APPENDIX G

RESOLUTION OF WATER QUALITY

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BEFORE THE STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION,

Complainant,

vs. OGC FILE NO. 12-1148

SOUTH FLORIDA
WATER MANAGEMENT DISTRICT.

Respondent.
_____/

CONSENT ORDER

This Consent Order is entered into between the State of Florida Department of Environmental Protection ("Department") and the South Florida Water Management District ("Respondent") to reach settlement of certain matters at issue between the Department and the Respondent.

The Department finds and Respondent admits the following:

1. The Department is the administrative agency of the State of Florida having the power and duty to protect Florida's air and water resources and to administer and enforce Chapter 373 and Chapter 403, Florida Statutes ("F.S."), and the rules promulgated and authorized thereunder, Title 62, Florida Administrative Code ("F.A.C."). The Department has jurisdiction over the matters addressed in this Consent Order. The Department is authorized by Section 403.121, Florida Statutes, to institute

administrative proceedings to order the prevention, abatement, or control of the conditions creating a violation of Chapter 403, and to order other appropriate corrective action.

2. Respondent is a public corporation of the State of Florida existing by virtue of Chapter 25270, Laws of Florida, 1949, and operating pursuant to Chapter 373, F.S., and Title 40E, F.A.C., as a multipurpose water management district with its principal office at 3301 Gun Club Road, West Palm Beach, Florida, 33406. Respondent is a person within the meaning of Sections 373.019(15) and 403.031(5), F.S.

3. Respondent is the local sponsor for the Central and Southern Florida Flood Control Project ("C&SF Project") which provides flood control in the EAA, C-139, and other tributary basins and urban, agricultural, and environmental water supply to the Everglades and Lower East Coast of Florida.

4. As authorized pursuant to Section 373.4592, F.S., Respondent built and operates large, state of the art manmade treatment wetlands, known as stormwater treatment areas ("STAs"), to remove excess phosphorus from surface waters that flow from Lake Okeechobee, the EAA, the C-139 Basin, the L-8 Basin and the C-51 West Basin to the Everglades Protection Area ("EPA"). Respondent is required to obtain a National Pollutant Discharge Elimination System ("NPDES") permit from the Department pursuant to 403.0885, F.S., to operate, maintain and discharge from the STAs.

5. Respondent is the operator of STA-1 East and the owner and operator of STA-1 West, STA-2, STA-3/4 and STA-5/6 which discharge into Water Conservation Area ("WCA") 1, 2 and 3 of the EPA. WCA-1, 2 and 3 are designated Class III waters of the State and WCA-1 is also an Outstanding Florida Water pursuant to Rule 62-302.700, F.A.C.

6. Respondent, to date, has constructed approximately 60,000 acres of STAs. While the STAs have greatly reduced the amount of phosphorus entering the EPA, the phosphorus criterion established in Rule 62-302.540, F.A.C., has not been met in all the ambient waters of the EPA.

7. In the accompanying permit (NPDES Permit No. FL0778451-001-GL7A/RA), issued concurrently with this Consent Order, the Department is establishing a water quality based effluent limitation ("WQBEL") for total phosphorus ("TP") discharges from the STAs into the EPA. The WQBEL was derived to ensure that STA discharges do not cause or contribute to exceedance of the Everglades phosphorus criterion in Rule 62-302.540, F.A.C., throughout the EPA (See Exhibit A). The WQBEL consists of two components 1) a maximum TP annual flow-weighted mean ("AFWM") of 19 parts per billion ("ppb"); and, 2) a TP long-term flow-weighted mean ("LTFWM") of 13 ppb not to be exceeded in more than three (3) out of five (5) years.

To date, TP levels in discharges from the best performing STA, STA-3/4, have averaged 17 ppb. No STA has achieved an annual flow-weighted mean of 13 ppb in more than three out of five years. As such, the STAs are not predicted to achieve the

WQBEL without additional corrective actions.

8. While the phosphorus levels in the STA discharges have not yet achieved concentrations necessary to meet the phosphorus criterion, significant reductions in the levels of phosphorus delivered to the EPA have occurred since their initial construction and operation. As of water year 2011 the STAs, in combination with best management practices, have removed 3,800 metric tons of phosphorus from water that would have alternatively been delivered to the EPA untreated. If the STAs cease operations, untreated water would flow directly into the EPA. The Department finds that it is clearly in the public interest to exercise its enforcement discretion to allow the continued operation of STAs while the corrective actions required by this Consent Order are implemented so long as the STAs are operated in compliance with Paragraph 12.

Having reached a resolution of the matter, Respondent and the Department mutually agree and it is,

ORDERED:

9. Respondent shall operate and maintain STA-1 East, STA-1 West, STA-2, STA 3/4 and STA 5/6 in accordance with the terms and conditions of NPDES Permit No.: FL0778451-001-GL7A/RA, except as specified in Paragraph 12 below. This Order does not alter the obligation to comply with the WQBEL for TP in Section I.A.1 of the permit upon its effective date. However, effluent from the STAs is not predicted to

achieve the WQBEL for TP until completion of the corrective actions described in Paragraph 10 below.

10. In order to bring discharges from STA 1 East, 1 West, STA 2, STA 3/4 and STA 5/6 into compliance with the WQBEL, Respondent shall expeditiously proceed with the planning, design, construction and operation of the Eastern (STA-1 East and STA-1 West), Central (STA-2 and STA-3/4) and Western (STA-5/6) Flow-path corrective actions which are more particularly described in Exhibit B. Respondent shall obtain all necessary local, state and federal authorizations, including appropriate Department permits, for these activities. These corrective actions and the associated deadlines for completion and operation are as follows:

Eastern Flow-path Corrective Actions and Deadlines	
Activity	Deadline
Complete land acquisition for expansion	09/30/2013
Initiate design of expansion	09/30/2013
Submit state and federal permit applications for expansion	07/30/2014
Complete design of expansion	07/30/2015
Initiate construction of expansion	01/31/2016
Construction status report	03/01/2017
Construction status report	03/01/2018
Complete construction of expansion	12/31/2018
Initial flooding and optimization period complete	12/31/2020
Initiate design of structure expansion	09/30/2013
Complete design of structure expansion	07/30/2015
Initiate construction of structure expansion	01/31/2016
Complete construction of structure expansion	12/31/2018
Initiate design of structure expansion	10/01/2012
Complete design of structure expansion	09/30/2014
Initiate construction of structure expansion	10/01/2016
Complete construction of structure expansion	09/30/2018

Eastern Flow-path: S-333 Modifications	
Initiate design of structure modifications	10/01/2012
Complete design of structure expansion	09/30/2014
Initiate construction of structure expansion	10/01/2014
Complete construction of structure expansion	09/30/2016
Eastern Flow-path: 1,000 Acre Expansion	
Complete land acquisition for expansion	03/31/2018
Initiate design for expansion	10/01/2018
Submit state and federal permit applications for expansion	08/01/2019
Complete design of expansion	07/31/2020
Initiate construction of expansion	11/30/2020
Construction status report	03/01/2021
Construction status report	03/01/2022
Complete construction of expansion	12/31/2022
Initial flooding and optimization period complete	12/31/2024
Eastern Flow-path: Flow Equalization Basin (FEB) 45,000 acre-feet	
Submit state and federal permit applications	01/31/2014
Construction status report	03/01/2014
Construction status report	03/01/2015
Completion of construction (multi-purpose operation begins)	12/31/2016[1]
Long-term operations commence	12/31/2022[2]
Eastern Flow-path: G-341 and Related Improvements	
Initiate design of G-341 and related improvements	10/01/2020
Submit state and federal permit applications for G-341 and related improvements	08/01/2021
Complete land acquisition for G-341 related improvements (if required)	09/30/2021
Complete design of G-341 and related improvements	07/31/2022
Initiate construction of G-341 and related improvements	11/30/2022
Construction status report	03/01/2023
Construction status report	03/01/2024
Completion of construction for G-341 and related improvements	12/31/2024
Eastern Flow-path: Repairs and Modifications of Stormwater Treatment Area 1 East	
Periphyton Stormwater Treatment Area Decommissioning complete	Prior to Long-term operations commencing
Culvert repairs complete	Prior to Long-term Operations Commencing
Cell 5 and 7 improvements complete	Prior to Long-term Operations Commencing
Eastern Flow-path Corrective Action Completion Date	**12/31/2024**

[1] Multi-purpose operations until replacement storage on-line
[2] Long term operations- replacement storage on-line

Central Flow-path Corrective Actions and Deadlines	
Activity	Deadline
[illegible]	[illegible]
Initial flooding and optimization period complete	05/31/2014
[illegible]	[illegible]
Initiate design of A-1 FEB	04/01/2012
Submit state and federal permit applications	12/01/2012
Design status report	03/01/2013
Complete design of A-1 FEB	08/01/2013
Initiate construction of A-1 FEB	06/30/2014
Construction status report	03/01/2015
Construction status report	03/01/2016
Complete construction of A-1 FEB	07/30/2016
FEB Operational monitoring and testing period complete	07/29/2018
[illegible]	[illegible]

Western Flow-path Corrective Actions and Deadlines	
Activity	Deadline
[illegible]	[illegible]
Initial flooding and optimization period complete	05/31/2014
[illegible]	[illegible]
Initiate design of scraping/earthwork improvements	10/31/2019
Submit state and federal permit applications	08/30/2020
Complete design of scraping/earthwork improvements	10/31/2021
Initiate scraping/earthwork activities	01/31/2022
Construction status report	03/01/2023
Construction status report	03/01/2024
Completion of scraping/earthwork activities	12/31/2024
Initial flooding and optimization period complete	12/31/2025
[illegible]	[illegible]
Initiate design of FEB	10/31/2018
Submit state and federal permit applications	08/30/2019
Complete design of FEB	10/31/2020
Initiate construction of FEB	01/31/2021
Construction status report	03/01/2021
Construction status report	03/01/2022
Construction status report	03/01/2023
Complete construction of FEB	12/31/2023
Operational monitoring and testing period	12/31/2024
[illegible]	[illegible]

Unless terminated by mutual consent of the parties, this Consent Order, setting forth the corrective actions, shall remain in effect for all flow-paths until the corrective actions for all flow-paths in this Paragraph are completed and sufficient discharge data required under the permit exists to assess compliance with both components of the WQBEL for all flow-paths.

