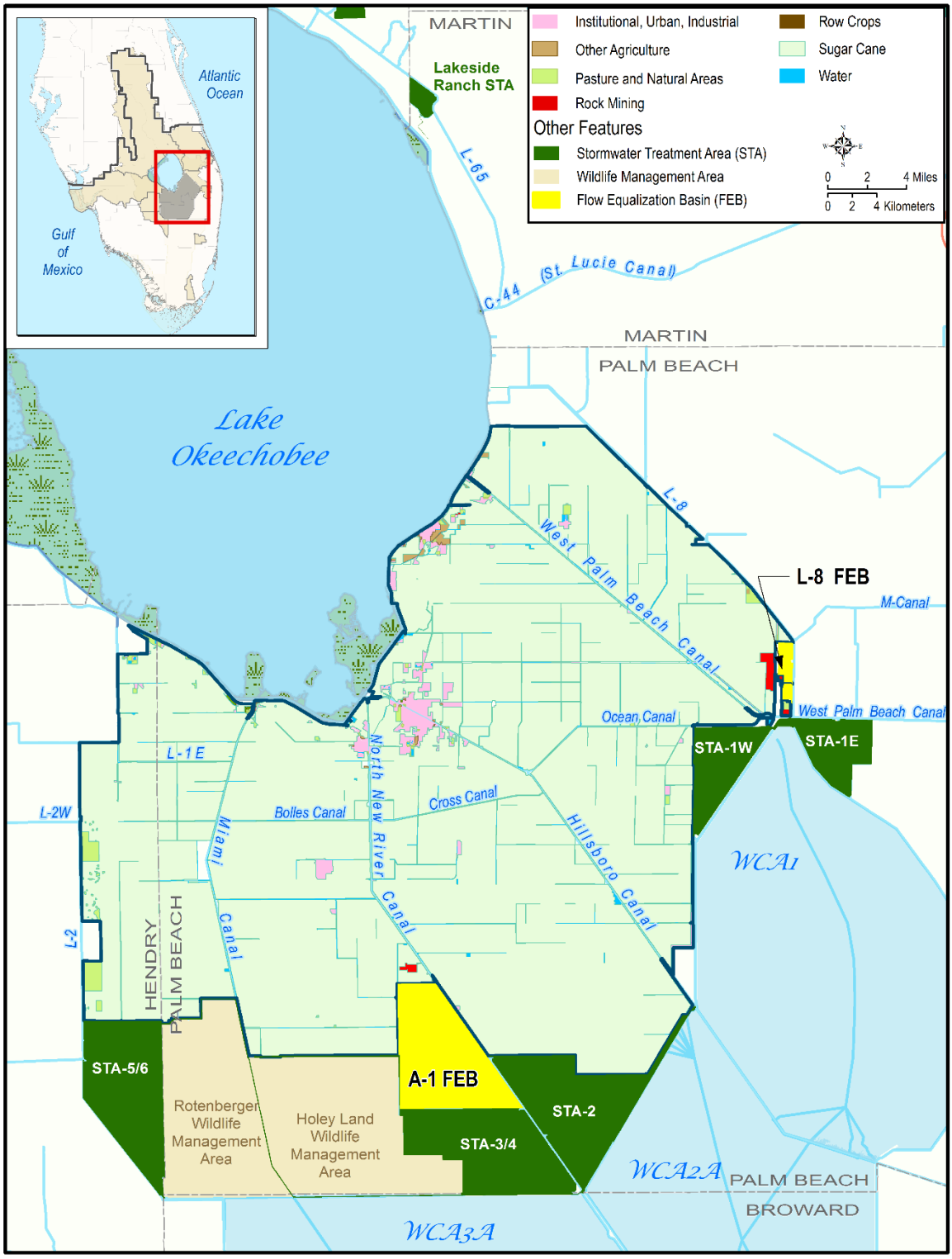

Figure 2. Land use data (2009) for the EAA Basin and primary compliance water control structures. [Note: FEB – Flow Equalization Basin; and WCA – Water Conservation Area.]

Table 2. WY2015 flow volumes, TP loads, and TP FWMC for EAA Basin structures.

Subbasin (Canal)	Direction		Structure	Load (mt)[a]	Flow (kac-ft)[b]	Concentration (µg/L)[c]
S-5A (West Palm Beach Canal)	**Outflow**	to Lake Okeechobee	S-352	0.00	0.00	N/A[d]
		to STA-1 inflow and distribution works	S-5A + S-5AW	61.40	345.33	144
		Total		**61.40**	**345.33**	**144**
	Inflow	from Lake Okeechobee	S-352	60.57	261.38	188
		from L-8 Canal/C-51 Canal	S-5A + S-5AW	0.01	0.05	124
		from East Beach Water Control District[e]	EBPS[e]	4.35	7.71	458
		Total		**64.93**	**269.14**	**196**
S-2/S-6 (Hillsboro Canal)	**Outflow**	to Lake Okeechobee[f]	S-2	0.16	0.67	198
		to STA-2 inflow distribution canal	S-6	36.22	367.97	80
		to STA-2 inflow distribution canal	G-328	1.07	22.18	39
		Total		**37.46**	**390.82**	**78**
	Inflow	from Lake Okeechobee[f]	S-351	71.90	479.10	122
		from East Shore Water Control District and Closter Farms	ESPS2	2.60	19.89	106
		Total		**74.50**	**498.99**	**121**
S-2/S-7 (North New River Canal)	**Outflow**	to Lake Okeechobee[f]	S-2	see S-2 above[f]		
		to STA-3/4	G-370	5.60	67.40	67
		to STA-3/4 bypass structure	G-371	0.00	0.05	27
		to STA-2	G-434	9.80	124.42	64
		to STA-2	G-435	0.67	20.17	27
		Total[2]		**16.08**	**212.04**	**61**
	Inflow	from Lake Okeechobee[f]	S-351	see S-351 above[f]		
		from Water Conservation Area 2	G-371	0.00	0.00	N/A
		Total[f]		**0.00**	**0.00**	**N/A**
S-3/S-8 (Miami Canal)	**Outflow**	to Lake Okeechobee	S-3	0.01	0.07	89
		to STA-3/4	G-372	43.36	434.26	81
		to STA-3/4 bypass structure	G-373	0.56	7.72	59
		Total		**43.94**	**442.05**	**81**
	Inflow	from Lake Okeechobee	S354 (S3)	38.48	302.20	103
		from South Shore Drainage District	SSDDMC	0.70	6.27	91
		from South Florida Conservancy District	SFCD5E	1.80	17.32	84
		from Water Conservation Area 3	G-373	0.00	0.00	N/A
		from C-139 Basin	G-136	3.66	24.28	122
		Total		**44.64**	**350.07**	**103**

a. mt = metric tons.

b. kac-ft = thousand acre-feet.

c. µg/L = microgram per liter; 1 µg/L = 1 part per billion (ppb).

d. N/A – not available.

e. The load and flow shown represent 81.3 percent of the runoff flow and load at the EBPS3 structure in order to exclude a 1,233-acre portion of the East Beach Water Control District not represented in EAA baseline period as they were discharges to Lake Okeechobee.

f. The S-351 inflow and S-2 outflow sites serve the S-2/S-6 and S-2/S-7 subbasins. To avoid double counting data, totals for inflows and outflows of the S-2/S-7 subbasin do not include the inflows and outflows from S-351 and S-2, which are included in the S-2/S-6 subbasin totals.

EAA Basin Flows and Total Phosphorus Loads and Flow-Weighted Mean Concentrations by Subbasin

Based on the boundary conditions, **Table 3** presents the summaries of flows and TP loads for each subbasin within the EAA. These summaries generally describe the mass balance of inflows and outflows from the EAA subbasins. The runoff TP load and volume from each subbasin, summing up to a total EAA Basin runoff TP load of 39 metric tons (mt) and runoff volume of 669,775 acre-feet (ac-ft), are noted in this table. More detailed information on the WY2015 load, flow, and TP FWMC at each of the individual inflow and outflow structures, along with TP data collection statistics and the current quality level of flow information at each structure, are presented in **Tables 1** and **2**. The locations of the EAA boundary structures represented as inflows and outflows in **Table 3** are depicted on Figure 4-3 of this volume.

Table 3. EAA subbasin flows and TP loads by source for WY2015.[a]
[Note: kac-ft – 1,000 ac-ft.]

Source	Load (mt)		Flow (kac-ft)	
	Inflow	Outflow	Inflow	Outflow
S-5A Subbasin (West Palm Beach Canal)				
EAA[b]	N/A[c]	10.55	N/A	137.34
Lake Okeechobee	60.57	46.34	261.38	200.28
East Beach Water Control District[d]	4.31	4.31	7.71	7.71
Total	**64.88**	**61.20**	**269.09**	**345.33**
S-2/S-6 Subbasin (Hillsboro Canal)				
EAA[b]	N/A	16.12	N/A	253.76
Lake Okeechobee	25.05	18.67	166.94	116.74
East Shore Water Control District and Closter Farms	2.58	2.58	19.89	19.89
Total	**27.63**	**37.38**	**186.83**	**390.38**
S-2/S-7 Subbasin (North New River Canal)				
EAA[b]	N/A	1.87	N/A	105.16
Lake Okeechobee	46.85	14.32	312.17	107.32
Total	**46.85**	**16.18**	**312.17**	**212.48**
S-3/S-8 Subbasin (Miami Canal)				
EAA[b]	N/A	10.13	N/A	173.52
Lake Okeechobee	38.48	27.65	302.20	220.66
C-139	3.66	3.66	24.28	24.28
South Shore Drainage District	0.70	0.70	6.27	6.27
South Florida Conservancy District	1.80	1.80	17.32	17.32
Total	**44.64**	**43.94**	**350.07**	**442.05**

a. The total loads and flows leaving the subbasins represent pass-through volumes as well as volumes originating within the basin. With the exception of lake inflows, it is assumed that 100 percent of all other inflow sources to the EAA subbasins pass through the main EAA conveyance canals directly to the outlet of each subbasin. These assumptions are mandated in the model developed under Chapter 40E-63, F.A.C., for determining EAA Basin TP load reductions. Any inflows from the water conservation areas or the L-8 Canal/C-51 Canal are not represented in this table, as they are not used in the EAA Basin-scale Compliance Model.

b. EAA represents each subbasin's portion of total EAA Basin TP load and volume from runoff.

c. N/A – not applicable.

d. The load and flow shown represent 81.3 percent of the runoff flow and load at the EBPS3 structure in order to exclude a 1,233-acre portion of the East Beach Water Control District represented in the EAA baseline period.

Annual computation of the EAA Basin's TP load reduction for compliance determination requires quantification of TP load sources in discharges from the EAA as defined by Chapter 40E-63, F.A.C., in order to establish the portion of the total TP load attributable to the EAA Basin permittees. EAA Basin permittee (runoff) TP load is estimated based on the total TP load discharged from each EAA subbasin boundary less TP load entering in pass-through operation water, which flows from Lake Okeechobee south through the EAA, and less TP load from other external non-irrigation sources that flow into the EAA boundary. Inflows to the EAA Basin from Lake Okeechobee, water conservation areas, and L-8 Canal/C-51 Canal to meet irrigation demands and canal-level management consistent with baseline period agricultural operations do not affect the EAA Basin TP load calculation when estimating EAA Basin permittee runoff. The many sources of water for each subbasin are indicated in **Table 3**. For example, during WY2015, the Miami Canal conveyed EAA Basin permittee runoff, Lake Okeechobee pass-through flows, C-139 Basin permittee runoff, and external loads from two diversion area basins (South Florida Conservancy District and South Shore Drainage District) to the Stormwater Treatment Area (STA-) 3/4 inflow structure (G-372). Therefore, G-372 received multiple sources of water of varying amounts (flow and TP load), which contributed to the total flow and TP load measured at that site.

It should be noted that this document does not quantify or report how flows and TP loads from the various sources are allocated or apportioned to the various subbasin outflow points. However, this information is useful in knowing how much water from sources external to the EAA Basin (Lake Okeechobee and EAA 298 and 715 Farms Diversion Basins), in addition to EAA Basin permittee runoff, is routed for treatment into an STA as allowed by capacity constraints in any given water year. This detailed information is reported in other chapters of this volume, specifically Chapters 3A and 5B, which provide a comprehensive picture of flow and TP loads (and the source) being discharged to the Everglades Protection Area (EPA) and STA performance, respectively.

