Appendix 3-1b: Annual Permit Compliance Monitoring Summary Reports for EAA and C-139 Discharge Structures

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INTRODUCTION

The Everglades Regulatory Program Chapter 40E-63, Florida Administrative Code (F.A.C.) (Rule) requires the South Florida Water Management District (District or SFWMD) to report on the status of the required water quality monitoring, as stated in Appendix A3, page A3-1, paragraph 3 and Appendix B2, page B2-1, paragraph 3. The Rule also requires that a specific model be used for calculating the TP loads at every structure used in determining overall load compliance for the EAA and C-139 basins. Information on the monitoring requirements, specific equations and the models used to calculate the EAA and C-139 basin TP loads can be found by accessing the District web site at http://www.sfwmd.gov/org/reg/rules/40e-63.pdf, and navigating to Appendices A and B, respectively: Additional information on the history of how the load computation methodology was developed can be found at http://www.sfwmd.gov/org/reg/rules/40e-63_tech.pdf.

Monitoring consistency is an extremely important aspect to consider in the EAA and C-139 basin-level monitoring programs from both a water quality and quantity perspective. Much effort goes into developing monitoring programs and protocols to ensure consistency and minimize potential biases. The way in which monitoring is conducted and the way sites are located are specified by rule in Appendices A and B, Chapter 40E-63. The monitoring program and network design is setup to minimize the introduction of monitoring biases so that changes in the system can be measured utilizing the most accurate data. Therefore, all inflow and outflow monitoring sites are required to have flow-proportional autosamplers for the collection of TP samples. The samplers are setup for seven day collection cycles and samples are collected proportional to flow. Grab samples are also collected on the seventh day to serve as a backup to compute a load estimate at a specific site in the event of equipment failure or in case the composite sample is flagged during lab analysis.

The goal of the water quantity program (flow estimations) is to achieve an excellent accuracy level in which there is 95% confidence level that the flow estimate is accurate at all structures. The accuracy of flow rating equations is constantly improved through collection of field flow measurements for calibrating the flow equations. It generally takes several years of field data collection to improve or calibrate a flow rating equation. At the startup of a new structure, as was the case with STA-3/4 structures (i.e., G-370 and G-372), the flow estimates will have lower accuracy levels, but do improve with time as more data is collected. Additionally, all structures are monitored through telemetry to collect continuous real-time data on water levels and operations information (gate height openings, pump rpms, etc.) so that instantaneous discharge can be computed.

METHODS

WATER QUALITY AND HYDROLOGIC DATA

The water quality and hydrologic data evaluated in this appendix were retrieved from the District's DBHYDRO database. Before water quality data are entered into the database, the District follows strict quality assurance/quality control (QA/QC) procedures outlined in the District's Chemistry Laboratory Manual and Field Sampling Quality Manuals (SFWMD, 2004). The Laboratory Manual was developed in accordance with the National Laboratory Accreditation Conference (NELAC) requirements and the Field Manual in accordance with Florida Department of Environmental Protection Quality Assurance Rule (Chapter 62-160, F.A.C.). The quality manuals provide assurances that the water quality monitoring program is providing accurate data and that sufficient progress is being made toward achieving water quality standards.

The standards used to evaluate flow ratings' accuracy are consistent with the District's Standard Operating Procedures (SOP) for Flow Data Management in the District Hydrologic Database (SFWMD, 2003) and the U.S. Geological Survey (USGS) approach, as outlined by Novak (1985) (http://pubs.er.usgs.gov/pubs/ofr/ofr85480). Four accuracy classifications are adopted to assess a rating's accuracy. The rating is classified as "excellent" when about 95 of the predicted flow rates are within ±5 percent of the measured discharges, "good" if they are within ±10 percent, "fair" if they are within ±15, and "poor" when they are not within ±15 percent.

SAMPLING SITES

The rule requires monitoring of flow and total phosphorus (TP) data for all structures discharging flow into and from the EAA and C-139 basins to determine flows and TP loads entering and leaving those basins.

The District typically collects water quality samples on the upstream side of a structure or at a nearby location representative of the quality of water flowing through a structure. Flow-composited auto-samplers collect samples during periods of flow for each structure. Time composited auto-samplers may collect samples at certain locations where it is not possible to collect flow composited samples.

Samples are collected by District personnel from the Water Quality Monitoring Division, or by subcontractors contracted by the District to collect samples at locations specified by the District and using methods required by the District's Field Sampling Quality Manual. The samples are preserved in the field and transported to the District's laboratory for analysis.

During WY2005, there were 53 structures comprising the modeling boundary of the EAA basin and 39 water quality monitoring sampling points representing the water quality of flow through those structures. The monitoring locations (sampling points) were either situated directly at a structure (site) or at a surrogate location that was deemed to be representative for several adjacent structures. Surrogate monitoring locations are chosen when the water quality is considered the same for two or three structures in the same vicinity and the structures all convey water from the same upstream source (i.e. several adjacent outflow structures from a flow-way cell in an STA). In the C-139 basin, all six modeling boundary structures (G-406, G-342A–D, and G-136) are monitored directly. The G-136 structure also serves as the boundary point for both the EAA and C-139 basins.