11. The Respondent commits to expediting the corrective actions set forth in Paragraph 10, to the maximum extent practicable while fulfilling its other agency responsibilities, in an effort to incrementally improve water quality discharges into the EPA.

12. Upon completion of the specific corrective actions identified in Paragraph 10, it is anticipated that the facilities will be discharging consistent with the WQBEL for TP established in Section I.A.1 of the permit. Until such time as the corrective actions identified in Paragraph 10 are completed consistent with the deadlines set forth therein, the Department will exercise its enforcement discretion to allow the STAs to maintain operations. In the interim, the Respondent shall operate and maintain all STA facilities and systems of treatment control in an effort to maximize reductions in TP concentrations to the Everglades Protection Area. Such operations shall be in accordance with any approved operational plan, pollution prevention plan and the accompanying permit.

13. Whereas it is predicted that discharges from the facilities will not achieve the WQBEL until the corrective actions in Paragraph 10 have been completed, this

Order provides the following alternate reporting provisions in lieu of those required in Section I.A.6 through I.A.10 of the permit: 1) The Respondent shall provide, as part of the annual report in Section I.E.6. of the permit, status updates on the activities described in Paragraph 10 and TP AFWM concentrations for each STA over the course of the prior water year (May 1st through April 30th). The TP AFWM shall also be reported in accordance with Section I.A.5. of the permit. In both cases, the TP AFWM shall be calculated in accordance with Section I.A.1. of the permit; and 2) The Respondent shall prepare a weekly STA performance summary (report) that sets forth inflow volumes, inflow FWM TP concentrations, outflow volumes, outflow FWM TP concentrations for the prior 7 day, 28 day and 365 day period of record and inflow and outflow TP load for the prior 28 day and 365 day period of record. The weekly report shall also include the 365 day loading rate, 6 month trend in outflow TP concentrations, and concentration, load and flow in comparison to the period of record observed conditions. Copies of the weekly reports shall be transmitted to the Department and USEPA representatives to be identified in accordance with Paragraph 14. The District shall consult with the representatives on a semi-annual basis to evaluate the STAs performance and the District shall determine what, if any, operational changes may be implemented to ensure compliance with the Operational and Pollution Prevention Plans. Other relevant information collected by the Respondent shall be presented to the representatives of the State and Federal agencies designated under Paragraph 14 prior

to their semi-annual consultation to ensure that adequate time is available to review and facilitate informed technical discussions.

Interim reporting requirements established by this Paragraph shall no longer apply subsequent to the Flow-path Corrective Action Completion Deadline.

14. The Respondent shall develop and implement a science plan in order to identify the factors that collectively influence phosphorus reduction and treatment performance in order to meet the WQBEL. The Respondent shall develop the science plan in consultation with representatives as designated by the Department and the United States Environmental Protection Agency, Region IV (USEPA), respectively, on behalf of State and Federal agencies.

After consulting with the representatives, the Respondent shall: 1) identify the critical information gaps and research areas that influence treatment performance; 2) prioritize the science needs; 3) develop and implement the science plan; 4) evaluate the results of ongoing scientific efforts to meet the prioritized science needs; 5) modify the science plan as needed based on results of completed or ongoing scientific studies, and 6) determine how the results of the scientific studies could be implemented to improve phosphorus reductions and treatment performance. Of particular interest is a better understanding of design and operations that sustain outflow concentrations at low phosphorus concentrations (<20 ppb).

Key areas that should be considered for further scientific studies include the effect of the following factors on STA performance: 1) phosphorus loading rates; 2)

inflow phosphorus concentration; 3) hydraulic loading rates; 4) inflow water volumes, timing, pulsing, peak flows, and water depth; 5) phosphorus speciation at inflows and outflows; 6) effects of microbial activity and enzymes on phosphorus uptake; 7) phosphorus re-suspension and flux; 8) the stability of accreted phosphorus; 9) phosphorus concentrations and forms in soil and floc; 10) soil flux management measures; 11) influence of water quality constituents such as calcium; 12) emergent and submerged vegetation speciation; 13) vegetation density and cover; 14) weather conditions such as hurricane and drought; and 15) the inter-relationships between those factors.

The representatives will perform only technical functions such as:

- Information gathering and fact-finding regarding scientific studies presented to it.
- Evaluation and comparison of the results of the scientific studies through identification of positive, neutral and negative impacts of any options presented in the results of the scientific studies.
- Provide expert technical opinions regarding viability and outcomes of any options presented in the results of the scientific studies.
- Develop and provide technical opinions on STA interim operational data with regard to observed water year conditions and resulting phosphorus reductions;
- Assess water quality and progress in achieving the corrective actions and deadlines in this Consent Order.

The representatives shall not vote nor shall they make any consensus recommendations or decisions regarding matters that are presented.

The results of scientific studies and interim operational performance will be presented to and evaluated by the representatives and ultimately used by the agency representatives to inform their respective agencies as to how the information could be utilized to optimize phosphorus reduction and treatment performance.

The Respondent shall convene regular meetings of the representatives as often as needed, but no less than once every six (6) months. The first meeting of the representatives shall take place no later than six (6) months after the date of permit issuance. The Respondent shall develop a detailed science plan including a work plan and schedules within nine (9) months of issuance of the permit. The Respondent shall begin to implement studies and research identified in the work plan within twelve (12) months of issuance of the permit.

15. Respondent shall conduct monthly monitoring at a series of sites downstream of STA-1E, STA-1W and STA-2 in order to characterize the effects of the STAs' discharge on the receiving water bodies. The tables below identify thirty one (31) downstream sampling sites. Of the thirty one (31) sites, eighteen (18) are located in areas currently identified as impacted (i.e., sediment TP concentration greater than 500 mg/kg) and ten (10) sites are located in areas currently identified as unimpacted. Three sampling sites are located in the Rim Canal. Upon demonstration that an additional sampling site or removal of an existing sampling site or parameter is warranted, the

Respondent may request a modification to the monitoring program as appropriate. The Department shall review and approve such requests on a case by case basis after consultation with USEPA. Any alteration in the monitoring program must be approved by the Department. The Department will assess whether continuance of, modifications to, or elimination of downstream monitoring efforts are warranted prior to the conclusion of this Order.

All water quality, sediment, and vegetation samples shall be collected and reported for the parameters and at the frequency specified in the Respondent's March 2012 "Downstream STA1W, STA1E, and STA2 Transect Monitoring Plan (Project Code: STAT) SFWMD-FIELD-MP-078-01".

Transect Monitoring for STA-1E			
Station	Latitude	Longitude	Category
LOXA-135	26° 37′ 24.1″ N	80° 18′ 58.0″ W	Rim Canal
LOXA-136	26° 37′ 7.7″ N	80° 19′ 7.2″ W	Impacted
LOXA-137	26° 36′ 54.4″ N	80° 19′ 18.1″ W	Impacted
LOXA-138	26° 36′ 24.5″ N	80° 19′ 36.0″ W	Unimpacted
LOXA-139	26° 35′ 36.0″ N	80° 20′ 13.8″ W	Unimpacted

Transect Monitoring for STA-1W			
Station	Latitude	Longitude	Category
LOXA-104	26° 35′ 52.7″ N	80° 26′ 24.2″ W	Rim Canal
LOXA-104.5	26° 35′ 38.8″ N	80° 26′ 20.8″ W	Impacted
LOXA-105	26° 35′ 30.8″ N	80° 26′ 9.9″ W	Impacted
LOXA-106	26° 35′ 31.9″ N	80° 25′ 52.6″ W	Impacted
LOXA-107	26° 35′ 14.6″ N	80° 25′ 17.2″ W	Impacted
LOX-107U	26° 34′ 52.3″ N	80° 24′ 43.2″ W	Unimpacted
LOXA-108	26° 34′ 40.7″ N	80° 24′ 21.1″ W	Unimpacted
Z-0[3]	26° 28′ 1.1″ N	80° 26′ 31.8″ W	Rim Canal
Z-1[3]	26° 28′ 5.9″ N	80° 26′ 24.4″ W	Impacted

[3] Monitoring of the Z transect station, in accordance with the parameters and frequencies in the March 2012 'Downstream STA-1W, STA-1E and STA-2 Transect Monitoring Plan' shall not commence until such time as the Respondent initiates construction activities associated with the 1,800 acre STA Expansion identified in Paragraph 10 of this Order.

Z-2[3]	26° 27′ 52.3″ N	80° 25′ 40.6″ W	Impacted
Z-3[3]	26° 27′ 29.9″ N	80° 24′ 31.0″ W	Impacted
Z-4[3]	26° 26′ 46.2″ N	80° 23′ 18.6″ W	Unimpacted

Transect Monitoring for STA-2			
Station	Latitude	Longitude	Category
2AN.25	26° 27′ 14.34″ N	80° 27′ 23.34″ W	Impacted
2AN1	26° 24′ 43.39″ N	80° 28′ 16.97″ W	Impacted
2AN2	26° 26′ 20.28″ N	80° 27′ 14.46″ W	Impacted
2AN4	26° 25′ 21.48″ N	80° 27′ 01.38″ W	Impacted
2AN5	26° 24′ 49.54″ N	80° 26′ 52.69″ W	Unimpacted
2AN6	26° 24′ 18.12″ N	80° 26′ 44.08″ W	Unimpacted
2AC0.25	26° 25′ 34.68″ N	80° 28′ 30.90″ W	Impacted
2AC2	26° 24′ 43.39″ N	80° 28′ 16.97″ W	Impacted
2AC4	26° 23′ 42.54″ N	80° 28′ 05.10″ W	Unimpacted
2AC5	26° 23′ 09.50″ N	80° 28′ 00.97″ W	Unimpacted
2AFS.25	26° 20′ 44.77″ N	80° 31′ 36.59″ W	Impacted
2AFS1	26° 20′ 38.46″ N	80° 31′ 10.32″ W	Impacted
2AFS3	26° 20′ 15.84″ N	80° 30′ 01.62″ W	Impacted
CA 29	26° 19′ 31.40″ N	80° 28′ 21.54″ W	Unimpacted

16. Except as provided for in Paragraph 17, Respondent agrees to pay the Department stipulated penalties in the amount of $1,000.00 per day for each and every day Respondent fails to complete any of the corrective actions by the respective deadlines identified in Paragraph 10 of this Order. A separate stipulated penalty shall be assessed for each violation of this Consent Order. Within 30 days of written demand from the Department, Respondent shall make payment of the appropriate stipulated penalties to the "State of Florida Department of Environmental Protection" by cashier's check or money order and shall include thereon the notations "OGC Case No. 12-1148" and "Ecosystem Management and Restoration Trust Fund." The Department may make demands for payment at any time after violations occur. Nothing in this Paragraph shall prevent the Department from filing suit to specifically enforce any of

the terms of this Consent Order. If the Department is required to file a lawsuit to recover stipulated penalties under this Paragraph, the Department will not be foreclosed from seeking civil penalties for violations of this Consent Order in an amount greater than the stipulated penalties due under this Paragraph.