Another measure of the EAA Basin permittee runoff is the individual EAA permit-level monitoring data (**Table 4** in the *EAA Permit-Level Monitoring* section of this appendix), which represents the discharges from each farm structure into the regional canal system. These data are collected by the permittee. In contrast, the EAA Basin permittee runoff described above is District-collected data at the EAA Basin boundary structures of the regional canal system. Although permit-level discharges do not always result in EAA Basin runoff at a boundary structure, analysis of the timing, location, and volumes can provide insight into the EAA Basin runoff TP load.

EAA Basin Short-Term and Long-Term Variations

Rainfall variation in both spatial and temporal distribution influence runoff patterns throughout the basin. For instance, rainfall in excess of 1 inch would be more likely to result in a farm discharging offsite during the summer months than during the winter and spring when basinwide rainfall is at its lowest and irrigation demand is high.

Figure 3 depicts the variation of WY2015 subbasin monthly rainfall compared to the total monthly rainfall for the EAA Basin. A more detailed summary of WY2015 rainfall and predicted load adjustments based on Chapter 40E-63, F.A.C., compliance calculations for the EAA is provided in the *EAA Basin Compliance Calculation Details* section of this appendix. Chapter 2 of this volume includes details of the hydrologic events that occurred throughout the District region during WY2015.

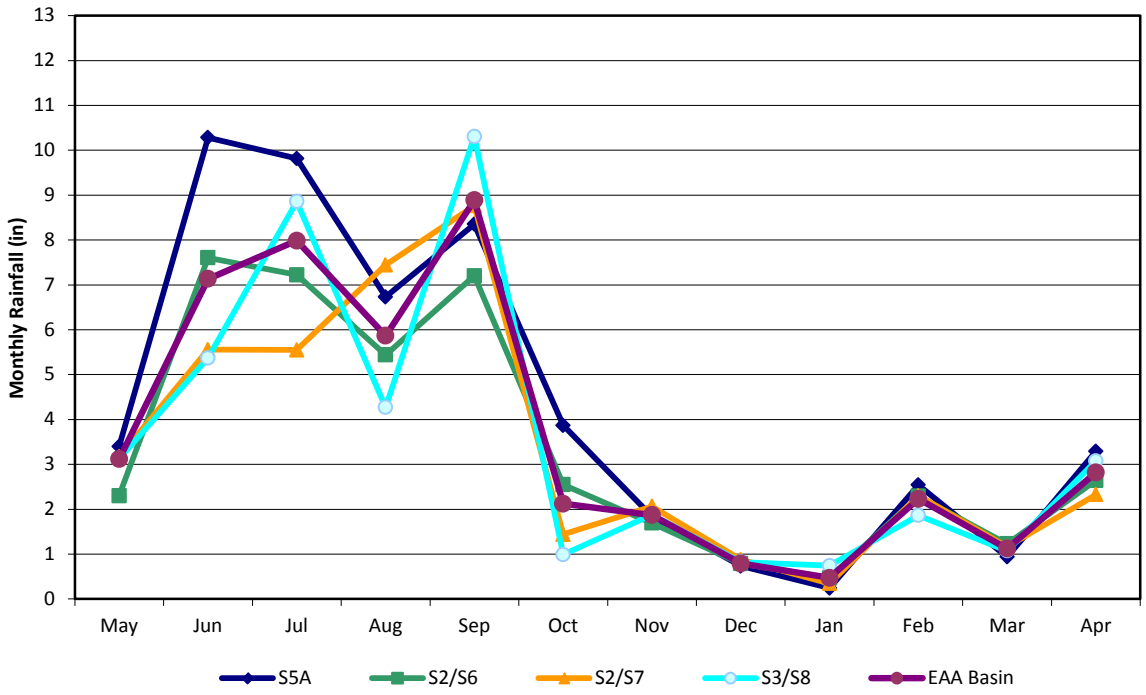

Figure 3. WY2015 EAA Basin and subbasins monthly rainfall distribution trend.

Since WY1996, runoff volumes between the subbasins have typically shown a more evenly distributed and narrow range of variation than TP load when based on the percent contribution of each (typically 20 to 30 percent each) to the total EAA Basin runoff (**Figure 4**, top panel). A wider range of variation is observed with runoff TP loads among the subbasins (**Figure 4**, bottom panel). Over the last five years, the S-2/S-6 Basin has shown an increase in the percentage of the EAA Basin runoff flow, with four of the past five years being over 30 percent. The runoff load percentages for S-2/S-6 do not show the same trend.

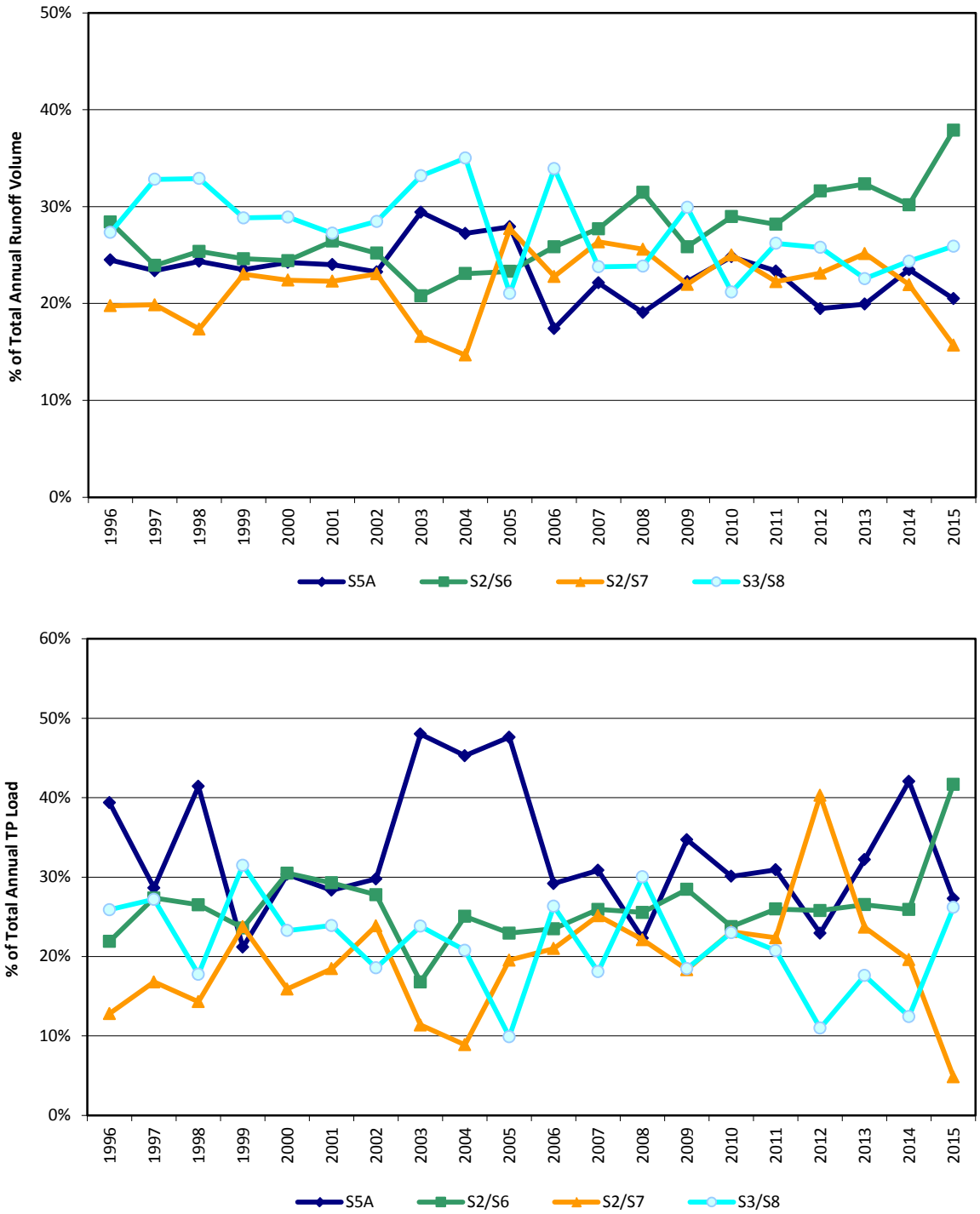

Figure 4. WY1996–WY2015 EAA subbasin annual runoff volume percent relative contribution trend of basin total (top) and WY1996–WY2015 EAA subbasin annual TP load percent relative contribution trend of basin total (bottom).

EAA PERMIT-LEVEL MONITORING

Permit-level data are required for a secondary compliance method to regulate TP loads from individual permittee's offsite discharges if the EAA Basin as a whole does not meet its compliance requirement. The permit-level results are not used to calculate TP reduction at the EAA Basin level. Because the EAA Basin has been in compliance each year since the program's inception, the secondary compliance method at the permit-level has not been necessary.

Permit-level data are useful in specific cases to track individual basin ID water quality trends. Permit-level data allows relative comparisons (1) between permittees, (2) between water years for a single farm, and (3) between water years and a baseline for a single farm. The District uses such relative comparisons when considering individual BMP verifications and in communicating recommendations to permittees. Factors that affect permit-level concentrations and loads are discussed in Chapter 3 of the *2006 South Florida Environmental Report* (SFER) – *Volume I* (Adorisio et al. 2006; refer to the *EAA Basin Permit-Level Monitoring Results* section).

The WY2015 TP concentration and load for permit-level data within the EAA Basin are presented in this section in both tabular form and as a spatial distribution. Individual permittees within the EAA are required to collect data representative of daily discharges at all offsite discharge structures. Permittees submit these to comply with conditions of their BMP permit issued in accordance with Chapter 40E-63, F.A.C. Permittee water quality monitoring is required on a flow-proportional basis, and is accomplished through automatic samplers for most permittees or daily grab samples during discharges for select qualifying permittees. For each hydraulic drainage area, the determination of permit basin load is only valid if the percent sampled load (i.e., portion of load computed from submitted data relative to the total of submitted plus estimated data) is at least 75 percent. The District estimates loads for periods in which data are missing only for the purpose of preparing for the secondary compliance determination, which is used to rank permit basins in the case of EAA basin-level noncompliance. Estimation of the missing data by the District does not relieve the individual permittees of their compliance requirement to collect a complete data set representative of daily discharges.

Table 4 identifies separate hydraulic drainage areas (e.g., individual farms) within the EAA Basin. Drainage areas are identified according to the unit area or basin identification (ID) number. The table summarizes each area's TP FWMC, TP unit area load (UAL), rainfall adjusted UAL, and percent sampled load for WY2015.

Table 4 includes five 298 Diversion Project areas [East Beach Water Control District, East Shore Water Control District, Closter Farms (715 Farms), South Shore Drainage District, and South Florida Conservancy District] that prior to calendar year 2001 discharged to Lake Okeechobee and therefore were not included in the Chapter 40E-63, F.A.C., regulatory EAA Basin model boundary. Their discharges were not represented by the baseline period data used to determine compliance with the 25 percent TP load reduction requirement for the EAA. The five diversion basins are shown in Figures 4-3 and 4-4 of this volume. Refer to Chapter 4 of this volume for additional information on source control activities and requirements in these areas.

Figures 5, **6**, and **7** depict the spatial distribution of TP FWMC, rainfall adjusted UALs, and UALs found in the EAA, respectively. These figures are graphical representations of the **Table 4** data from individual permit holders. Each basin ID is mapped as a whole, and no information is available to account for localized variations within a basin. **Figures 8** and **9** present the basin ID's WY2015 frequency distributions for rainfall adjusted UALs and TP FWMC, respectively.

Table 4 lists the TP data using the following column designations:

- **Permit number** identifies the permit associated with each basin ID. A permit may include one or more basin IDs.
- **Basin ID** is a unique identifier for each hydraulic drainage area within a permit. It may represent one or more permittees.
- **Subbasin** is the EAA subbasin in which each basin ID resides.
- **Baseline year** is the water year for which a farm established its baseline period load. For early baseline permit-basins, the baseline period load is based on data collected from May 1, 1993, through April 30, 1994.
- **Rainfall adjusted unit area load**:
  - Baseline is the TP load per unit area measured for the baseline year for a basin ID, which includes a 10-year base period rainfall adjustment.
  - WY2015 (adjusted UAL) is the TP load per unit area for the current water year for a farm, which includes a 10-year base period rainfall adjustment.
- **WY2015 TP concentration** is the TP FWMC for the farm for WY2015.
- **WY2015 percent sampled load** is the percentage of WY2015 TP load for a basin ID computed from data submitted by the permittee as compared to the total of submitted and estimated load.