DATA ANALYSIS

Table 1 provides sampling statistics for all the locations monitored by the District during WY2005 in the EAA and C-139 basins. Data are sorted by sampling station and sampling method, indicating values for grab samples and composited samples. Composited samples are comprised of flow proportional samples and time proportional samples. For each location and sampling method, the number of samples collected, the number of samples used in the model, and sample statistics are presented. The flow curve rating is given for each flow site.

Table 2 summarizes the annual flow, TP load, and concentrations for every structure used during WY2005 for determining overall compliance with the EAA load reduction requirements. The annual individual summaries are not meant to be aggregated together to mass balance the flows and loads to arrive at the reported EAA TP load. The structure summaries are merely presented as an accounting of the calculations at each structure. The mass balance procedures outlined in the rule for deriving the annual water year EAA TP load values are more complicated and are accomplished through a daily mass balancing of individual structure results for each hydrologic sub-basin.

Table 1. Everglades Agricultural Area (EAA) and C-139 water quality sample statistics.

Site	Sampling Point	Sample Type	Number Sampled	Number Used	Min. (ppm)	Max. (ppm)	Number Flagged	Flow Curve Rating
EBPS	EBEACH	Grab	38	26	0.100	0.632	1	Good[1]
		Composite*	25	24	0.102	0.930	1	
ESPS	ESHORE2	Grab	34	19	0.045	0.063	1	Good[1]
		Composite*	27	25	0.280	1.780	1	
G-136	G136	Grab	51	18	0.025	0.451	0	Poor[3]
G-200A**	G200A	Grab	13	4	0.018	0.122	0	N/A
		Composite*	3	2	0.058	0.079	1	
G-328	G328	Grab	52	17	0.011	0.076	0	Fair
		Composite*	31	23	0.019	0.088	7	
G-342A	G342A	Grab	52	23	0.027	0.222	1	Good
		Composite*	31	29	0.031	0.231	0	
G-342B	G342B	Grab	51	25	0.046	0.297	0	Good
		Composite*	31	31	0.056	0.251	0	
G-342C	G342C	Grab	51	26	0.049	0.348	0	Good
		Composite*	26	26	0.054	0.366	0	
G-342D	G342D	Grab	51	24	0.043	0.483	1	Good
		Composite*	29	27	0.058	0.449	1	
G-344A	G344A	Grab	43	17	0.019	0.089	0	Good
		Composite*	22	21	0.023	0.086	1	
G-344B	G344B	Grab	43	19	0.019	0.206	0	N/A
		Composite*	20	17	0.046	0.164	3	
G-344C	G344C	Grab	51	21	0.036	0.314	0	N/A
		Composite*	19	19	0.043	0.264	0	
G-344D	G344D	Grab	51	20	0.024	0.296	0	Good
		Composite*	19	19	0.039	0.370	0	
G-349B	G349B	Grab	2	1	0.029	0.050	0	Good[1]
		Composite*	2	1	0.050	0.053	0	
G-350B	G350B	Grab	1	1	0.040	0.040	0	Good[1]
		Composite*	1	1	0.047	0.047	0	
G-357**	G357	Grab	36	2	0.012	0.101	1	Good
		Composite*	20	3	0.016	0.090	2	
G-404**	G404	Grab	36	17	0.010	0.098	1	Fair
		Composite*	25	18	0.010	0.103	2	
G-402A**	G402A	Grab	10	9	0.013	0.056	0	Fair[2]
		Composite*	9	9	0.016	0.060	0	
G-402B**	G402A	Grab	10	9	0.013	0.056	0	Fair[2]
		Composite*	9	9	0.016	0.060	0	
G-402C**	G402C	Grab	10	9	0.012	0.031	0	Fair[2]
		Composite*	5	5	0.011	0.019	0	
G-406	G406	Grab	12	6	0.043	0.537	0	Fair
		Composite*	10	8	0.049	0.539	2	
G-410	G410	Grab	51	22	0.015	0.197	0	Good
		Composite*	28	27	0.032	0.174	0	
G-600	G600	Grab	51	33	0.015	0.192	0	Fair
		Composite*	41	36	0.018	0.209	1	
S-150**	S150	Grab	33	0	0.011	0.076	0	Poor
		Composite*	32	8	0.009	0.079	0	
S-2 Complex	S2/S351	Grab	52	35	0.054	0.441	0	Good
		Composite*	33	33	0.056	0.295	0	
S-3 Complex	S3/S354	Grab	44	23	0.039	0.265	0	Excellent
		Composite*	31	29	0.054	0.277	0	
S-352	S352	Grab	44	25	0.099	0.679	0	Good
		Composite*	34	31	0.131	0.514	0	
S-5A Complex	S5A	Grab	53	34	0.072	0.822	0	Good
		Composite*	43	40	0.068	0.450	2	
S-6	S6	Grab	53	30	0.014	0.233	1	Good
		Composite*	50	38	0.016	0.288	6	
S-7**	S7	Grab	35	28	0.010	0.199	0	Good
		Composite*	25	25	0.009	0.089	0	
S-8**	S8	Grab	36	17	0.010	0.097	0	Good
		Composite*	18	17	0.010	0.037	0	

Table 1. Continued.