17. If any event occurs which causes delay or the reasonable likelihood of delay in complying with the requirements of this Order, Respondent shall have the burden of proving that the delay was or will be caused by circumstances beyond the reasonable control of the Respondent and could not have been or cannot be overcome by Respondent's due diligence. Upon occurrence of such an event, or upon becoming aware of a potential for delay, Respondent shall notify the Department orally within seven (7) days and as soon thereafter as possible shall notify the Department and USEPA in writing of the anticipated length and cause of the delay, the measures taken or to be taken to prevent or minimize the delay, and the timetable by which Respondent intends to implement these measures. If the Department agrees that the delay or anticipated delay has been or will be caused by circumstances beyond the reasonable control of Respondent, the Department will notify the Respondent in writing that the time for performance for specified project activities in this Consent Order shall be extended for a period equal to the agreed delay resulting from such circumstances, including all reasonable measures necessary to avoid or minimize future delay.

18. Entry of this Consent Order does not relieve Respondent of the need to comply with applicable federal, state or local laws, regulations or ordinances.

19. The terms and conditions set forth in this Consent Order may be enforced in a court of competent jurisdiction pursuant to Sections 120.69, 373.129 and 403.121 and 403.131, F.S. Failure to comply with the terms of this Order shall constitute a violation of Sections 373.430 and 403.161, F.S.

20. Respondent is fully aware that a violation of the terms of this Order may subject Respondent to judicial imposition of damages, civil penalties of up to $10,000 per day per violation and criminal penalties.

21. The Department and Respondent hereby irrevocably, knowingly, voluntarily, and intentionally waive their right to trial by jury with respect to any litigation based wholly or partially on the enforcement of this Consent Order.

22. Persons who are not parties to this Consent Order but whose substantial interests are affected by this Consent Order have a right, pursuant to Sections 120.569 and 120.57, F.S., to petition for an administrative hearing on it. The Petition must contain the information set forth below and must be filed (received) at the Department's Office of General Counsel, 3900 Commonwealth Boulevard, MS# 35, Tallahassee, Florida 32399-3000 within 21 days of receipt of this notice. A copy of the Petition must also be mailed to the Office of Ecosystem Projects, Program Coordination and Regulation Section, 3900 Commonwealth Boulevard, MS 24, Tallahassee, Florida 32399-3000. Failure to file a petition within the 21 days constitutes a waiver of any right such person has to an administrative hearing pursuant to Section 120.57, F.S.

The petition shall contain the following information:

a) OGC No. 12-1148 and the county in which the subject matter is located;

b) The name, address, and telephone number of each petitioner; the name, address, and telephone number of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding;

c) An explanation of how the petitioner's substantial interests will be affected by the Consent Order;

d) A statement of when and how the petitioner received notice of the Consent Order;

e) A statement of all material facts disputed by the petitioner, if any;

f) A statement of the specific facts the petitioner contends warrant reversal or modification of the Consent Order;

g) A statement of which rules or statutes the petitioner contends require reversal or modification of the Consent Order; and

h) A statement of the relief sought by the petitioner, stating precisely the action petitioner wishes the Department to take with respect to the Consent Order.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this Consent Order. Persons whose substantial interests will be affected by any decision of the Department with regard to the subject Consent Order have the right to petition to become a party to the proceeding. The petition must

conform to the requirements specified above and be filed (received) within 21 days of receipt of this notice in the Department's Office of General Counsel at the address specified above. Failure to file a petition within the allowed timeframe constitutes a waiver of any right such person has to request a hearing under Sections 120.569 and 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-106.205, F.A.C.

23. Because this Consent Order accompanies and references NPDES Permit No. FL0778451-001-GL7A/RA, this Consent Order shall not be effective until NPDES Permit No. FL0778451-001-GL7A/RA becomes effective.

24. The Department hereby expressly reserves the right to initiate appropriate legal action to prevent or prohibit any violations of applicable statutes, or the rules promulgated thereunder that are not specifically addressed by the terms of this Consent Order.

25. The Department, for and in consideration of the complete and timely performance by Respondent of the obligations agreed to in this Consent Order, hereby waives its right to seek judicial imposition of damages or civil penalties for alleged violations addressed in this Consent Order.

26. Respondent acknowledges and waives its right to an administrative hearing pursuant to Sections 120.569 and 120.57, F.S., on the terms of this Consent Order. Respondent acknowledges its right to appeal the terms of this Consent Order

pursuant to Section 120.68, F.S., and waives that right upon signing this Consent Order. Respondent waives no other rights or defenses other than those explicitly addressed in this Consent Order.

27. This document constitutes the entire agreement and understanding of the parties to this Consent Order concerning settlement of the above-captioned action and there are no representations, warranties, covenants, terms or conditions agreed upon between the parties other than those expressed in this Consent Order. Nothing in this Consent Order shall prohibit the Respondent from petitioning for other available relief, waiver, or variance provisions provided for under Chapters 120 or 403, F.S., and the rules promulgated there under.

28. No modifications of the terms of this Consent Order shall be effective until reduced to writing and executed by Respondent and the Department. The corrective actions and deadlines identified in Paragraph 10 (as in effect on the effective date of this Order) are incorporated by reference as separately and independently enforceable requirements in NPDES Permit No. FL0778451-001-GL7A/RA. Modifications of this Consent Order do not automatically modify the NPDES permit requirements. This Consent Order gives no rights or benefits to any third party beneficiary and shall not serve as a waiver of any claims Respondent may have against any third parties. This Consent Order cannot be assigned by Respondent.

29. This Consent Order is issued in conjunction with Consent Order 12-1149. The material provisions in these Orders are non severable. This Order shall not become effective until the date Consent Order 12-1149 becomes effective.

30. All submittals and payments required by this Consent Order to be submitted to the Department, unless otherwise indicated, shall be sent to the Department of Environmental Protection, Office of Ecosystem Projects, 3900 Commonwealth Boulevard, MS 24, Tallahassee, Florida 32399-3000.

31. This Consent Order is a settlement of the Department's civil and administrative authority arising under Florida law to resolve the matters addressed herein. This Consent Order is not a settlement of any criminal liabilities that may arise under Florida law, nor is it a settlement of any violation that may be prosecuted criminally or civilly under federal law.

32. This Consent Order is a final order of the Department pursuant to Section 120.52(7), F.S., and it is final and effective as provided in Paragraphs 23 and 29 and when filed with the Clerk of the Department.

FOR THE RESPONDENT

8/10/12
DATE

Melissa L. Meeker, Executive Director
South Florida Water Management District

DONE AND ORDERED this 15th day of August, 2012, in Tallahassee, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Herschel T. Vinyard Jr.
Secretary

Filed, on this date, pursuant to Section 120.52, F.S., with the designated Department Clerk, receipt of which is hereby acknowledged.

Kay Buchanan
CLERK

8/15/12
DATE

cc: Lea Crandall, Agency Clerk (Mail Station 35)

BEFORE THE STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION,

Complainant,

vs. OGC FILE NO. 12-1149

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WATER MANAGEMENT DISTRICT.

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conditions creating a violation of Chapter 403, and to order other appropriate corrective action.

2. Respondent is a public corporation of the State of Florida existing by virtue of Chapter 25270, Laws of Florida, 1949, and operating pursuant to Chapter 373, F.S., and Title 40E, F.A.C., as a multipurpose water management district with its principal office at 3301 Gun Club Road, West Palm Beach, Florida, 33406. Respondent is a person within the meaning of Sections 373.019(15) and 403.031(5), F.S.

3. Respondent is the local sponsor for the Central and Southern Florida Flood Control Project ("C&SF Project") which provides flood control in the EAA, C-139, and other tributary basins and urban, agricultural, and environmental water supply to the Everglades and Lower East Coast of Florida.

4. As authorized pursuant to Section 373.4592, F.S., Respondent built and operates large, state of the art manmade treatment wetlands, known as stormwater treatment areas ("STAs"), to remove excess phosphorus from surface waters that flow from Lake Okeechobee, the EAA, the C-139 Basin, the L-8 Basin and the C-51 West Basin to the Everglades Protection Area ("EPA"). Respondent is required to obtain an Everglades Forever Act ("EFA") permit from the Department pursuant to 373.4592, F.S., to construct, operate, maintain and discharge from the STAs.

5. Respondent is the operator of STA-1 East and the owner and operator of STA-1 West, STA-2, STA-3/4 and STA-5/6 which discharge into Water Conservation Area ("WCA") 1, 2 and 3 of the EPA. WCA-1, 2 and 3 are designated Class III waters of

the State and WCA-1 is also an Outstanding Florida Water pursuant to Rule 62-302.700, F.A.C.

6. Respondent, to date, has constructed approximately 60,000 acres of STAs. While the STAs have greatly reduced the amount of phosphorus entering the EPA, the phosphorus criterion established in Rule 62-302.540, F.A.C., has not been met in all the ambient waters of the EPA.