Table 4. WY2015 permit-level data for the EAA Basin. [Note: lbs/ac – pounds per acre and µg/L – micrograms per liter.]

Permit Number	Basin ID	Basin Acres	Sub-basin	Base-line Year	Rain Adjusted UAL (lbs/ac)		WY2015 TP Concentra-tion (µg/L)	WY2015 Percent Sampled Load	Comments
					Baseline	WY2015			
26-00001-E	26-001-01	778	S-8	1994[a]	2.12	0.63	86	100%	
26-00002-E	26-002-01	898	S-8	2001	Unable to calculate	0.00	N/A	100%	Pasture area, which historically has not reported flow off-site
26-00007-E	26-007-01	653	S-8	1999	2.07	0.20	65	100%	
26-00008-E	26-008-01	120	S-8	1994[a]	2.12	0.63	86	100%	
26-00010-E	26-010-01	1231	S-8	1995	1.81	0.88	130	93%	
26-00010-E	26-010-02	10004	S-8	1995	5.83	0.18	56	95%	
50-00002-E	50-002-01	5636	S-5A	1994[a]	3.21	0.47	128	100%	
50-00002-E	50-002-02	9285	S-5A	1994[a]	2.90	0.45	103	100%	
50-00009-E	50-009-04	317	S-6	1999	5.19	3.08	167	99%	
50-00009-E	50-009-05	1479	S-7	1994[a]	1.54	1.88	137	100%	
50-00009-E	50-018-15	732	S-7	1994[a]	1.12	1.29	180	100%	
50-00009-E	50-047-05	314	S-6	1997	0.55	3.66	244	100%	
50-00010-E	50-010-02	6867	S-6	1994	1.80	0.36	94	100%	
50-00010-E	50-010-03	6071	S-8	1994[a]	1.31	0.29	76	100%	
50-00010-E	50-010-04	8511	S-6	1994[a]	4.76	0.63	149	99%	
50-00011-E	50-011-03	14356	S-6	1994[a]	5.79	Unable to calculate[c]		45%	
50-00011-E	50-011-04	4047	S-6	1994[a]	5.21	1.03	269	80%	
50-00015-E	50-015-01	3339	S-5A	1994[a]	2.62	0.42	217	100%	
50-00015-E	50-015-02	2689	S-5A	1994[a]	5.28	0.55	249	100%	
50-00018-E	26-003-01	598	S-8	1999	0.27	0.00	N/A	100%	No reported flows for WY2015
50-00018-E	26-006-01	1198	S-8	1998	1.19	0.92	158	100%	
50-00018-E	50-008-01	7289	S-8	1994[a]	0.34	0.64	85	100%	Baseline unit load value in the low 5th percentile of basin IDs
50-00018-E	50-011-06	638	S-8	2000	0.82	0.30	90	100%	
50-00018-E	50-018-01	5860	S-5A	1994[a]	2.82	0.54	199	78%	
50-00018-E	50-018-03	9062	S-5A	1994[a]	1.98	0.65	165	100%	
50-00018-E	50-018-04	1913	S-8	1994[a]	3.88	1.07	98	100%	
50-00018-E	50-018-05	1846	S-8	1995	3.64	0.78	93	99%	
50-00018-E	50-018-06	1255	S-8	1994[a]	1.46	0.80	56	100%	
50-00018-E	50-018-07	1277	S-8	1994[a]	2.12	0.63	86	100%	
50-00018-E	50-018-08	3209	S-8	1994[a]	2.28	0.15	30	98%	
50-00018-E	50-018-09	1737	S-8	1994[a]	4.22	0.57	68	100%	
50-00018-E	50-018-10	8254	S-6	1994[a]	3.05	0.81	97	100%	
50-00018-E	50-018-11	1871	S-6	1994[a]	19.73	3.82	431	100%	
50-00018-E	50-018-12	1655	S-5A	1994[a]	1.78	0.42	101	100%	
50-00018-E	50-018-13	594	S-5A	1994[a]	0.40	0.66	77	100%	Baseline unit load value in the low 5th percentile of basin IDs
50-00018-E	50-018-16	240	S-7	1994[a]	4.11	1.07	74	100%	
50-00018-E	50-018-18	358	S-7	1994[a]	0.64	1.12	97	100%	
50-00018-E	50-018-19	314	S-7	1994[a]	35.32	7.91	124	100%	
50-00018-E	50-018-20	381	S-7	1994[a]	3.59	1.60	69	100%	
50-00018-E	50-018-22	4482	S-8	1994[a]	8.18	1.00	195	100%	
50-00018-E	50-018-23	2946	S-8	1994[a]	2.22	0.55	102	100%	
50-00018-E	50-018-24	3804	S-8	1994[a]	1.96	0.36	72	100%	
50-00018-E	50-018-25	3808	S-7	1994[a]	4.99	0.26	61	100%	
50-00018-E	50-061-17	781	S-5A	1995	12.22	0.46	120	100%	
50-00024-E	50-024-01	555	S-7	1995	6.43	0.06	19	90%	
50-00031-E	50-003-01	233	S-7	1994[a]	0.40	1.22	268	77%	Baseline unit load value in the low 5th percentile of basin IDs
50-00031-E	50-003-02	520	S-7	1994[a]	0.62	Unable to calculate[c]		28%	
50-00031-E	50-003-03	119	S-6	1995	0.22	Unable to calculate[c]		30%	
50-00031-E	50-004-01	909	S-5A	1994[a]	3.68	Unable to calculate[c]		68%	
50-00031-E	50-005-01	639	S-7	1994[a]	0.91	Unable to calculate[c]		55%	
50-00031-E	50-005-02	232	S-7	1994[a]	0.06	2.92	744	76%	Baseline unit load value in the low 5th percentile of basin IDs

Table 4. Continued.

Permit Number	Basin ID	Basin Acres	Sub-basin	Base-line Year	Rain Adjusted UAL (lbs/ac) Baseline	Rain Adjusted UAL (lbs/ac) WY2015	WY2015 TP Concentra-tion (µg/L)	WY2015 Percent Sampled Load	Comments
50-00031-E	50-005-03	320	S-7	1994[a]	0.26	Unable to calculate[c]		36%	
50-00031-E	50-005-04	310	S-7	1994[a]	1.49	Unable to calculate[c]		7%	
50-00031-E	50-005-05	603	S-8	1994[a]	1.95	1.09	250	93%	
50-00031-E	50-005-06	532	S-7	1994[a]	1.56	Unable to calculate[c]		47%	
50-00031-E	50-006-01	388	S-5A	1994[a]	4.53	0.46	274	100%	
50-00031-E	50-006-02	359	S-6	1994[a]	5.50	Unable to calculate[c]		17%	
50-00031-E	50-006-03	655	S-6	1994[a]	3.55	Unable to calculate[c]		21%	
50-00031-E	50-007-01	6473	S-6	1994[a]	1.56	1.12	83	98%	
50-00031-E	50-007-02	5716	S-5A	1994[a]	15.11	0.42	169	84%	
50-00031-E	50-008-02	401	L-8	-	0.00	3.61	306	75%	
50-00031-E	50-008-03	1050	L-8	-	0.00	0.25	114	100%	
50-00031-E	50-011-01	1747	S-6	1994[a]	2.76	Unable to calculate[c]		51%	
50-00031-E	50-012-01	1016	S-6	1994[a]	4.06	Unable to calculate[c]		72%	
50-00031-E	50-014-01	1520	S-7	1994[a]	1.37	0.41	134	75%	
50-00031-E	50-016-01	1462	S-5A	1994[a]	15.11	1.03	180	100%	
50-00031-E	50-017-01	878	S-7	1994[a]	3.22	0.54	78	95%	
50-00031-E	50-018-17	464	S-7	1994[a]	3.10	Unable to calculate[c]		66%	
50-00031-E	50-019-01	568	S-7	1994[a]	1.54	Unable to calculate[c]		49%	
50-00031-E	50-019-02	1210	S-7	1994[a]	1.38	Unable to calculate[c]		17%	
50-00031-E	50-019-03	1051	S-7	1994[a]	0.58	Unable to calculate[c]		44%	
50-00031-E	50-019-04	317	S-7	1994[a]	0.44	0.22	59	100%	
50-00031-E	50-020-01	320	S-6	1994[a]	3.32	2.68	186	94%	
50-00031-E	50-021-01	2558	S-6	1994[a]	8.92	3.21	254	81%	
50-00031-E	50-022-01	320	S-7	1994[a]	0.80	0.01	53	96%	
50-00031-E	50-023-01	289	S-6	1994[a]	11.83	1.31	351	79%	
50-00031-E	50-025-01	824	S-5A	1994[a]	3.68	0.32	90	86%	
50-00031-E	50-027-01	2810	S-6	1994[a]	2.40	0.61	130	82%	
50-00031-E	50-027-02	798	S-6	1994[a]	1.22	1.55	125	79%	
50-00031-E	50-027-03	731	S-6	1994[a]	2.32	Unable to calculate[c]		26%	
50-00031-E	50-027-04	2519	S-6	1994[a]	2.10	Unable to calculate[c]		40%	
50-00031-E	50-028-01	212	S-6	1994[a]	14.54	1.20	162	97%	
50-00031-E	50-029-01	681	S-7	1994[a]	4.30	1.38	152	80%	
50-00031-E	50-030-01	446	S-6	1994[a]	14.14	Unable to calculate[c]		27%	
50-00031-E	50-031-01	1609	S-6	1994[a]	2.56	Unable to calculate[c]		61%	
50-00031-E	50-031-02	1387	S-6	1994[a]	5.48	Unable to calculate[c]		28%	
50-00031-E	50-031-03	609	S-6	1994[a]	8.57	Unable to calculate[c]		52%	
50-00031-E	50-032-01	306	S-7	1994[a]	0.84	Unable to calculate[c]		73%	
50-00031-E	50-034-01	7897	S-6	1994[a]	1.68	0.91	89	89%	
50-00031-E	50-034-02	601	S-6	1994[a]	3.37	0.36	128	100%	
50-00031-E	50-034-03	4246	S-7	1994[a]	4.08	0.63	68	79%	
50-00031-E	50-034-04	4503	S-7	1994[a]	1.54	Unable to calculate[c]		73%	
50-00031-E	50-035-01	478	S-6	1994[a]	5.74	2.84	240	85%	
50-00031-E	50-038-01	1285	S-5A	1994[a]	3.71	Unable to calculate[c]		38%	
50-00031-E	50-039-01	63	S-6	1995	4.01	0.09	92	100%	
50-00031-E	50-039-02	144	S-6	1995	4.25	0.58	120	100%	
50-00031-E	50-040-01	216	S-5A	1995	1.40	0.55	82	100%	
50-00031-E	50-040-02	494	S-5A	1995	3.61	0.49	90	100%	
50-00031-E	50-041-01	109	S-6	1998	2.69	1.31	124	96%	
50-00031-E	50-041-02	300	S-7	1998	2.44	0.97	114	100%	
50-00031-E	50-042-01	320	S-7	1995	0.14	0.00	N/A	100%	No reported flows for WY2015
50-00031-E	50-045-01	282	S-6	1995	4.35	0.66	130	100%	
50-00031-E	50-045-02	152	S-6	1995	1.41	1.16	98	90%	
50-00031-E	50-048-01	1185	S-6	1995	1.25	0.57	62	100%	
50-00031-E	50-048-02	640	S-7	1995	0.36	0.12	76	100%	Baseline unit load value in the low 5th percentile of basin IDs
50-00031-E	50-051-01	835	S-6	1995	0.97	0.10	43	78%	
50-00031-E	50-053-01	149	S-6	1995	5.16	Unable to calculate[c]		0%	
50-00031-E	50-058-01	157	S-7	1995	0.02	0.00	N/A	100%	No reported flows for WY2015
50-00031-E	50-061-13	1077	S-7	1995	1.16	Unable to calculate[c]		42%	< 75% load sampled

Table 4. Continued.