Site	Sampling Point	Sample Type	Number Sampled	Number Used	Min. (ppm)	Max. (ppm)	Number Flagged	Flow Curve Rating
G-204**	G204	Grab	2	0	0.047	0.058	0	N/A
G-205**	G205	Grab	2	0	0.035	0.070	0	N/A
G-206**	G206	Grab	2	0	0.020	0.048	0	N/A
G-507	G507	Grab	5	3	0.023	0.052	0	N/A
		Composite*	4	3	0.039	0.066	0	
SSDDMC	SSDDMC	Grab	19	8	0.049	0.216	0	N/A
		Composite*	9	9	0.040	0.236	0	
G-370	G370	Grab	52	28	0.026	0.215	0	Excellent
		Composite*	51	37	0.047	0.199	0	
G-372	G372	Grab	52	31	0.017	0.252	0	Excellent
		Composite*	51	28	0.019	0.219	0	
G-376A,B,C**	G376A	Grab	9	4	0.009	0.025	0	Excellent
G-376D,E,F**	G376D	Grab	9	4	0.010	0.018	0	Good
G-379A,B,C**	G379A	Grab	4	0	0.016	0.026	0	Good
G-379D,E**	G379D	Grab	29	3	0.015	0.055	0	Excellent
G-381A,B**	G381A	Grab	9	4	0.010	0.023	0	Good
G-381C,D,E,F**	G381C	Grab	9	4	0.008	0.024	0	N/A

* Composite samples could be time proportional or flow proportional or a combination of the two.
** These structures where evaluated through 1/8/05 when they became outside the model boundaries and were no longer used in the regulatory models.
[1] Good, Based on experience with theoretical ratings based on pump manufacturers' performance curves
[2] Fair, Based on experience with new theoretical rating
[3] Poor, based on our experience with ratings at culverts with flashboards
N/A Flow Curve Rating not available

Table 2. Summary of EAA basin TP calculations.

EAA Related Loads by Structure

Water Year 2005

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

EAA to Lake

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S3	0.20	0.54	294
S2	3.54	21.52	133
S352	0	0.00	N/A
Total	**3.74**	**22.06**	**137**

Lake to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S354 (S3)	34.94	183.34	154
S351 (S2)	58.49	294.89	161
S352	39.46	132.33	242
Total	**132.88**	**610.56**	**176**

EAA to WCAs (through 1/8/05)

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S8	6.72	260.58	21
G404	1.29	41.21	25
G357	0.55	11.62	38
S150	1.32	34.79	31
S7	5.37	274.27	16
Total	**15.25**	**622.48**	**20**

WCAs to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S8	0.01	0.25	43
G404	0.00	0.00	N/A
G357	0.00	0.00	N/A
S150	0.00	0.00	N/A
S7	0.00	0.00	N/A
Total	**0.01**	**0.25**	**43**

EAA to STA1W Distribution Works

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S5A	**113.02**	**405.42**	226

C-51 to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S5AW	**0.13**	**0.80**	**132**

EAA to STA2

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
S6	47.79	291.87	133
G328	1.28	24.41	42
Total	**49.07**	**316.28**	**126**

STA2 to EAA

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

EAA to STA6

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G600	**3.29**	**34.03**	78

STA6 to EAA

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

EAA to STA5

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G344 (a,b,c,d)	0.000	0.00	N/A
G349B	0.010	0.16	53
G350B	0.010	0.16	47
G507	0.170	3.07	45
Total	**0.190**	**3.389**	46

STA5 to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G344 (a,b,c,d)	12.22	121.43	81
G349B	0.00	0.00	N/A
G350B	0.00	0.00	N/A
Total	**12.22**	**121.43**	82

EAA to STA3/4

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G370	46.74	305.24	124
G372	40.70	366.21	90
Total	**87.44**	**671.45**	106

STA3/4 to EAA (through 1/8/05)

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G376-culverts	3.71	202.66	15
G379-culverts	0.31	18.37	14
G381-culverts	3.72	257.91	12
Total	**7.75**	**478.94**	13

EAA to Rotenberger

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G410	3.91	44.42	71
G402(a,b,c,d)	0.00	0.00	N/A
Total	**3.91**	**44.42**	71

Rotenberger to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G410	0.00	0.00	N/A
G402(a,b,c,d)	0.92	34.05	22
Total	**0.92**	**34.05**	22

EAA to Holeyland

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G200	**2.29**	**13.67**	136

C-139 to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
G136	**5.21**	**17.37**	243

298 Districts to EAA

Structure	Load(mtons)	Flow (kac-ft)	Conc. (ppb)
EBPS	11.91	21.55	447
ESPS	5.98	34.33	141
SSDD	2.17	10.98	160
Total	**20.06**	**66.86**	243