7. In the accompanying permit (EFA Permit No. 0311207-001), issued concurrently with this Consent Order, the Department is establishing a water quality based effluent limitation ("WQBEL") for total phosphorus ("TP") discharges from the STAs into the EPA. The WQBEL was derived to ensure that STA discharges do not cause or contribute to exceedance of the Everglades phosphorus criterion in Rule 62-302.540, F.A.C., throughout the EPA (See Exhibit A). The WQBEL consists of two components 1) a maximum TP annual flow-weighted mean ("AFWM") of 19 parts per billion ("ppb"); and, 2) a TP long-term flow-weighted mean ("LTFWM") of 13 ppb not to be exceeded in more than three (3) out of five (5) years.

To date, TP levels in discharges from the best performing STA, STA-3/4, have averaged 17 ppb. No STA has achieved an annual flow-weighted mean of 13 ppb in more than three out of five years. As such, the STAs are not predicted to achieve the WQBEL without additional corrective actions.

8. While the phosphorus levels in the STA discharges have not yet achieved concentrations necessary to meet the phosphorus criterion, significant reductions in the levels of phosphorus delivered to the EPA have occurred since their initial construction and operation. As of Water year 2011 the STAs, in combination with best management practices, have removed 3,800 metric tons of phosphorus from water that would have alternatively been delivered to the EPA untreated. If the STAs cease operations, untreated water would flow directly into the EPA. The Department finds that it is clearly in the public interest to exercise its enforcement discretion to allow the continued operation of STAs while the corrective actions required by this Consent Order are implemented so long as the STAs are operated in compliance with Paragraph 12.

Having reached a resolution of the matter, Respondent and the Department mutually agree and it is,

ORDERED:

9. Respondent shall operate and maintain STA 1 East, 1 West, STA-2, STA-3/4 and STA-5/6 in accordance with the terms and conditions of EFA Permit No.: 0311207-001, except as specified in Paragraph 12 below. This Order does not alter the obligation to comply with the WQBEL for TP in Table 1 of the permit upon its effective date. However, effluent from the STAs is not predicted to achieve the WQBEL for TP until completion of the corrective actions described in Paragraph 10 below.

10. In order to bring discharges from STA 1 East, STA-1 West, STA-2, STA-3/4 and STA-5/6 into compliance with the WQBEL, Respondent shall expeditiously proceed with the planning, design, construction and operation of the Eastern (STA-1 East and STA-1 West), Central (STA-2 and STA-3/4) and Western (STA-5/6) Flow-path corrective actions which are more particularly described in Exhibit B. Respondent shall obtain all necessary local, state and federal authorizations, including appropriate Department permits, for these activities. These corrective actions and the associated deadlines for completion and operation are as follows:

Eastern Flow-path Corrective Actions and Deadlines	
Activity	Deadline
Complete land acquisition for expansion	09/30/2013
Initiate design of expansion	09/30/2013
Submit state and federal permit applications for expansion	07/30/2014
Complete design of expansion	07/30/2015
Initiate construction of expansion	01/31/2016
Construction status report	03/01/2017
Construction status report	03/01/2018
Complete construction of expansion	12/31/2018
Initial flooding and optimization period complete	12/31/2020
Initiate design of structure expansion	09/30/2013
Complete design of structure expansion	07/30/2015
Initiate construction of structure expansion	01/31/2016
Complete construction of structure expansion	12/31/2018
Initiate design of structure expansion	10/01/2012
Complete design of structure expansion	09/30/2014
Initiate construction of structure expansion	10/01/2016
Complete construction of structure expansion	09/30/2018
Initiate design of structure modifications	10/01/2012
Complete design of structure expansion	09/30/2014
Initiate construction of structure expansion	10/01/2014
Complete construction of structure expansion	09/30/2016

Complete land acquisition for expansion	03/31/2018
Initiate design for expansion	10/01/2018
Submit state and federal permit applications for expansion	08/01/2019
Complete design of expansion	07/31/2020
Initiate construction of expansion	11/30/2020
Construction status report	03/01/2021
Construction status report	03/01/2022
Complete construction of expansion	12/31/2022
Initial flooding and optimization period complete	12/31/2024
Eastern Flow-path: Flow Equalization Basin (FEB) 45,000 acre-feet	
Submit state and federal permit applications	01/31/2014
Construction status report	03/01/2014
Construction status report	03/01/2015
Completion of construction (multi-purpose operation begins)	12/31/2016[1]
Long-term operations commence	12/31/2022[2]
Eastern Flow-path: Conveyance Improvements	
Initiate design of G-341 and related improvements	10/01/2020
Submit state and federal permit applications for G-341 and related improvements	08/01/2021
Complete land acquisition for G-341 related improvements (if required)	09/30/2021
Complete design of G-341 and related improvements	07/31/2022
Initiate construction of G-341 and related improvements	11/30/2022
Construction status report	03/01/2023
Construction status report	03/01/2024
Completion of construction for G-341 and related improvements	12/31/2024
Eastern Flow-path: Repairs and Modifications of Stormwater Treatment Area 1 East	
Periphyton Stormwater Treatment Area Decommissioning complete	Prior to Long-term Operations Commencing
Culvert repairs complete	Prior to Long-term Operations Commencing
Cell 5 and 7 improvements complete	Prior to Long-term Operations Commencing
Eastern Flow-path Corrective Action Completion Date	**12/31/2024**

Central Flow-path Corrective Actions and Deadlines	
Activity	Deadline
Central Flow-path STA-2 Expansion: Compartment B North and South Build-outs	
Initial flooding and optimization period complete	05/31/2014
Central Flow-path: Flow Equalization Basin (FEB) 54,000 acre-feet	
Initiate design of A-1 FEB	04/01/2012
Submit state and federal permit applications	12/01/2012
Design status report	03/01/2013
Complete design of A-1 FEB	08/01/2013

[1] Multi-purpose operations until replacement storage on-line
[2] Long term operations- replacement storage on-line

Initiate construction of A-1 FEB	06/30/2014
Construction status report	03/01/2015
Construction status report	03/01/2016
Complete construction of A-1 FEB	07/30/2016
FEB Operational monitoring and testing period complete	07/29/2018

Western Flow-path Corrective Actions and Deadlines	
Activity	Deadline
Initial flooding and optimization period complete	05/31/2014
Initiate design of scraping/earthwork improvements	10/31/2019
Submit state and federal permit applications	08/30/2020
Complete design of scraping/earthwork improvements	10/31/2021
Initiate scraping/earthwork activities	01/31/2022
Construction status report	03/01/2023
Construction status report	03/01/2024
Completion of scraping/earthwork activities	12/31/2024
Initial flooding and optimization period complete	12/31/2025
Initiate design of FEB	10/31/2018
Submit state and federal permit applications	08/30/2019
Complete design of FEB	10/31/2020
Initiate construction of FEB	01/31/2021
Construction status report	03/01/2021
Construction status report	03/01/2022
Construction status report	03/01/2023
Complete construction of FEB	12/31/2023
Operational monitoring and testing period	12/31/2024

Unless terminated by mutual consent of the parties, this Consent Order, setting forth the corrective actions, shall remain in effect for all flow-paths until the corrective actions for all flow-paths in this Paragraph are completed and sufficient discharge data required under the permit exists to assess compliance with both components of the WQBEL for all flow-paths.

11. The Respondent commits to expediting the corrective actions set forth in Paragraph 10, to the maximum extent practicable while fulfilling its other agency responsibilities, in an effort to incrementally improve water quality discharges into the EPA.

12. Upon completion of the specific corrective actions identified in Paragraph 10, it is anticipated that the facilities will be discharging consistent with the WQBEL for TP established in Table 1 of the permit. Until such time as the corrective actions identified in Paragraph 10 are completed consistent with the deadlines set forth therein, the Department will exercise its enforcement discretion to allow the STAs to maintain operations. In the interim, the Respondent shall operate and maintain all STA facilities and systems of treatment control in an effort to maximize reductions in TP concentrations to the Everglades Protection Area. Such operations shall be in accordance with any approved operational plan, pollution prevention plan and the accompanying permit.

13. Whereas it is predicted that discharges from the facilities will not achieve the WQBEL until the corrective actions in Paragraph 10 have been completed, this Order provides the following alternate reporting provisions in lieu of those required in Specific Condition 15.B. through 15.F. of the permit: 1) The Respondent shall provide, as part of the annual report in Specific Condition 25 of the permit, status updates on the activities described in Paragraph 10 and TP AFWM concentrations for each STA over the course of the prior water year (May 1st through April 30th). The TP

AFWM shall also be reported in accordance with Specific Condition 15.A. of the permit. In both cases, the TP AFWM shall be calculated in accordance with Table 1 of the permit; and 2) The Respondent shall prepare a weekly STA performance summary (report) that sets forth inflow volumes, inflow FWM TP concentrations, outflow volumes, outflow FWM TP concentrations for the prior 7 day, 28 day and 365 day period of record and inflow and outflow TP load for the prior 28 day and 365 day period of record. The weekly report shall also include the 365 day loading rate, 6 month trend in outflow TP concentrations, and concentration, load and flow in comparison to the period of record observed conditions. Copies of the weekly reports shall be transmitted to the Department and USEPA representatives to be identified in accordance with Paragraph 14. The District shall consult with the representatives on a semi-annual basis to evaluate the STAs performance and the District shall determine what, if any, operational changes may be implemented to ensure compliance with the Operational and Pollution Prevention Plans. Other relevant information collected by the Respondent shall be presented to the representatives of the State and Federal agencies designated under Paragraph 14 prior to their semi-annual consultation to ensure that adequate time is available to review and facilitate informed technical discussions.

Interim reporting requirements established by this Paragraph shall no longer apply subsequent to the Flow-path Corrective Action Completion Deadline.

14. The Respondent shall develop and implement a science plan in order to identify the factors that collectively influence phosphorus reduction and treatment performance in order to meet the WQBEL. The Respondent shall develop the science plan in consultation with representatives as designated by the Department and the United States Environmental Protection Agency, Region IV (USEPA), respectively, on behalf of State and Federal agencies.