Permit Number	Basin ID	Basin Acres	Sub-basin	Base-line Year	Rain Adjusted UAL (lbs/ac)		WY2015 TP Concentra-tion (µg/L)	WY2015 Percent Sampled Load	Comments
					Baseline	WY2015			
50-00031-E	50-070-01	225	S-6	1995	3.82	1.60	132	100%	
50-00031-E	50-070-02	264	S-6	1995	3.09	0.81	100	100%	
50-00031-E	50-078-01	71	S-7	1999	8.71	0.45	111	100%	
50-00037-E	50-037-01	1194	S-5A	1994[a]	6.70	0.00	N/A	100%	There is an on-site rock pit that maintains enough storage so that off-site discharge did not occur
50-00046-E	50-046-01	35	S-7	1994	2.21	2.40	145	100%	
50-00047-E	50-044-01	2169	S-5A	1996	5.02	0.54	110	100%	
50-00047-E	50-047-01	630	S-6	1996	1.46	1.20	132	100%	
50-00047-E	50-047-02	640	S-6	1995	0.84	1.03	93	100%	
50-00047-E	50-047-03	1832	S-6	1997	0.44	0.82	85	100%	
50-00047-E	50-047-04	198	S-6	1996	0.68	0.34	38	100%	
50-00047-E	50-047-07	3494	S-5A	1996	0.67	0.25	55	100%	
50-00047-E	50-047-08	1558	S-6	1996	0.96	1.49	117	100%	
50-00047-E	50-054-01	10360	S-5A	1996	1.16	0.48	128	100%	
50-00047-E	50-054-03	7586	S-5A	1996	0.35	0.22	47	100%	Baseline unit load value in the low 5th percentile of basin IDs
50-00047-E	50-055-01	393	S-6	1997	0.86	0.26	37	100%	
50-00047-E	50-055-02	810	S-6	1999	0.45	0.18	49	100%	
50-00047-E	50-056-01	850	S-6	1996	0.98	1.09	113	100%	
50-00047-E	50-059-01	11551	S-5A	1996	2.35	2.06	624	100%	
50-00047-E	50-059-02	1783	S-5A	1997	1.07	0.46	120	100%	
50-00047-E	50-059-03	720	S-5A	1996	1.65	0.72	144	100%	
50-00047-E	50-059-04	306	S-5A	1996	1.14	0.88	222	100%	
50-00047-E	50-061-18	1555	S-6	1995	9.82	0.80	19	100%	
50-00047-E	50-062-01	4626	S-7	1996	0.20	0.12	82	100%	Baseline unit load value in the low 5th percentile of basin IDs
50-00047-E	50-062-02	32535	S-7	1996	0.46	0.35	61	100%	
50-00047-E	50-062-11	960	S-7	1996	0.44	0.29	39	100%	
50-00047-E	50-067-03	634	S-8	1996	1.02	2.75	42	100%	
50-00047-E	50-067-04	3832	S-8	1996	0.55	0.41	37	100%	
50-00047-E	50-068-01	2616	S-5A	1996	1.13	0.26	74	100%	
50-00060-E	50-060-01	8208	S-6	1995	0.18	0.22	39	100%	Baseline unit load value in the low 5th percentile of basin IDs
50-00060-E	50-060-02	7790	S-6	1995	0.75	0.66	70	100%	
50-00061-E	50-061-03	3434	S-7	1995	0.76	0.16	45	100%	
50-00061-E	50-061-10	24785	S-8	1996	0.60	0.11	34	100%	
50-00061-E	50-061-15	4084	S-5A	1995	1.91	0.51	96	100%	
50-00061-E	50-061-22	3739	S-8	1996	0.49	0.43	42	99%	
50-00062-E	26-004-01	4502	S-8	1999	1.22	0.14	54	100%	
50-00062-E	50-061-05	314	S-7	1995	1.89	1.56	65	100%	
50-00062-E	50-061-06	237	S-7	1995	1.68	0.13	49	100%	
50-00062-E	50-061-07	318	S-7	1995	1.24	0.36	49	100%	
50-00062-E	50-061-12	730	S-7	1995	2.55	0.36	61	96%	
50-00062-E	50-062-03	1179	S-7	1996	0.54	0.27	62	100%	
50-00062-E	50-062-04	901	S-7	1996	0.26	0.22	66	100%	Baseline unit load value in the low 5th percentile of basin IDs
50-00062-E	50-063-01	9760	S-7	1996	0.45	0.79	134	100%	
50-00062-E	50-067-01	1133	S-8	1996	0.40	0.47	165	100%	Baseline unit load value in the low 5th percentile of basin IDs
50-00062-E	50-067-02	10274	S-8	1996	0.94	0.34	47	98%	
50-00062-E	50-067-05	7323	S-8	1996	0.42	0.17	33	100%	
50-00062-E	50-067-06	1277	S-8	1999	0.49	0.05	42	100%	
50-00062-E	50-067-07	1981	S-8	1999	0.54	0.34	40	100%	
50-00062-E	50-067-09	1278	S-8	1999	0.54	0.88	107	100%	

Table 4. Continued.

Permit Number	Basin ID	Basin Acres	Sub-basin	Base-line Year	Rain Adjusted UAL (lbs/ac)		WY2015 TP Concentra-tion (µg/L)	WY2015 Percent Sampled Load	Comments
					Baseline	WY2015			
50-00062-E	50-067-10	2539	S-8	1999	1.21	0.39	38	100%	
50-00062-E	50-067-11	6153	S-8	1999	0.85	0.14	32	100%	
50-00065-E	50-055-03	2871	S-6	1996	0.74	0.31	114	100%	
50-00065-E	50-061-01	639	S-6	1995	1.44	0.70	99	100%	
50-00065-E	50-061-08	368	S-5A	1999	1.76	0.47	138	100%	
50-00065-E	50-065-02	938	S-6	1995	3.64	0.47	128	100%	
50-00065-E	50-065-07	512	S-6	1995	3.92	1.00	140	94%	
50-00065-E	50-065-10	792	S-6	1995	1.55	0.92	30	100%	
50-00069-E	50-069-01	317	S-7	1996	1.06	0.83	183	98%	
50-00073-E	50-073-01	68	S-5A	2001	Unable to Calculate	0.00	N/A	100%	Non-agricultural area served by wet and dry detention areas, which historically has not reported flow off-site
50-00074-E	50-010-01	784	S-6	1995	2.42	0.17	115	100%	
50-00081-E	50-018-14	534	S-7	1994	2.21	2.40	145	100%	
50-00081-E	50-081-01	225	S-7	2004	0.66	0.23	135	100%	
50-00082-E	50-082-01	484	S-7	1995	9.82	3.93	62	100%	
50-00083-E	50-013-01	1360	S-5A	1997	2.98	0.75	140	100%	
50-00083-E	50-035-02	1666	S-5A	1997	2.98	0.75	140	100%	
50-00083-E	50-064-01	899	S-5A	1997	2.98	0.75	140	100%	
50-00083-E	50-064-03	145	S-5A	1997	2.98	0.75	140	100%	
50-00083-E	50-064-04	1134	S-5A	1997	2.98	0.75	140	100%	
50-00083-E	50-065-03	3722	S-5A	1997	2.98	0.75	140	100%	
50-00083-E	50-065-05	930	S-5A	1997	2.98	0.75	140	100%	
50-00083-E	50-065-06	454	S-5A	1997	2.98	0.75	140	100%	
50-00083-E	50-065-08	628	S-5A	1997	2.98	0.75	140	100%	
50-00084-E	50-018-02	6722	S-5A	1994[a]	3.54	0.61	122	100%	
Diversion Projects – 298 Districts and Closter Permitees[b]									
50-00033-E	50-033-02	6020	S-5A	1994	12.52	1.06	457	100%	Baseline is derived from the 1,183 acres that discharged into the EAA prior to the diversion project being implemented
50-00047-E	50-077-01	3127	S-6			0.92	78	100%	715 Farms (Closter Farms)
50-00080-E	50-080-01	8012	S-6			1.15	117	100%	East Shore Drainage District
50-00010-E	50-010-06	10497	S-8	2007	1.00	0.30	84	100%	Baseline is derived from the 2,111 acres that discharged into the EAA prior to the diversion project being implemented
50-00081-E	50-081-02	4006	S-8	1994	1.31	0.37	88	100%	Baseline is derived from the 136 acres that discharged into the EAA prior to the diversion project being implemented

a. Indicates basins that elected to participate in the Early Baseline Option and met requirements as described in Chapter 40E-63.145(4), F.A.C.

b. The five diversion project areas (East Beach Water Control District, East Shore Water Control District, South Florida Conservancy District, South Shore Drainage District, and 715 Farms) discharged to Lake Okeechobee and therefore were not included in the Chapter 40E-63, F.A.C., EAA Basin regulatory model boundary. Their discharges were not represented by the baseline period data used to determine compliance with the 25 percent TP load reduction requirement for the EAA. Refer to Chapter 4 of this volume for additional information on source control activities and requirements in these areas.

c. Unable to calculate indicates the data quality requirement of greater than 75% sampled load was not achieved.

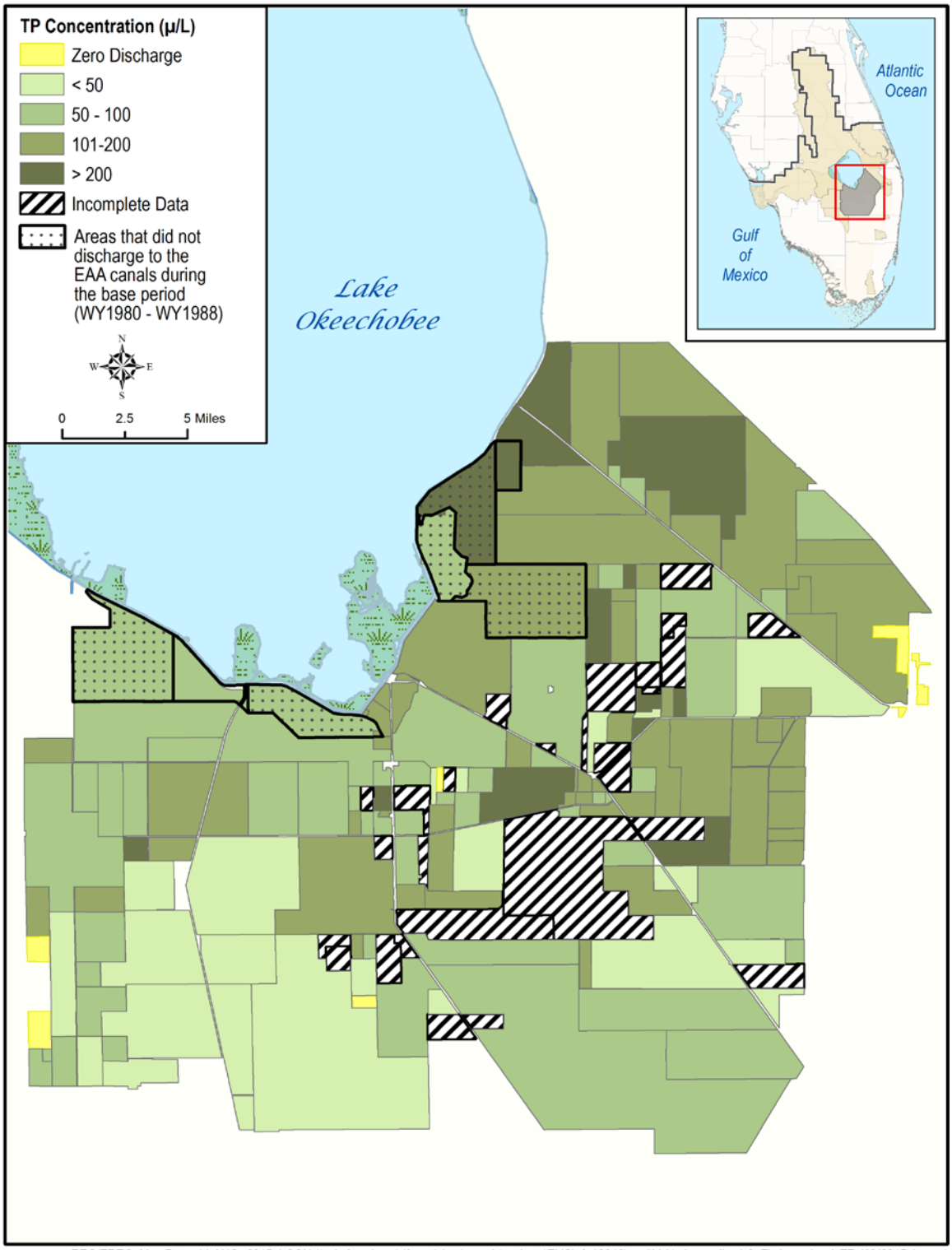

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Figure 5. WY2015 TP FWMC for the EAA Basin.
[Note: 1 microgram per liter (µg/L) = 1 parts per billion.]