After consulting with the representatives, the Respondent shall: 1) identify the critical information gaps and research areas that influence treatment performance; 2) prioritize the science needs; 3) develop and implement the science plan; 4) evaluate the results of ongoing scientific efforts to meet the prioritized science needs; 5) modify the science plan as needed based on results of completed or ongoing scientific studies, and 6) determine how the results of the scientific studies could be implemented to improve phosphorus reductions and treatment performance. Of particular interest is a better understanding of design and operations that sustain outflow concentrations at low phosphorus concentrations (<20 ppb).

Key areas that should be considered for further scientific studies include the effect of the following factors on STA performance: 1) phosphorus loading rates; 2) inflow phosphorus concentration; 3) hydraulic loading rates; 4) inflow water volumes, timing, pulsing, peak flows, and water depth; 5) phosphorus speciation at inflows and outflows; 6) effects of microbial activity and enzymes on phosphorus uptake; 7) phosphorus re-suspension and flux; 8) the stability of accreted phosphorus; 9)

phosphorus concentrations and forms in soil and floc; 10) soil flux management measures; 11) influence of water quality constituents such as calcium; 12) emergent and submerged vegetation speciation; 13) vegetation density and cover; 14) weather conditions such as hurricane and drought; and 15) the inter-relationships between those factors.

The representatives will perform only technical functions such as:

- Information gathering and fact-finding regarding scientific studies presented to it.
- Evaluation and comparison of the results of the scientific studies through identification of positive, neutral and negative impacts of any options presented in the results of the scientific studies.
- Provide expert technical opinions regarding viability and outcomes of any options presented in the results of the scientific studies.
- Develop and provide technical opinions on STA interim operational data with regard to observed water year conditions and resulting phosphorus reductions;
- Assess water quality and progress in achieving the corrective actions and deadlines in this Consent Order.

The representatives shall not vote nor shall they make any consensus recommendations or decisions regarding matters that are presented.

The results of scientific studies and interim operational performance will be presented to and evaluated by the representatives and ultimately used by the agency

representatives to inform their respective agencies as to how the information could be utilized to optimize phosphorus reduction and treatment performance.

The Respondent shall convene regular meetings of the representatives as often as needed, but no less than once every six (6) months. The first meeting of the representatives shall take place no later than six (6) months after the date of permit issuance. The Respondent shall develop a detailed science plan including a work plan and schedules within nine (9) months of issuance of the permit. The Respondent shall begin to implement studies and research identified in the work plan within twelve (12) months of issuance of the permit.

15. Respondent shall conduct monthly monitoring at a series of sites downstream of STA-1E, STA-1W and STA-2 in order to characterize the effects of the STAs' discharge on the receiving water bodies (See Exhibit C). The tables below identify thirty one (31) downstream sampling sites. Of the thirty one (31) sites, eighteen (18) are located in areas currently identified as impacted (i.e., sediment TP concentration greater than 500 mg/kg) and ten (10) sites are located in areas currently identified as unimpacted. Three sampling sites are located in the Rim Canal. Upon demonstration that an additional sampling site or removal of an existing sampling site or parameter is warranted, the Respondent may request a modification to the monitoring program as appropriate. The Department shall review and approve such requests on a case by case basis after consultation with USEPA. Any alteration in the monitoring program must be approved by the Department. The Department will assess whether continuance of,

modifications to, or elimination of downstream monitoring efforts are warranted prior to the conclusion of this Order.

All water quality, sediment, and vegetation samples shall be collected and reported for the parameters and at the frequency specified in the Respondent's March 2012 "Downstream STA1W, STA1E, and STA2 Transect Monitoring Plan (Project Code: STAT) SFWMD-FIELD-MP-078-01".

Transect Monitoring for STA-1E			
Station	Latitude	Longitude	Category
LOXA-135	26° 37′ 24.1″ N	80° 18′ 58.0″ W	Rim Canal
LOXA-136	26° 37′ 7.7″ N	80° 19′ 7.2″ W	Impacted
LOXA-137	26° 36′ 54.4″ N	80° 19′ 18.1″ W	Impacted
LOXA-138	26° 36′ 24.5″ N	80° 19′ 36.0″ W	Unimpacted
LOXA-139	26° 35′ 36.0″ N	80° 20′ 13.8″ W	Unimpacted

Transect Monitoring for STA-1W			
Station	Latitude	Longitude	Category
LOXA-104	26° 35′ 52.7″ N	80° 26′ 24.2″ W	Rim Canal
LOXA-104.5	26° 35′ 38.8″ N	80° 26′ 20.8″ W	Impacted
LOXA-105	26° 35′ 30.8″ N	80° 26′ 9.9″ W	Impacted
LOXA-106	26° 35′ 31.9″ N	80° 25′ 52.6″ W	Impacted
LOXA-107	26° 35′ 14.6″ N	80° 25′ 17.2″ W	Impacted
LOX-107U	26° 34′ 52.3″ N	80° 24′ 43.2″ W	Unimpacted
LOXA-108	26° 34′ 40.7″ N	80° 24′ 21.1″ W	Unimpacted
Z-0[3]	26° 28′ 1.1″ N	80° 26′ 31.8″ W	Rim Canal
Z-1[3]	26° 28′ 5.9″ N	80° 26′ 24.4″ W	Impacted
Z-2[3]	26° 27′ 52.3″ N	80° 25′ 40.6″ W	Impacted
Z-3[3]	26° 27′ 29.9″ N	80° 24′ 31.0″ W	Impacted
Z-4[3]	26° 26′ 46.2″ N	80° 23′ 18.6″ W	Unimpacted

Transect Monitoring for STA-2			
Station	Latitude	Longitude	Category
2AN.25	26° 27′ 14.34″ N	80° 27′ 23.34″ W	Impacted
2AN1	26° 24′ 43.39″ N	80° 28′ 16.97″ W	Impacted
2AN2	26° 26′ 20.28″ N	80° 27′ 14.46″ W	Impacted
2AN4	26° 25′ 21.48″ N	80° 27′ 01.38″ W	Impacted

[3] Monitoring of the Z transect station, in accordance with the parameters and frequencies in the March 2012 'Downstream STA-1W, STA-1E and STA-2 Transect Monitoring Plan' shall not commence until such time as the Respondent initiates construction activities associated with the 1,800 acre STA Expansion identified in Paragraph 10 of this Order.

2AN5	26° 24′ 49.54″ N	80° 26′ 52.69″ W	Unimpacted
2AN6	26° 24′ 18.12″ N	80° 26′ 44.08″ W	Unimpacted
2AC0.25	26° 25′ 34.68″ N	80° 28′ 30.90″ W	Impacted
2AC2	26° 24′ 43.39″ N	80° 28′ 16.97″ W	Impacted
2AC4	26° 23′ 42.54″ N	80° 28′ 05.10″ W	Unimpacted
2AC5	26° 23′ 09.50″ N	80° 28′ 00.97″ W	Unimpacted
2AFS.25	26° 20′ 44.77″ N	80° 31′ 36.59″ W	Impacted
2AFS1	26° 20′ 38.46″ N	80° 31′ 10.32″ W	Impacted
2AFS3	26° 20′ 15.84″ N	80° 30′ 01.62″ W	Impacted
CA 29	26° 19′ 31.40″ N	80° 28′ 21.54″ W	Unimpacted

16. Respondent shall enforce the requirements of the Everglades Source Control Program described under Ch. 40E-63, F.A.C. Part IV. The objectives of this rule are to: 1) Implement and continuously improve through adaptive management, a BMP program for reducing and controlling phosphorus discharges from the C-139 Basin; 2) Provide a water quality monitoring program, performance measures and a compliance methodology to evaluate the effectiveness of the BMP program in reducing phosphorus discharges; 3) Establish a BMP compliance verification and enforcement program to ensure that phosphorus discharges from the basin do not exceed the historic base period levels; and, 4) Conduct research and demonstration projects to improve and confirm the effectiveness of BMPs for reducing phosphorus.

If, during the interim period between enactment of this Order and construction completion, the Respondent determines, in accordance with Rule 40E-63, Part IV, F.A.C., the C-139 Basin is out of compliance and is not tracking towards compliance and sufficient information from the implementation of the Eastern and Central Flow-path projects does not provide reasonable assurance that the Western Flow-path projects will ultimately result in compliance with the WQBEL, Respondent shall take steps to enforce

the provisions of the Rule or develop and submit a water quality improvement plan with specific schedules and strategies to refine the design of the currently proposed projects described in Paragraph 10 so that the final outcome will result in compliance with the WQBEL.

17. Except as provided for in Paragraph 18, Respondent agrees to pay the Department stipulated penalties in the amount of $1,000.00 per day for each and every day Respondent fails to complete any of the corrective actions by the respective deadlines identified in Paragraph 10 of this Order. A separate stipulated penalty shall be assessed for each violation of this Consent Order. Within 30 days of written demand from the Department, Respondent shall make payment of the appropriate stipulated penalties to the "State of Florida Department of Environmental Protection" by cashier's check or money order and shall include thereon the notations "OGC Case No. 12-1149" and "Ecosystem Management and Restoration Trust Fund." The Department may make demands for payment at any time after violations occur. Nothing in this Paragraph shall prevent the Department from filing suit to specifically enforce any of the terms of this Consent Order. If the Department is required to file a lawsuit to recover stipulated penalties under this Paragraph, the Department will not be foreclosed from seeking civil penalties for violations of this Consent Order in an amount greater than the stipulated penalties due under this Paragraph.