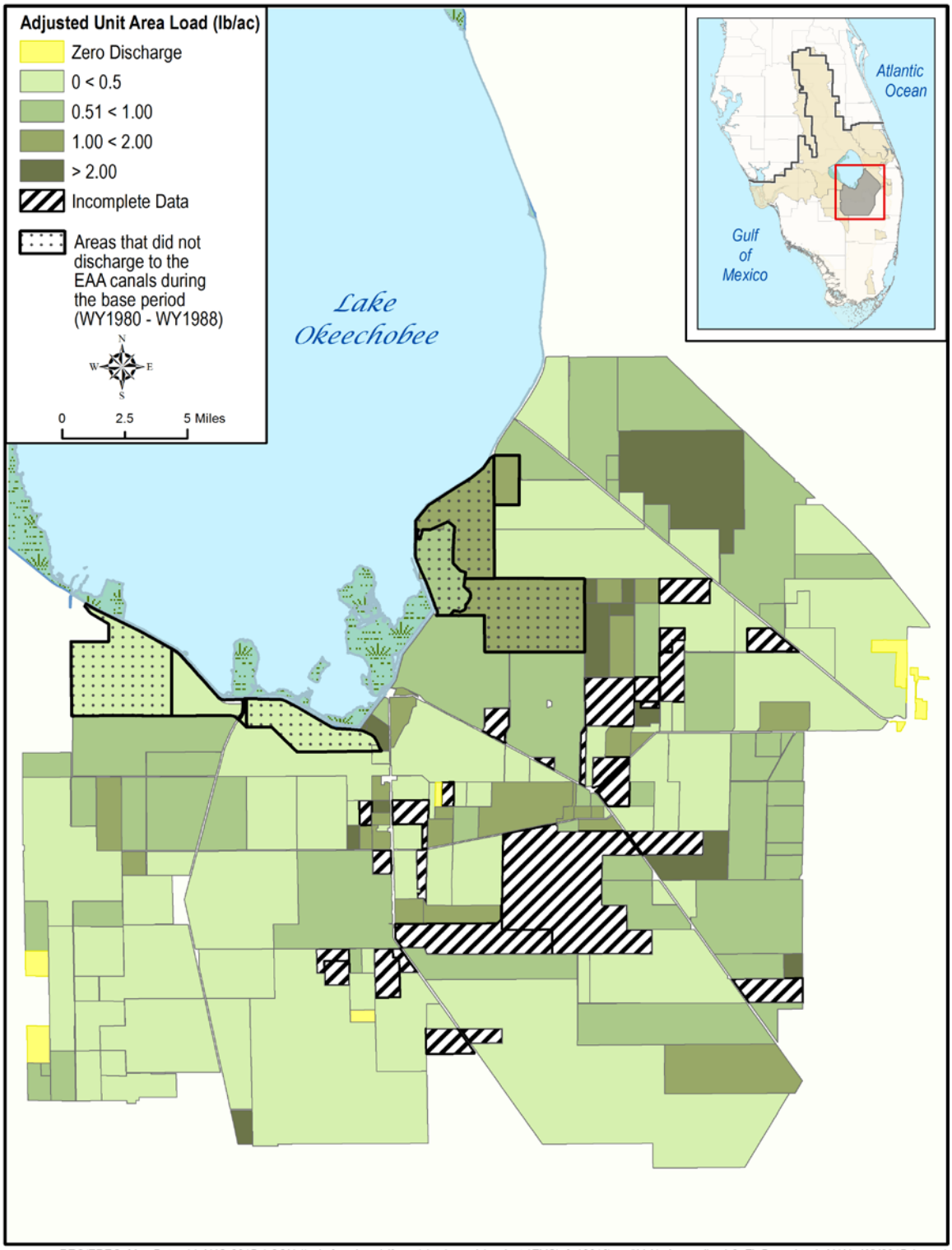

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Figure 6. WY2015 rainfall-adjusted unit area TP load for the EAA Basin. [Note: lb/ac – pound per acre.]

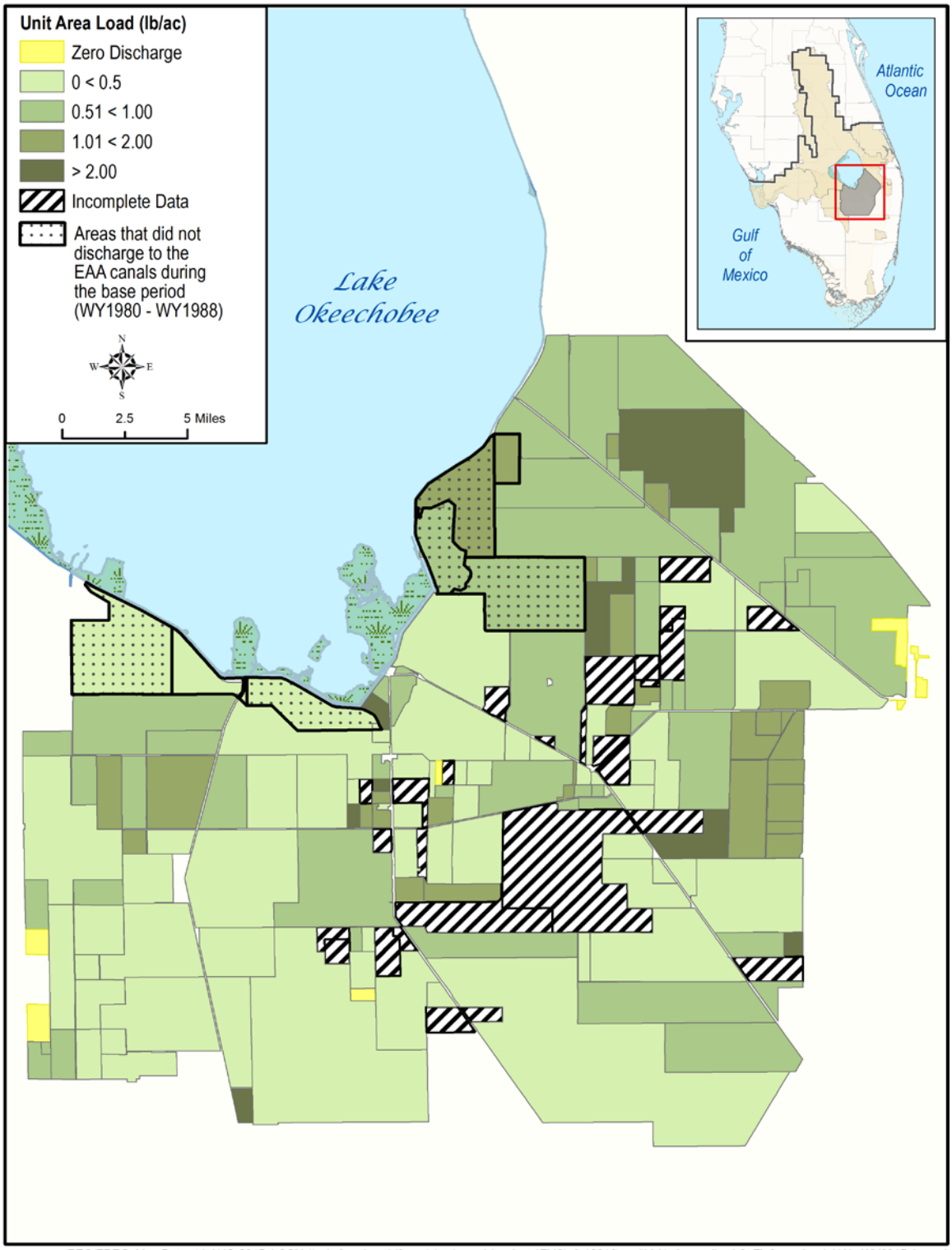

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Figure 7. WY2015 TP UAL for the EAA Basin.

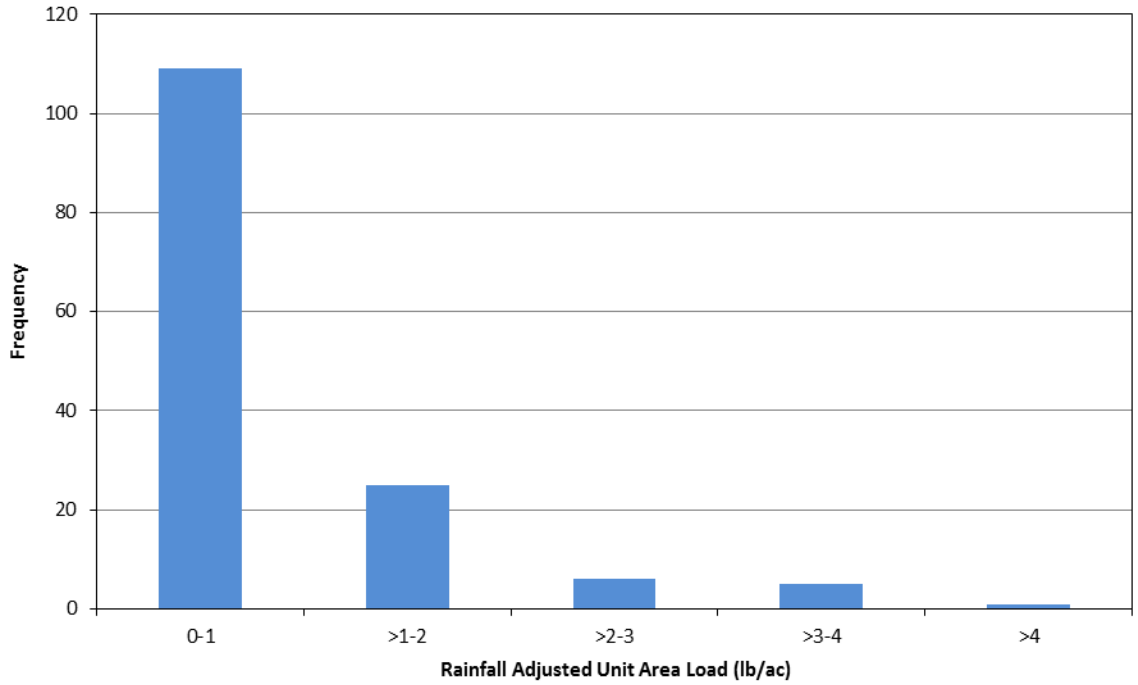

Figure 8. WY2015 EAA basin ID rainfall-adjusted UAL frequency distribution.

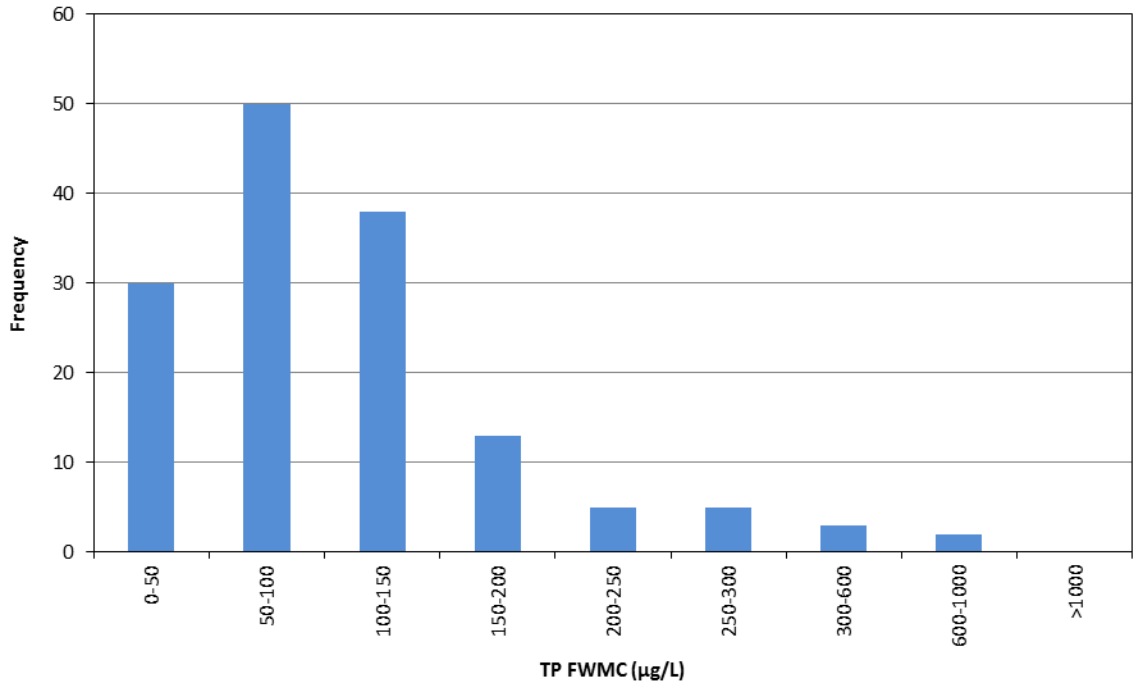

Figure 9. WY2015 EAA basin ID TP FWMC frequency distribution.

C-139 BASIN SUPPLEMENTAL EVALUATION

C-139 BASIN COMPLIANCE CALCULATION DETAILS

Compliance with C-139 Basin mandates to maintain discharges at or below the collective average annual phosphorus loading based proportionally on the historical rainfall during the baseline period is defined by mathematical equations and methodology dictated by Chapter 40E-63, F.A.C. The equations relevant to WY2015 compliance are reproduced in **Figure 10**. **Figure 11** presents the monthly rainfall totals for the C-139 Basin during WY2015 and related coefficients used to calculate the target load per the rule's equations. The runoff load is based on flow and water quality data measured during the water year. The target load is pre-BMP baseline period load predicted considering the current water year rainfall characteristics. The target load applies a base period regression model to the current water year rainfall characteristics to account for the hydrologic variability between WY2015 and the baseline period. The target load model was developed to meet the EFA requirement of maintaining pre-BMP baseline period loading rates. Therefore, the target load and predicted load are equivalent. A one-year limit is calculated as the target plus a 90 percent confidence interval based on the regression statistics. A two-prong test is considered for the compliance determination. The C-139 Basin is out of compliance when the runoff TP load is above the target for three successive years or above the limit any one year, within the rule's designated rainfall range.

The runoff TP load for WY2015 is below the target load for the pre-BMP baseline period adjusted for rainfall and meets the performance measure for WY2015. Submittal of permit-level data is not currently a mandatory requirement, but rather an optional method for individual permittees to show farm-level compliance with TP loads when the basin as a whole is out of compliance. The optional farm-level monitoring and farm-level compliance methodology for the C-139 Basin is described in Appendix B3 of Chapter 40E-63, F.A.C. Since the C-139 Basin regulatory program began in WY2003, BMP permit holders in the basin have not requested the optional farm-level compliance method and, therefore, no data have been submitted.

RULE 40E-63 C-139 BASIN COMPLIANCE MODEL (from Chapter 40E-63, F.A.C.)

The target, limit and adjusted rainfall will be calculated according to the following equations and explanation:

Target = exp (-17.0124 + 4.5995 X + 3.9111 C – 1.0055 S)

Explained Variance = 74.2%, Standard Error of Estimate = 0.5440

Predictors (X, C, S) are calculated from the first three moments (m_1,m_2,m_3) of the 12 monthly rainfall totals (r_i, i=1 to 12, inches) for the current year:

m_1 = Sum [r_i] / 12

m_2 = Sum [r_i - m_1]^2 / 12

m_3 = Sum [r_i - m_1]^3 / 12

X = ln (12 m_1)

C = [(12/11) m_2]$^{0.5}$/m_1

S = (12/11) m_3 / m_2 $^{1.5}$

Limit = Target exp (1.440 SE)

SE = standard error of predicted ln(L) for May-April interval

$$SE = 0.5440 [1 + 1/10 + 4.8500 (X-X_m)^2 + 8.1932 (C-C_m)^2 + 0.9247 (S-S_m)^2 + 4.5950 (X-X_m) (C-C_m) - 0.3624 (X-X_m) (S-S_m) - 4.0048 (C-C_m) (S-S_m)]^{0.5}$$

Adjusted Rainfall = exp [X + 0.8503 (C - C_m) – 0.2186 (S - S_m)]

Where :

Target = predicted load for future rainfall conditions (metric tons/yr)

Limit = upper 90% confidence limit for Target (metric tons/yr)

Adjusted Rainfall = equivalent rainfall for mean C and S variables (inches)

X = the natural logarithm of the 12-month total rainfall (inches)

C = coefficient of variation calculated from 12 monthly rainfall totals

S = skewness coefficient calculated from 12 monthly rainfall totals

X_m = average value of the predictor in calibration period = 3.8434

C_m = average value of the predictor in calibration period = 0.9087

S_m = average value of the predictor in calibration period = 0.8200

Figure 10. Chapter 40E-63, F.A.C. (referred to as Rule 40E-63 in the figure), Appendix B2 excerpts of hydrologic adjustment and basin compliance mathematical equations to calculate annual TP reductions.

WY2015 C-139 Basin compliance TP load calculation

See 40E-63 Appendix B2 for "Target" equation

Month	Rainfall (in)			
May	3.84	in	m_1 =	4.12
June	6.32	in	m_2 =	11.09
July	9.51	in	m_3 =	27.99
August	4.84	in	X =	3.902
September	10.86	in	C =	0.843
October	1.10	in	S =	0.827
November	1.97	in	SE =	0.580
December	0.53	in		
January	0.98	in	Target[1] TP Load =	29.7 mt
February	1.48	in	Limit[2] TP Load =	68.5 mt
March	1.85	in	Runoff TP Load =	27.3 mt
April	6.23	in	Predicted[3]=	29.7 mt
Total Rainfall	49.50	in	% Reduction =	8%

Notes:

[1] Target load is adjusted for reduction in C139 land area (168450 ac./ 169700 ac.)

[2] Limit load in upper 90% confidence limit for Target

[3] Predicted load = Target load

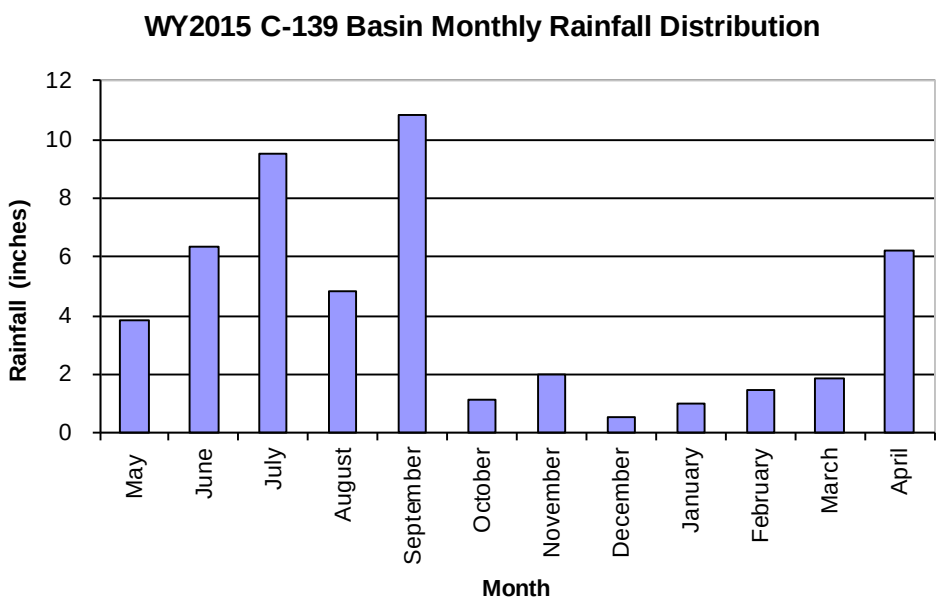

Figure 11. WY2015 C-139 Basin monthly rainfall, total rainfall, calculated target, limit, and runoff TP loads, based upon Chapter 40E-63, F.A.C., Appendix B2. [Notes: ac. = acres; in = inches; and mt = metric tons.]

C-139 BASIN-LEVEL MONITORING DATA

Chapter 40E-63, F.A.C., requires the District to report on the status of the required water quality monitoring for determining compliance with TP load mandates for the C-139 Basin. Appendices A3 and B2 of Chapter 40E-63, F.A.C., outline data collection requirements. Data collection efforts for WY2015 were consistent with Chapter 40E-63 and supporting appendices.

During WY2015, the water quality monitoring at G-508 represents both G-508 and G-342O. Therefore, for WY2015, eight structures comprised the modeling boundary of the C-139 Basin and seven water quality monitoring sampling points represented the water quality of flow through those structures. The G-136 structure serves as an outflow boundary point of the C-139 Basin into the EAA Basin. **Table 5** provides WY2015 TP sampling statistics for all the District-monitored locations in the C-139 Basin.

Table 5. Summary statistics for WY2015 TP monitoring data for the C-139 Basin.

Structure	Sampling Point	Sample Type	Number Sampled	Number Used	Minimum (µg/L)[a]	Maximum (µg/L)	Number Flagged	Flow[b] Curve Rating
G-342A	G342A	Grab	52	0	42	339	0	Fair
		Composite[c]	21	20	54	370	0	
G-342B	G342B	Grab	52	0	46	291	0	Good
		Composite[c]	20	20	53	330	0	
G-342C	G342C	Grab	52	0	49	1212	0	Good
		Composite[c]	22	22	56	512	0	
G-342D	G342D	Grab	52	0	60	684	0	Poor[d]
		Composite[c]	15	15	85	498	0	
G-406	G406	Grab	51	3	54	360	0	Good
		Composite[c]	3	3	99	204	0	
G-136	G136	Grab	22	0	21	519	0	Fair
		Composite[c]	21	21	32	403	0	
G-508	G508	Grab	52	1	60	525	0	Good[e]
		Composite[c]	35	34	57	522	0	

a. µg/L = microgram per liter; 1 µg/L = 1 part per billion (ppb).

b. Flow curve rating – discharge estimates derived from theoretical equations are within a range of expected values based on streamflow measurements used to calibrate the theoretical equations and are classified as excellent (< 5%), good (< 10%), fair (< 15%), or poor (> 15%).

c. Composite samples could be time-proportional, flow-proportional, or a combination of the two.

d. Poor, based on experience with ratings at culverts with flashboards, but streamflow measurements are not sufficient to calibrate theoretical equations and the flow curve rating cannot adequately be determined.

e. Good, based on experience with theoretical ratings based on pump manufacturers' performance curves, but streamflow measurements are not sufficient to calibrate theoretical equations and the flow curve rating cannot adequately be determined.

C-139 BASIN-LEVEL WATER QUALITY SUMMARY

As in the EAA Basin, the District is required to collect monitoring data from the C-139 Basin to determine compliance with TP load limitations. The TP load ultimately discharging to the Everglades is not the same as the TP loads leaving C-139 Basin outflow structures because discharges are directed into other water bodies. The outfall structures accounting for the loads in the C-139 Basin compliance determination include G-136 discharging to the L-1 canal; G-342A, G-342B, G-342C, and G-342D discharging into STA-5 flow-ways 1 and 2; and G-406, G-508, and G-342O discharging into the L-3 canal leading to STA-5 flow-ways 3, 4, and 5, and STA-6. **Table 6** summarizes the overall WY2015 flow, TP load, and TP FWMC at eight primary basin outflow structures. The locations of the C-139 primary outfall structures in **Table 6** are depicted in Figure 4-7 of this volume. A map showing 2009 land use in the C-139 Basin is presented in **Figure 12**. During WY2015, 23.6 mt of TP (86.6 percent) was exported to STA-5 and STA-6 via G-342A–D structures, G-406, G-342O, and G-508, and 3.7 mt (13.4 percent) to the L-1 canal via G-136.

Table 6. C-139 Basin TP loads in metric tons (mt), flows in thousand acre-feet (kac-ft), and TP FWMC in micrograms per liter (µg/L) by source for WY2015.