18. If any event occurs which causes delay or the reasonable likelihood of delay in complying with the requirements of this Order, Respondent shall have the burden of proving that the delay was or will be caused by circumstances beyond the reasonable control of the Respondent and could not have been or cannot be overcome by Respondent's due diligence. Upon occurrence of such an event, or upon becoming aware of a potential for delay, Respondent shall notify the Department orally within seven (7) days and as soon thereafter as possible shall notify the Department and USEPA in writing of the anticipated length and cause of the delay, the measures taken or to be taken to prevent or minimize the delay, and the timetable by which Respondent intends to implement these measures. If the Department agrees that the delay or anticipated delay has been or will be caused by circumstances beyond the reasonable control of Respondent, the Department will notify the Respondent in writing that the time for performance for specified project activities in this Consent Order shall be extended for a period equal to the agreed delay resulting from such circumstances, including all reasonable measures necessary to avoid or minimize future delay.

19. Entry of this Consent Order does not relieve Respondent of the need to comply with applicable federal, state or local laws, regulations or ordinances.

20. The terms and conditions set forth in this Consent Order may be enforced in a court of competent jurisdiction pursuant to Sections 120.69, 373.129 and 403.121 and 403.131, F.S. Failure to comply with the terms of this Order shall constitute a violation of Sections 373.430 and 403.161, F.S.

21. Respondent is fully aware that a violation of the terms of this Order may subject Respondent to judicial imposition of damages, civil penalties of up to $10,000 per day per violation and criminal penalties.

22. The Department and Respondent hereby irrevocably, knowingly, voluntarily, and intentionally waive their right to trial by jury with respect to any litigation based wholly or partially on the enforcement of this Consent Order.

23. Persons who are not parties to this Consent Order but whose substantial interests are affected by this Consent Order have a right, pursuant to Sections 120.569 and 120.57, F.S., to petition for an administrative hearing on it. The Petition must contain the information set forth below and must be filed (received) at the Department's Office of General Counsel, 3900 Commonwealth Boulevard, MS# 35, Tallahassee, Florida 32399-3000 within 21 days of receipt of this notice. A copy of the Petition must also be mailed to the Office of Ecosystem Projects, Program Coordination and Regulation Section, 3900 Commonwealth Boulevard, MS 24, Tallahassee, Florida 32399-3000. Failure to file a petition within the 21 days constitutes a waiver of any right such person has to an administrative hearing pursuant to Section 120.57, F.S.

The petition shall contain the following information:

a) OGC No. 12-1149 and the county in which the subject matter is located;

b) The name, address, and telephone number of each petitioner; the name, address, and telephone number of the petitioner's representative, if any,

which shall be the address for service purposes during the course of the proceeding;

c) An explanation of how the petitioner's substantial interests will be affected by the Consent Order;

d) A statement of when and how the petitioner received notice of the Consent Order;

e) A statement of all material facts disputed by the petitioner, if any;

f) A statement of the specific facts the petitioner contends warrant reversal or modification of the Consent Order;

g) A statement of which rules or statutes the petitioner contends require reversal or modification of the Consent Order; and

h) A statement of the relief sought by the petitioner, stating precisely the action petitioner wishes the Department to take with respect to the Consent Order.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this Consent Order. Persons whose substantial interests will be affected by any decision of the Department with regard to the subject Consent Order have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 21 days of receipt of this notice in the Department's Office of General Counsel at the address specified above. Failure to file a petition within the allowed timeframe constitutes a

waiver of any right such person has to request a hearing under Sections 120.569 and 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-106.205, F.A.C.

24. Because this Consent Order accompanies and references EFA Permit No. 0311207, this Consent Order shall not be effective until EFA Permit No. 0311207 becomes effective.

25. The Department hereby expressly reserves the right to initiate appropriate legal action to prevent or prohibit any violations of applicable statutes, or the rules promulgated thereunder that are not specifically addressed by the terms of this Consent Order.

26. The Department, for and in consideration of the complete and timely performance by Respondent of the obligations agreed to in this Consent Order, hereby waives its right to seek judicial imposition of damages or civil penalties for alleged violations addressed in this Consent Order.

27. Respondent acknowledges and waives its right to an administrative hearing pursuant to Sections 120.569 and 120.57, F.S., on the terms of this Consent Order. Respondent acknowledges its right to appeal the terms of this Consent Order pursuant to Section 120.68, F.S., and waives that right upon signing this Consent Order. Respondent waives no other rights or defenses other than those explicitly addressed in this Consent Order.

28. This document constitutes the entire agreement and understanding of the parties to this Consent Order concerning settlement of the above-captioned action and there are no representations, warranties, covenants, terms or conditions agreed upon between the parties other than those expressed in this Consent Order. Nothing in this Consent Order shall prohibit the Respondent from petitioning for other available relief, waiver, or variance provisions provided for under Chapters 120 or 403, F.S., and the rules promulgated there under.

29. No modifications of the terms of this Consent Order shall be effective until reduced to writing and executed by Respondent and the Department. This Consent Order gives no rights or benefits to any third party beneficiary and shall not serve as a waiver of any claims Respondent may have against any third parties. This Consent Order cannot be assigned by Respondent.

30. This Consent Order is issued in conjunction with Consent Order 12-1148. The material provisions in these Orders are non severable. This Order shall not become effective until the date Consent Order 12-1148 becomes effective.

31. All submittals and payments required by this Consent Order to be submitted to the Department, unless otherwise indicated, shall be sent to the Department of Environmental Protection, Office of Ecosystem Projects, 3900 Commonwealth Boulevard, MS 24, Tallahassee, Florida 32399-3000.

32. This Consent Order is a settlement of the Department's civil and administrative authority arising under Florida law to resolve the matters addressed

herein. This Consent Order is not a settlement of any criminal liabilities that may arise under Florida law, nor is it a settlement of any violation that may be prosecuted criminally or civilly under federal law.

33. This Consent Order is a final order of the Department pursuant to Section 120.52(7), F.S., and it is final and effective as provided in Paragraphs 24 and 30 and when filed with the Clerk of the Department.

FOR THE RESPONDENT

8/10/12
DATE

Melissa L. Meeker, Executive Director
South Florida Water Management District

DONE AND ORDERED this 15th day of August, 2012, in Tallahassee, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Herschel T. Vinyard Jr.
Secretary

Filed, on this date, pursuant to Section 120.52, F.S., with the designated Department Clerk, receipt of which is hereby acknowledged.

Kay Buchanan
CLERK

8/15/12
DATE

cc: Lea Crandall, Agency Clerk (Mail Station 35)

CO Exhibit B: Appendix C
Corrective Action Description and Details

I. General Schedule Information

The following areas apply to one or more of the milestones identified for the three flow-paths.

A. Permitting Schedule Analysis

While detailed design is ongoing, the Respondent must obtain a number of different authorizations (permits) from state and federal agencies before it can initiate construction on a component of the Eastern, Central or Western Flow-path. These may include: an EFA[1] or similar environmental resource permit from the State for construction, operation and maintenance of the project; a CWA Section 404[2] permit from the U.S. Army Corps of Engineers (USACE) for the discharge of dredged or fill material into waters of the US; a Section 10 permit under the Rivers and Harbors Act from the USACE if the project impacts a navigable water; a Clean Air Act permit from FDEP if the project includes a diesel pump station; a general CWA Section 402 NPDES permit(s) from FDEP along with any modifications to existing CWA NPDES Industrial Wastewater permits; a consumptive water use permit from the State; and in some cases, permits from the local government for a land use change. If the project involves alterations to an U.S. Army Corps of Engineers (USACE) flood control levee, and a private party (not the USACE) is the applicant, then a 33 U.S.C. Section 408 analysis may be conducted.

B. Construction/Design Status Reports

In cases when periods between corrective action dates for an individual flow-path exceed one year, the Department has required a construction and/or design status report, as applicable. These reports detail project design/construction status, percent completion, identification of factors which may affect the rate of design/construction, any actions taken to resolve any factors which affected the rate of design/construction and projected completion dates.

C. STA Initial Flooding and Optimization Period

Upon completion of construction/earthwork activities, expanded or modified treatment works will be inundated with surface water. This process allows for the establishment of desired marsh vegetation and the existing legacy TP within the flooded area, if any, to be reduced. Based on prior STA operational history, it is expected that the treatment area expansions will demonstrate net improvement in total phosphorus concentrations (i.e. TP flow-weighted mean outflow concentrations are better than TP flow-weighted mean inflow concentrations) within the first year of flooding. Once

[1] FDEP will not generally accept an EFA permit application until the project design is 30% complete, and will generally not issue the permit until the project design is 90% complete. Following completion of 90% design, it is assumed that two additional months will be required to acquire final permits.

[2] The federal CWA Section 404 permit also must comply with the federal requirements under the National Environmental Policy Act (NEPA), including an Environmental Impact Statement (EIS) where the permit is considered a "major action significantly affecting the quality of the environment." The federal Section 404 permit would likely be the lengthiest of the permit processes, and will be necessary for construction on the project to begin.

net improvement has occurred, the Respondent may begin discharging from the STA to the Everglades Protection Area. This operational period allows for the maturation of desired vegetation, identification and correction of hydraulic short circuiting and the equilibration of operations across portions of the existing and expanded facility treatment works. This period may vary depending on the site conditions.

Intensive management of the STA's may be required for fine-tuning the treatment works to achieve their desired performance. This "optimization" may include adjustments in the type and proportion of vegetation which could take several growing periods to accomplish.[3] While it may be possible, under an optimistic scenario for an STA to reach its desired performance in a lesser period of time, the Department believes that a more realistic expectation is for an STA expansion to begin performing optimally no later than 2 years subsequent to flooding.

D. Corrective Actions Completion Date

It is the Department's judgment, based on the modeling conducted for the proposed projects, that discharges from the STA's will be consistent with the WQBEL for total phosphorus once all of the compliance activities for the individual flow-paths have been completed and the STA is properly optimized and functioning consistent with its design.[4] With regard to STA expansions identified as the final compliance action in a particular flow-way, discharges consistent with the WQBEL established in the permits is expected once the initial flooding and optimization period for the expanded treatment facilities concludes. Compliance with the WQBEL will be determined in accordance with the provisions of the NPDES and EFA permits.