Source	TP Load (mt)	Flow (kac-ft)	TP FWMC (µg/L)[a]	Percent of Total Load	Percent of Total Flow
			C-139 Basin to EAA		
G-136 Total[b]	**3.7**	**24.3**	**122**	**13.4%**	**22.6%**
			C-139 Basin to STA-6/6		
G-342A	2.3	8.7	215	8.5%	8.1%
G-342B	2.1	8.8	191	7.6%	8.2%
G-342C	2.3	8.3	228	8.5%	7.7%
G-342D	2.4	6.7	296	9.0%	6.2%
G-406[c]	0.1	0.2	184	0.2%	0.2%
G-508	14.3	49.8	233	52.4%	46.4%
G-342O	0.1	0.6	156	0.4%	0.5%
STA-5/6 Total	**23.6**	**83.1**	**230**	**86.6%**	**77.4%**
			C-139 Basin		
Basin Total	**27.3**	**107.4**	**206**	**100%**	**100%**

a. 1 µg/L = 1 part per billion (ppb).

b. G-136 discharges runoff from C-139 Basin lands that are tributary to the L-1 canal. Conveyance of runoff through the G-136 structure into the Miami Canal for eventual treatment in STA-3/4 is for flood control in the L-1 canal and to address capacity limitations in sending the runoff to the south through the L-2 and L-3 canals for treatment in STA-5/6.

c. G-406 is no longer a STA-5 diversion structure. Discharge through G-406 flows south typically to STA-5/6, unless diversion is necessary through G-407 to Water Conservation Area 3.

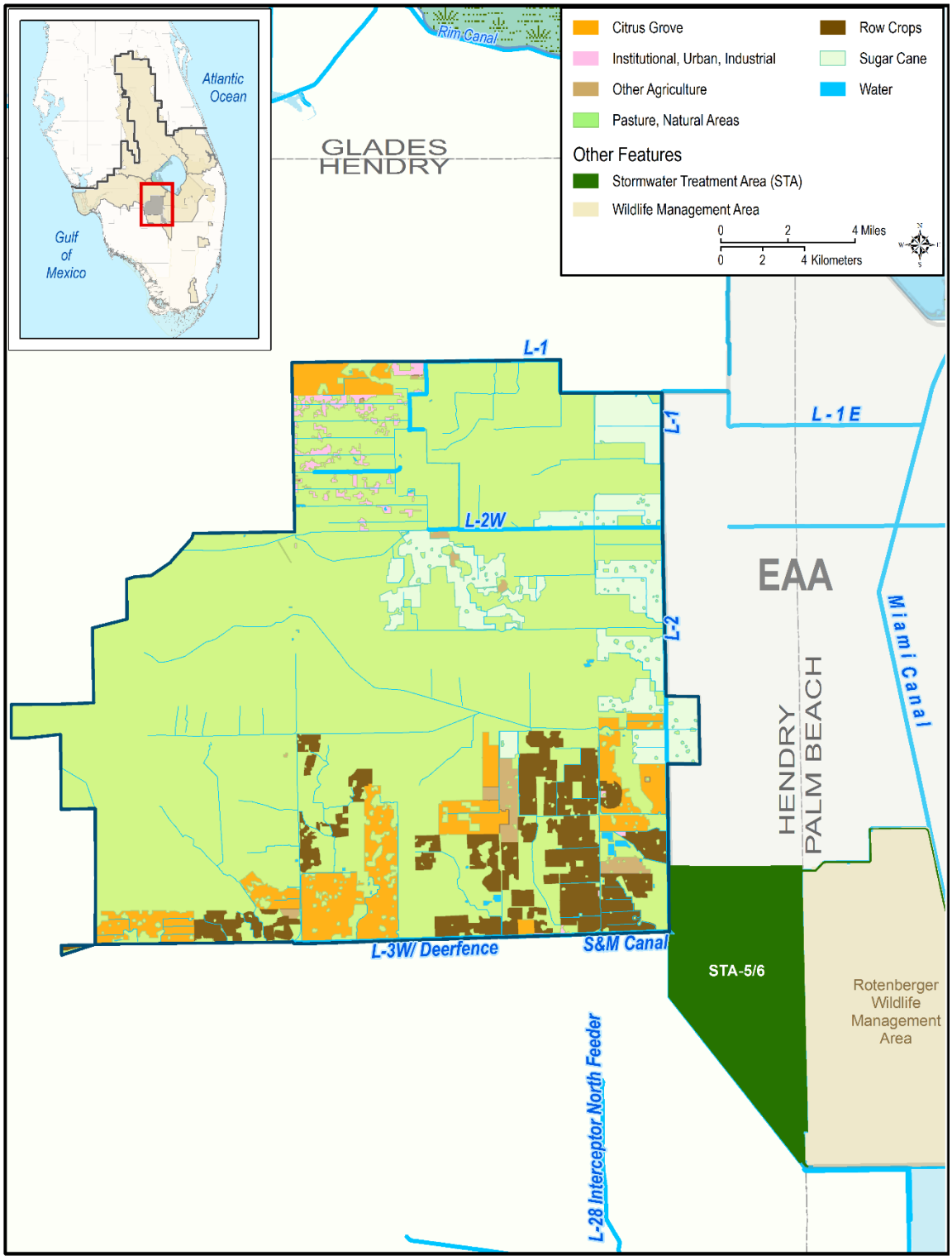

Figure 12. Land use data for the C-139 Basin (2009).

C-139 Basin Short-Term and Long-Term Variations

The 2008 SFER – Volume I, Chapter 4 (Van Horn et al. 2008), presents a preliminary review of rainfall, runoff volumes, and water quality data conducted to identify causes for the C-139 Basin recurring out of compliance results, specifically focusing on WY2007. Further analysis including WY2008 and WY2009 data supports the conclusion that the temporal distribution of rainfall substantially affects the ability for the basin to retain runoff. Detailed discussions of potential factors that contribute to the variation of the basin runoff and loads are presented in the 2009 and 2010 SFERs – Volume I, Chapter 4 (Van Horn et al. 2009, Van Horn and Wade 2010), under the *C-139 Basin Short-Term and Long-Term Variations* section. In part, the results of these analyses were incorporated in the amendment to Chapter 40E-63, F.A.C., refining the load performance methodology for the basin to incorporate monthly rainfall statistics to the regression for determining performance relative to base period conditions. The following discussion focuses on the derivation of relationships from monthly rainfall, flow, and TP load data over the period of record. These efforts, combined with the concurrent activities described in Chapter 4 of this volume, is intended to provide a more accurate representation of the effects of BMPs on C-139 Basin TP discharges compared to the pre-BMP baseline period.

WY2015 rainfall in the C-139 Basin was approximately 0.03 inches above the average rainfall, relative to the WY1980–WY2015 period (**Figure 13**). **Figure 14** depicts how the amount of annual rainfall in the C-139 Basin compares with the amount of rainfall translated into excess runoff. In general, a higher annual rainfall corresponds with a higher fraction of rainfall that results in runoff (runoff coefficient). However, monthly rainfall distribution also affects the runoff coefficient. Evaluation of the intra-annual data has contributed to better understanding, future prediction, and control of TP discharges.

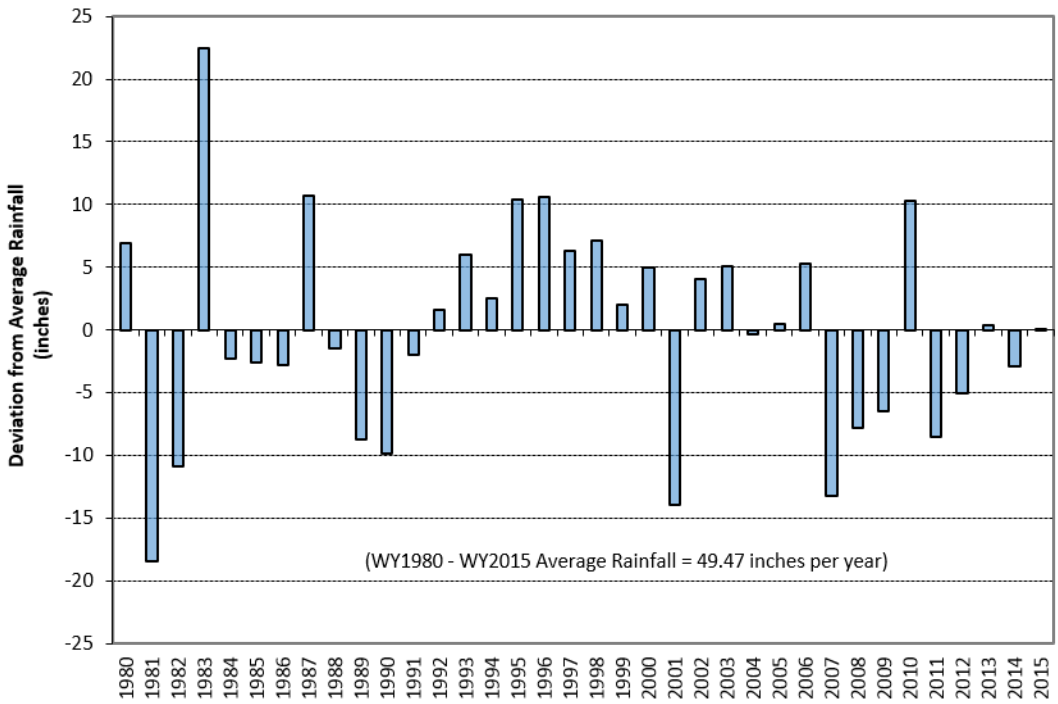

Figure 13. WY1980–WY2015 C-139 Basin annual rainfall deviation from the long-term average.

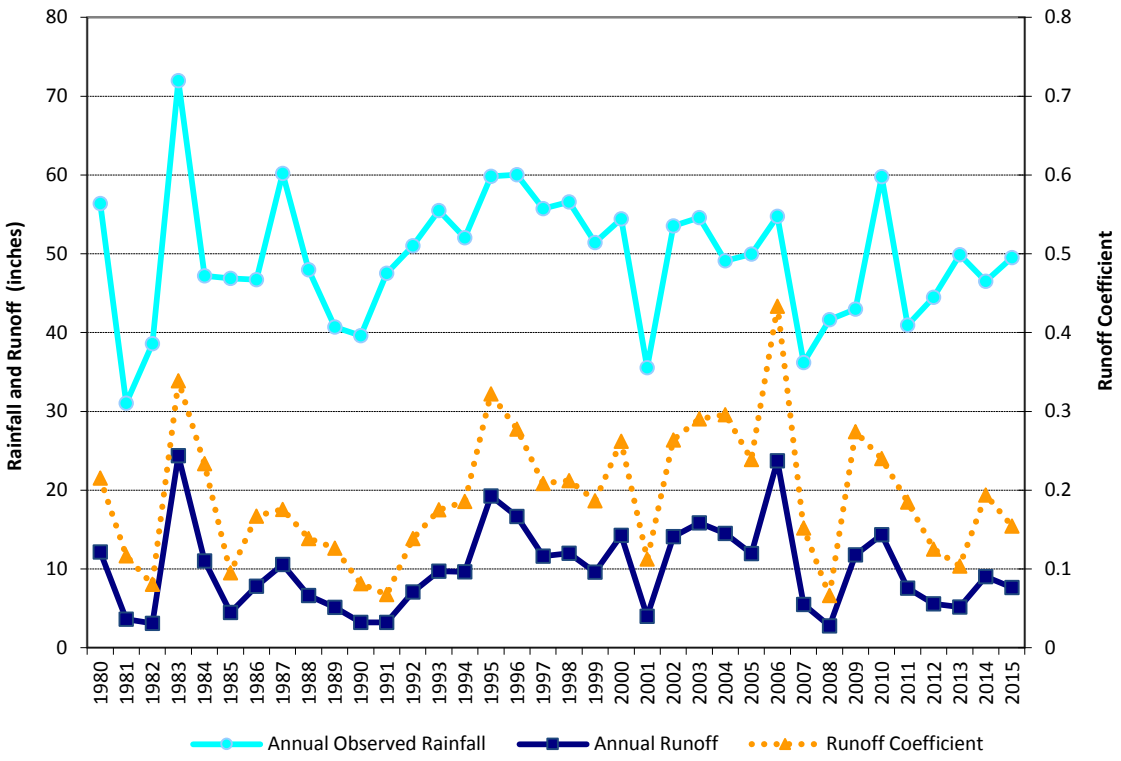

Figure 14. WY1980–WY2015 C-139 Basin annual rainfall and runoff relationship.