E. Initiate Design

Commencement of detailed design is the first stage at which plans and specifications for an individual project, which may have one or more features, are developed. Detailed design is the process by which the Respondent and/or their contractor will develop engineering plans for the civil works for each of the features identified in the list of flow-path specific compliance actions. Detailed design will analyze multiple configurations (based on available project footprint) based on accumulated project specific data, analyze STA components in series versus parallel, analyze FEB components, establish vegetation targets, determine extent of compartmentalization, size structures and perform any required hydraulics analysis. It is typical for several iterations of design (i.e. initial, intermediate and pre-final) to occur before final plans and specifications are prepared and certified by a professional engineer in accordance with Chapter 471, F.S.

[3] Vegetation management may include repeated herbicide treatments and seeding by helicopter or by hand to establish an STA with the most efficient mix of submerged or emergent aquatic vegetation to maximize TP assimilation.

[4] The Department recognizes that until such time as the WQBEL has been achieved, elevated TP loads will continue to enter the Everglades. In order to assess the cumulative effects of these discharges, specific monitoring has been required to evaluate phosphorus discharged over this period and its effects.

F. Initiate Construction

The Respondent, after receiving the appropriate authorizations, commences construction activities consistent with the final detailed design. It is the responsibility of the respondent to submit completed permit applications and respond to any requests of the permitting authority in a timely manner to assure permits can be obtained within the time allotted by this order. Based on the final design and existing site conditions, it is recognized that engineering during construction activities may occur and, as such, result in modifications to the final design. Should these changes result in a significant change to the project or, more importantly the project schedule, it is expected that the Respondent will work closely with the Department to address any items that arise. Construction activities undertaken by the Respondent are expected to occur over a 2-4 year interval depending on the individual project component.

II. Eastern Flow-path: STA 1W Expansion

A. Complete Land Acquisition for the Proposed 4,700 and 1,800 Acre Expansions Associated with Stormwater Treatment Area 1 West

Based on the Department's review of the modeling results conducted by the Respondent, approximately 6,500 acres of additional treatment area are required, in conjunction with the additional correctiveactions identified in the Order, to meet the WQBEL at each STA in the Eastern Flow-path. In order to construct and operate the additional treatment area, the Respondent is required to identify and acquire the lands necessary to construct approximately 4,700 and 1,800 acre expansions to the STA-1 West treatment works. The 4,700 and the 1,800 acre expansions are separate acquisition strategies, based on funding capabilities, to secure the 6,500 acres necessary for the final configuration. The Respondent shall work closely with property owners to negotiate land trades and perform necessary site assessments prior to any exchange commencing. The 6,500 acres of required lands include all of the acreage necessary for the final configuration which includes the construction of levees, pump stations, structures and canals. Detailed design has not commenced at this stage, however, the final configuration is expected to result in approximately 5,900 acres of effective treatment area.

B. Submit State and Federal Permit Applications for 4,700 and 1,800 Acre Expansions and S-375 Expansion

See section I.A. above.

C. Initiate design of 4,700 and 1,800 Acre Expansions

See section I.E above.

D. Complete Design of the STA-1 West 4,700 and 1,800 Acre Expansions and S-375 Expansion.

The detailed design, which is specific to the parcel of land on which the STA is built, requires access to the land for environmental assessments, testing, and data collection. The test results and other data provide the information needed for the production of detailed plans and specifications for land leveling, locations and sizing of levees, canals, structures and the hydraulics for how water will be moved into, through, and out of the STAs, including the size and locations of pumps. Completion of design typically satisfies the last remaining pre-construction regulatory requirement and begins the bid solicitation process for construction. Design is expected to require 22 months for each treatment area expansion component.

As part of the project, an additional structure will be constructed adjacent to the existing S-375. The new structure will have a design capacity of approximately 2,400 cfs to allow conveyance of full design flows from the S-319 Pump Station through use of both the S-375 structure and the new structure. Design and construction of this feature will occur concurrently with the STA-1West 4,700 acre expansion.

E. Initiate Construction

See section I.F. above

F. Construction Status Report Submittal

See I.B. above.

G. Complete Construction of the 4,700 and 1,800 Acre Expansions and S-375 Expansion

Once regulatory authorizations are obtained and a construction contract has been executed, construction can begin. Construction for these project features is estimated to require 2-3 years. Construction is considered complete when the Respondent has functional use of the facility and has accepted the facility for operations. This is also the time when project features are ready for inspection by regulatory agencies in order to determine consistency with the permits, including final plans and specifications. Construction completion signals the commencement of (or readiness to commence) the flooding and optimization period of the expanded treatment features.

H. Initial Flooding and Optimization Period

See section I.C. above.

I. Discharging Consistent with the Water Quality Effluent Limitation for Total Phosphorus

See section I.D above.

III. Eastern Flow-path: Flow Equalization Basin

A. Initiate Design/Construction

Flow equalization basin (FEB) design is not discussed separately as the Respondent is currently in the process of solicitation for a Design/Build contractor to complete design and construction on the remaining portions of the 45,000 acre-feet, L-8 flow equalization basin (FEB). The design/build process consists of hiring a firm to design and construct a 3,000 cubic feet per second (cfs) inlet structure and 450 cfs outflow pump station, revetment protection features for the surrounding levees, and final configuration of the flow path within the reservoir itself. Depending on the selected contractor's proposal and funding schedules, several phases may occur[5]. Completion of design typically satisfies the last remaining pre-construction regulatory requirement. It is expected that completion of construction activities will occur within 3.5 years.

B. Completion of Construction/Multi-use Operations for Flow Equalization Basin Features

Construction is considered complete when the Respondent has functional use of the facility and has accepted the facility for operations. This is also the time when the project features are ready for inspection by regulatory agencies in order to determine consistency with the permits, including final plans and specifications. Completion of the construction for the final phase of the design/build contract signals, in this case, commencement of (or readiness to commence) multi-use operations. The multi-use operational phase discussed herein refers to operations that will occur in the interim until replacement features for the FEB, which is currently identified for use as a Comprehensive Everglades Restoration Plan component, commence operations. It is expected that multi-use operations take place over a six year period subsequent to completion of construction. During these interim operations, the FEB will be used to advance the goals of both restoration plans. Prior to Long-term operations commencing it is expected that FEB multi-use operations and the 4,700 acre treatment expansion will produce measureable benefits.

C. Long-term Operations for Flow Equalization Basin Features

The proposed L-8 FEB is currently identified as a Comprehensive Everglades Restoration Plan (CERP) feature. Upon operations commencing of replacement features, multi-use operations (described above) shall cease and Long-term operations shall commence. Long-term operations are considered the operational phase where the FEB will serve the water quality features in the Eastern Flow-path (i.e. Stormwater Treatment Area 1 East and 1 West, including expansions).

[5] These could range anywhere from completion of design for the whole project prior to construction of the whole project to phased design and construction of portions of the project.

IV. Eastern Flow-path: Conveyance Features

C. Land Acquisition for the G-341 Related Improvements

Due to various constraints, the full intent of the G-341 structure's design has not been able to be implemented.[6] Whereas additional acreage may be required to implement G-341 related improvements, the Respondent will be required to acquire additional lands to construct and operate any proposed features that cannot be accomplished in the available right-of-way or Respondent owned lands. Multiple methods will be analyzed to identify the most cost effective measures available to fully implement the designed operations for the G-341 structure and, as such, the need and extent of land acquisition resulting from such a need has not been determined at this time. It is expected that any required land acquisition will be completed subsequent to initial design, but no longer than 12 months.

D. Initiate Design of G-341 Related Improvements

See section I.E above.

E. Submit State and Federal Permit Applications for the G-341 Related Improvements

See section I.A. above.

F. Complete Design of the G-341 Related Improvements

During the project design phase, multiple conceptual designs will be developed and analyzed. These alternatives could include modifications to the confluence of the Ocean and Hillsboro Canal, dredging of the Hillsboro Canal, additional capacity at the S-6 pump station, operational changes to the Central and Southern Florida Flood Control Project, or an alternative delivery path such as enlargement of the Cross Canal and delivery of waters down the North New River Canal. Regardless of the final design of the G-341 Structure and related conveyance improvements, all design related activities shall be, at a minimum, consistent with the assumptions in the model results. Completion of design typically satisfies the last remaining pre-construction regulatory requirement and begins the bid solicitation process for construction. Design is expected to require 22 months.

G. Complete Construction of the G-341 Related Improvements

Construction is considered complete when the Respondent has functional use of the facility and has accepted the facility for operations. This is also the time when project features are ready for inspection by regulatory agencies in order to determine consistency with the permits, including final plans and specifications. Construction completion signals commencement of (or readiness to commence) operations. Construction may include, depending on the structuring of the contract and funding schedules, a scenario where civil works components such as levees, canals and other structures are designed and constructed in succession or occur under a scenario similar to the design/build contract for

[6] These corrective actions require re-directing approximately 60,000 acre-ft of S-5A basin runoff for treatment in the Central Flow Path projects. G-341 related improvements are necessary to accommodate this corrective action.

the FEB. It is expected that construction of the feature will be completed within 25 months from initiation of construction.

V. Eastern Flow-path: USACE Repairs and Modifications to STA 1E

A. Periphyton Stormwater Treatment Area (PSTA) Pilot Project

In November of 2003, the U.S. Army Corps of Engineers authorized a project in Cell 2 of the eastern flow-way of STA-1East. The investigation began in 2007 and the Corps collected approximately 12 months worth of data. The USACE completed an environmental assessment regarding the decommissioning of the pilot project and the finding of no significant impact (FONSI) was signed on March 9, 2012. Once initiated, decommissioning in accordance with the selected alternative is expected to take approximately nine months.

B. Culvert Repairs

STA 1E has 44 internal 8 ft-by-8 ft precast segmented concrete box culverts that allow the flow of water to be distributed across treatment cells and into the perimeter canal. The SFWMD performed a survey identifying 23 culverts that have degraded joints and seals which may cause failure of the culverts in the future (similar to the problem at S-375.) STA-1E repairs will be completed prior to the initiation of long term operations associated with the Eastern Flow-path: Flow Equalization Basin in Section III above.