The scatter plot of monthly flow [more than 2 thousand acre-feet (kac-ft)] versus monthly TP FWMC in **Figure 15** implies that monthly TP concentrations from the C-139 Basin increase with monthly flow. In general, the WY2015 monthly flow and TP FWMC follow the trend stated above. Notably, in the three consecutive months of June, July, and August 2014, the C-139 Basin discharged TP FWMC of 267 micrograms per liter (µg/L), 255 µg/L, and 235 µg/L, respectively, which are all above the long-term average concentrations relative to their monthly flows. September produced the most TP load in WY2015 due to having the highest flow volume, despite a lower TP FWMC of 181 µg/L.

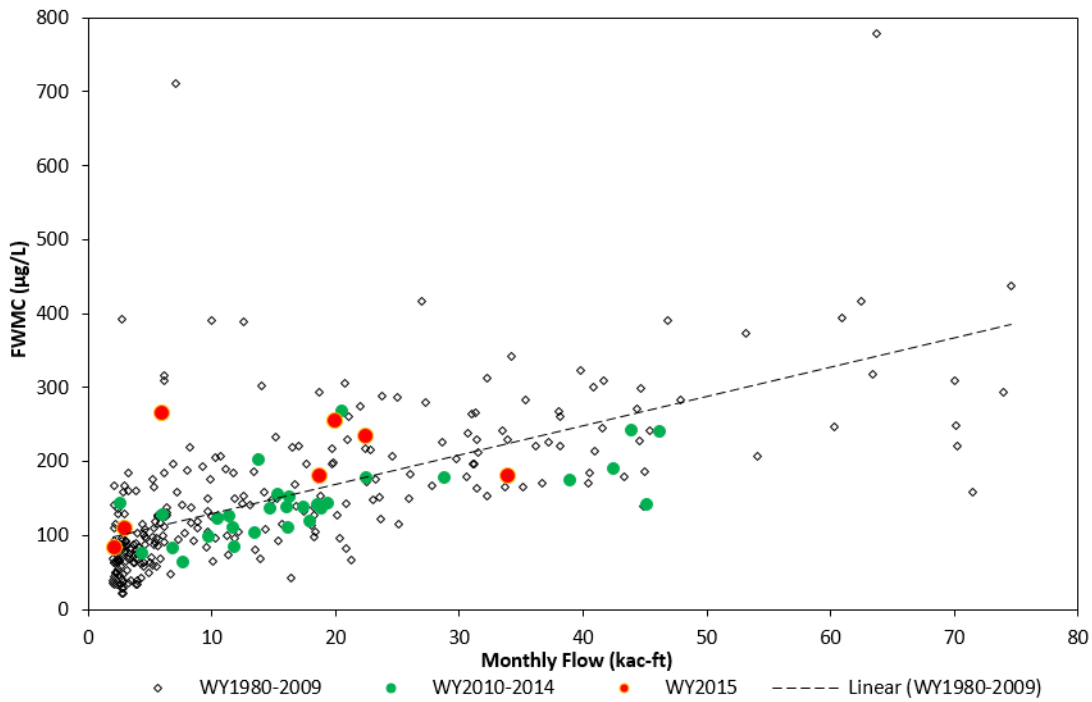

Figure 15. C-139 Basin monthly flow volume versus monthly TP FWMC for selected water years.

C-139 Subbasin Level Monitoring

The EFA mandates that if the C-139 Basin compliance determination is not met for the basin as a whole, remedial action by individual permittees shall be based on the permittee's proportional share of the TP loading. Permittees have the option to implement an individual monitoring plan to measure their proportional share or to rely on District monitoring considered to be representative of their runoff. For this purpose, the District has established an upstream monitoring network for flow and phosphorus concentration. Appendix B3.1 of Chapter 40E-63, F.A.C., defines use of the data to compute loads and UALs at the subbasin level to quantify a proportional share performance measure. This network currently has eight monitoring locations for collecting water quality and flow data from C-139 subbasins (**Figure 16**). Autosamplers are used to collect TP samples for the purpose of subbasin performance calculations. Additionally, grab samples are collected weekly at the same sites for TP, total dissolved phosphorus, and soluble reactive phosphorus. **Table 7** summarizes station names, sampling start date, and number of samples for each collection type during WY2015. The water quality data from these sites are stored in the District's DBHYDRO database under project name C139D.

The District continuously works to improve data collection processes and equipment to ensure accurate and representative data are collected. For the C-139 Basin upstream monitoring network, such improvements included, SM00.4TW, a new station located approximately 1,200 feet upstream of the previously used SMSBV site. SM000.4TW represents WY2015 flow and load from the SM subbasin. The new site is located at a weir structure. At another site, the replacement of the G-151 structure serving the L2W subbasin, resulted in its flow data source temporarily transitioning from the G-151 structure to the C139S4 index velocity site just downstream where water quality is collected. Future flow and water quality for this subbasin will be represented at the new G-151W structure, and WY2016 reporting will reflect any changes necessary to the contributing areas.

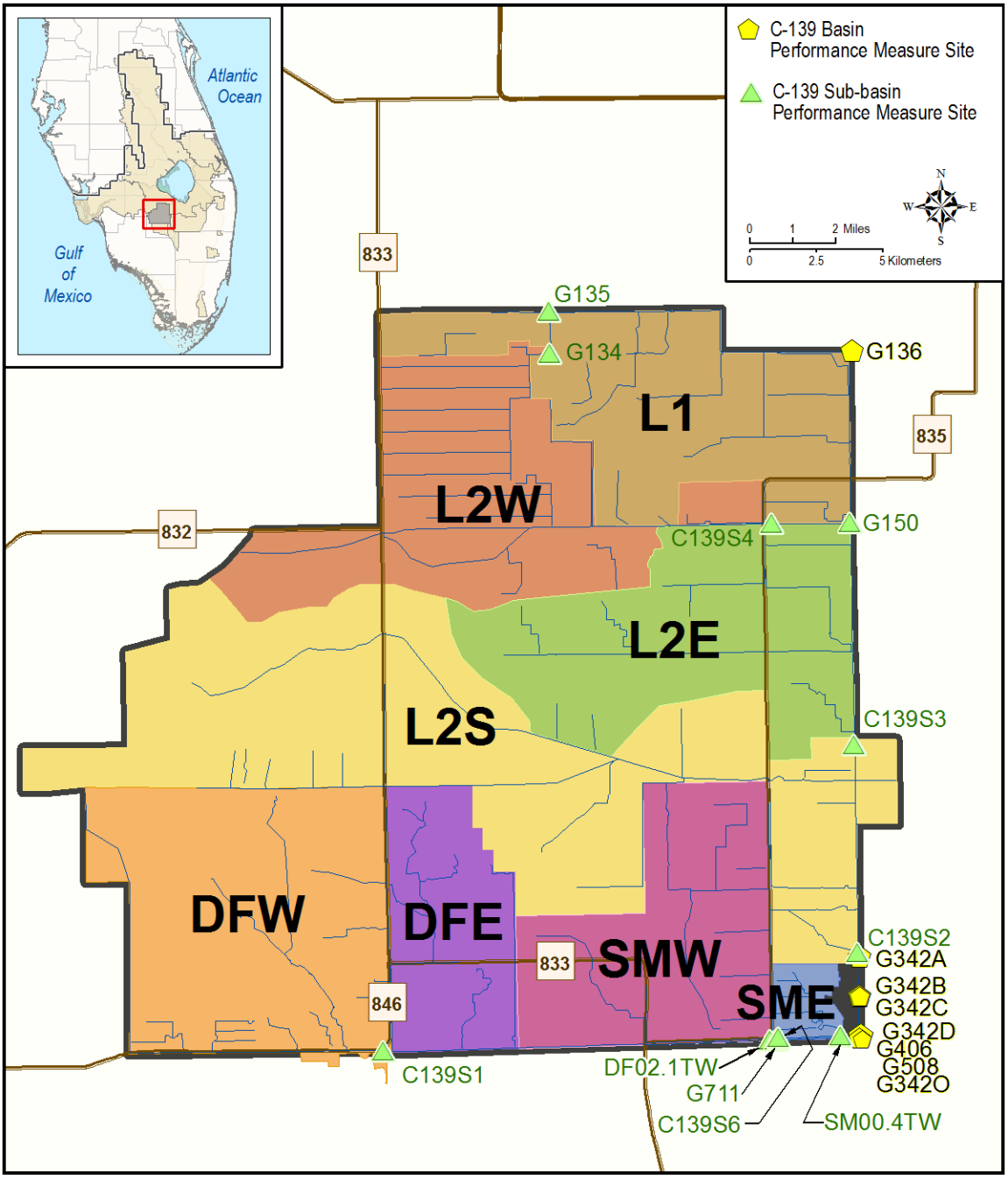

Figure 16. WY2015 C-139 Basin discharge (performance), subbasin, and upstream synoptic monitoring sites and subbasins location map.

Table 7. C-139 Basin upstream automatic sampling stations under the C139D Monitoring Project for WY2015.

Flow Station Name	Water Quality Station Name	Type of Flow Calculation	First Flow or Velocity Record	First Auto Collection	Number of WY2015 Samples Grab/Auto
G150	G150	culvert	5/3/1989	10/25/2006	14/24
C139S1	C139S1	index velocity	2/28/2007	12/20/2006	49/49
C139S2	C139S2	index velocity	8/30/2006	10/25/2006	52/46
C139S3	C139S3	index velocity	10/20/2006	10/25/2006	51/50
C139S4[a]	C139S4	index velocity	9/27/2007	1/2/2008	37/44
C139S6	C139S6	index velocity	3/6/2008	6/11/2008	49/25
SM00.4TW[b]	SM00.4TW[c]	weir	11/3/2014[b]	6/18/201[c,d]	17/16
G711	DF02.1TW	culvert	4/18/2011	4/25/2006	23/44

a. Prior to WY2015, flow station G151, located approximately 1,000 upstream of flow station C139S4, was used.

b. Prior to WY2015, flow station SMSBV, located approximately 1,200 feet downstream of flow station SM00.4TW, was used. Flow for period May 1, 2014, through November 2, 2014, was calculated based on a manual daily log record at flow station SM00.4TW, which is not archived in the District's DBHYDRO database.

c. Prior to WY2015, water quality station SM00.2TW, located approximately 1,200 downstream of flow station SM00.4TW, was used.

d. No flow occurred at flow station SM00.4TW from May 1, 2014, through June 17, 2014.

WY2015 is the fourth water year of performance measure determination under the rules amended in November 2010, and the C-139 Basin has met the TP load requirements based on the two-prong target and limit test. Therefore, no determinations of proportional share must be made based on WY2015 data. Appendix B3.1 of Chapter 40E-63, F.A.C., defines a process to verify whether monitoring at each subbasin site was adequate for the data to be representative of subbasin discharges. It also contains adjustments to ensure comparability with C-139 Basin UAL target results.

Table 8 provides a summary of WY2015 runoff flow, TP FWMC, and observed UAL for the monitoring sites. The table also identifies the C-139 subbasins represented by each monitoring site. The summary is for informational purposes only because the C-139 Basin as a whole has met its WY2015 performance measure.

Table 8. C-139 TP load monitoring site, subbasins, contributing area, runoff flow volume, TP FWMC, and observed UAL in pounds per acre (lbs/ac) for WY2015.

Monitoring Site	Subbasins[a]	Contributing Area (acres)	Runoff Flow (inches)	Observed TP FWMC (µg/L)	Observed UAL (lbs/ac)
G136	L1[b]	20,742	14.0	122	0.39
G342A-D, G342O, G406, G508	L3[b,c]	147,709	6.8	230	0.35
C139S2	L2E + L2W + L2S	91,097	7.2	143	0.23
G711	DFE + DFW	36,764	7.2	159	0.26
SM00.4TW	SME + SMW	19,288	4.9	772	0.85
C139S4	L2W	23,278	4.6	83	0.09
C139S1	DFW	25,945	5.7	252	0.33
C139S6	SMW	17,525	5.3	871	1.04

a. Subbasins L2E, L2S, DFE, and SME runoff values are not directly measured and therefore not included.

b. Insignificant flow occurred at G150 during WY2015.

c. Subbasin L3 includes subbasins L2E, L2W, L2S, DFE, DFW, SME, and SMW, and the area adjacent to STA-5.

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