C. Complete Re-grading of Cells 5 and 7

The Respondent commissioned a topographic survey of STA-1E in 2005. This survey indicated that Cells 5 and 7 (19% of the treatment area) are, on average, 0.73 feet and 1.19 feet too deep, respectively, in relation to the design elevation. The Respondent has concluded that the increased depth prevents the establishment of emergent vegetation growth, and re-grading of Cells 5 and 7 is necessary to correct the elevation. The re-grading of the cells will require a significant volume of fill to bring the bottom elevation of the cells up to the appropriate grade. STA-1E repairs will be completed prior to the initiation of long term operations associated with the Eastern Flow-path: Flow Equalization Basin in Section III above.

D. Trash Rakes and Screen Modifications

During severe weather events, the mass of floating vegetation which has been observed at the pump stations exceeds the current trash rake system's capacity. While the equipment installed by the USACE matches the plans and specifications, the USACE has agreed with the Respondent that the current system will not perform at an acceptable level during a storm event, and the USACE is currently planning to undertake modifications to the trash and rake system. STA-1E repairs will be completed prior to the initiation of long term operations associated with the Eastern Flow-path: Flow Equalization Basin in Section III above.

VI. Central Flow-path: Flow Equalization Basin

A. Initiate Design of the Everglades Agricultural Area (EAA) A-1 Flow Equalization Basin (FEB)

See section I.E. above.

B. Submit State and Federal Permit Applications for the EAA A-1 FEB

See section I.A. above.

E. Design Status Report Submittal

See I.B. above.

F. Complete design of the EAA A-1 FEB

The completion of the detailed design phase will result in final designs for an approximately 54,000 ac-ft of storage (i.e. FEB) upstream of STA-3/4 and the expanded STA-2 complex. The final design is expected to identify a feature that primarily delivers water to STA-3/4 with a designated percentage of flows going to STA-2 and Compartment B. Inflows to the EAA FEB will be from the North New River Canal and Miami Canal through the G-370 and G-372 pump stations, respectively. Completion of design typically satisfies the last remaining pre-construction regulatory requirement. Design is expected to occur within a 16 month period.

E. Initiate Construction

See section I.F.

F. Complete Construction of the EAA A-1 FEB

Construction is considered complete when the Respondent has functional use of the facility and has accepted the facility for operations. This is also the time when the project features are ready for inspection by regulatory agencies in order to determine consistency with the permits, including final plans and specifications. Completion of construction signals commencement of (or readiness to commence) operations. The EAA FEB will be constructed utilizing the materials and features resulting from the initial construction of the EAA A-1 Reservoir. It is expected that the final configuration will support vegetation that will aid in the uptake of phosphorus within the FEB. Construction of this component is expected to be completed within 25 months.

G. Operational Monitoring and Testing Period

Until the FEB comes online, flows and loads to STA-3/4 and STA-2 will be less than ideal. Once flows can be captured by the FEB, it will take the STAs some period of time to adjust to the new hydraulic conditions. There is currently no data from other STAs for estimating the time it takes an existing STA to adjust to new, albeit preferable, hydraulic conditions. Therefore, the estimate of time for this adjustment is uncertain. The Department is estimating, using best professional judgment that it will

take up to 24 months after flows are diverted to the FEB for the STAs to begin performing in a manner consistent with the WQBEL. Compliance with the WQBEL will be assessed in accordance with the EFA and NPDES permits.

H. Discharging Consistent with the Water Quality Effluent Limitation for Total Phosphorus

See section I.D. above.

VII. Western Flow-path: Flow Equalization Basin

A. Initiate Design of Flow Equalization Basin (FEB)

See section I.E. above.

B. Submit State and Federal Permit Applications

See section I.A. above

C. Design Status Report

See section I.B. above.

D. Complete Design of the FEB

The completion of the detailed design phase will result in final designs for an approximately 11,000 ac-ft FEB on the north end of the C-139 Annex property on up to 2,800 acres, depending on final investigation of the site and detailed design. The site has a significant variation in topography as well as some areas that may need to be avoided or may require engineering solutions. The final design is expected to result in a configuration that will reflect any modifications obtained through detailed surveys and site assessments. It is expected that the resulting configuration will yield two separate zones within the FEB footprint: Zone 1 would occupy the majority of the site and would focus on maintaining appropriate vegetation to provide attenuation of stormwater inflows and provide phosphorus removal; and the second zone, which would be considerably smaller (approximately 400 acres), would be used exclusively for storage. The C-139 FEB will be designed and operated to enable STA-5/6 to perform consistent with the WQBEL. Design is expected to take no longer than 24 months.

E. Initiate Construction of the FEB

See section I.F. above.

F. Construction Status Report

See section I.B. above.

G. Complete Construction of the FEB

Construction is considered complete when the Respondent has functional use of the facility and has accepted the facility for operations. This is also the time when the project features are ready for inspection by regulatory agencies in order to determine consistency with the permits, including final plans and specifications. Construction completion signals the commencement of (or readiness to commence) the flooding and optimization period of the expanded treatment features. Construction is expected to be completed in 35 months.

H. Operational Monitoring and Testing Period

Until the FEB comes online, flows and loads to STA-5/6 will be less than ideal. Once flows can be captured by the FEB, it will take the zoned configuration within the FEB and STA-5/6 some period of time to adjust to the new hydraulic conditions. There is currently no data from other STAs for estimating the time it takes an existing STA to adjust to new, albeit preferable, hydraulic conditions. Therefore, the estimate of time for this adjustment is uncertain. The Department is estimating, using best professional judgment that it will take up to 12 months after flows are diverted to the FEB for the STAs to begin performing in a manner consistent with the WQBEL. Compliance with the WQBEL will be assessed in accordance with the EFA and NPDES permits.

VIII. Western Flow-path: STA Earthwork Features

A. Initiate Design of Earthwork Improvements

See section I.E. above.

B. Submit State and Federal Permit Applications

See section I.A. above.

C. Complete Design of Earthwork Improvements

The completion of the detailed design phase will yield final designs for internal earthwork improvements to cells STA 5 2A and 3A. The areas within these cells adjacent to the L-2 and L-3 canals currently are at an elevation that prevents routine inundation and therefore inhibits the expansion of emergent wetland vegetation. As a result, these areas have previously been considered “non-effective treatment areas”. This detailed design phase is expected to yield land leveling specifications necessary to match the ground elevation of the adjacent effective treatment area to the east and plans to address short-circuiting. The detailed design is expected to identify improvements that will increase the STA’s effective treatment area by approximately 800 acres. Completion of design typically satisfies the last remaining pre-construction regulatory requirement and begins the bid solicitation process for construction. It is expected that the design of these features will be completed within 24 months.

D. Initiate Construction Activities Associated with Earthwork Improvements

See I.F. above.

E. Construction Status Report(s)

See section I.B. above.

F. Complete Construction of Earthwork Improvements

Construction is considered complete when the Respondent has functional use of the facility and has accepted the facility for operations. This is also the time when the project features are ready for inspection by regulatory agencies in order to determine consistency with the permits, including final plans and specifications. Construction completion signals the commencement of (or readiness to commence) the flooding and optimization period of the expanded treatment features. It is expected that construction activities shall be completed within 35 months.

E. Initial Flooding and Optimization Period

See section I.C. above.

F. Discharging Consistent with the Water Quality Effluent Limitation for Total Phosphorus

See section I.D. above.

Attachment H –
Assumptions and Modeling Report

Evaluation of Alternatives to Achieve Phosphorus WQBELs in Discharges to the Everglades Protection Area

prepared for

U.S. Environmental Protection Agency

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The following summarizes key assumptions and modeling results for alternative plans to achieve Water Quality Based Effluent Limits (WQBELs) for total phosphorus concentrations in discharges from Stormwater Treatment Areas (STAs) into the Everglades Protection Area. It is assumed that follow-up studies will be performed to optimize features of selected alternative(s), as well as to evaluate schedule and cost factors in order to provide a basis for selecting the final design.

1) The design target for STA outflow concentrations is 11.5 ppb, expressed long-term (40-year) flow-weighted mean outflow concentration (LTFWM). This target is approximately equivalent to a long-term geometric mean (LTGM) of 9.3 ppb, based upon the statistical derivation of the WQBEL. The target provides a margin of safety for achieving the P Criterion (LTGM= 10 ppb) and reducing the risk of exceeding the WQBELs.

2) Treatment objectives can be achieved using various combinations of (a) expanded Stormwater Treatment Areas (STAs), (b) Flow Equalization Basins (FEBs), (c) diversion of flows with relatively low P concentrations from the C51 East basin into the Refuge STAs, and (d) distribution of flows across the FEBs and STAs to optimize performance.

3) For purposes of design, no additional phosphorus source controls beyond those in place during 2005-2009 are assumed. Source controls, further optimization of the STA designs and operation, and other measures may be implemented by SFWMD to provide an additional margin of safety and reduce the risk of exceeding the WQBEL.

4) The existing treatment facilities do not include FEBs. In the scenarios evaluated, FEB maximum depths range from 8 to 44 feet, as compared with STA maximum depths of ~4 feet. Their primary functions are to improve STA performance by storing and attenuating

peak flows during wet periods and by releasing flow during dry periods to help maintain STA water levels and vegetation. FEBs provide operational flexibility for real-time regional water management (e.g. balancing flows across STAs; facilitating STA maintenance). These benefits provide an additional margin of safety that is not reflected in the model simulations. Optimization of the FEB parameters in subsequent design studies may improve performance and provide additional operational flexibility.

5) Average source flows, phosphorus loads, and phosphorus concentrations that provide a basis for design are listed in Table 1. The datasets have been developed jointly with SFWMD.

6) Flows are derived from Restoration Strategies Baseline South Florida Water Management Model (RSB2X2) daily simulation of WY 1966-2005 (May 1, 1966 – April 30, 2005) hydrologic conditions with current infrastructure.

7) Source concentrations are based upon monthly flow-weighted means computed from monitoring data collected between Water Years 2005-2009 (May 1, 2004 to April 30, 2009). Phosphorus concentrations in releases from Lake Okeechobee to STA-34 are based upon data collected at the lake outlet structure.

8) It is assumed that average STA inflow volumes, concentrations, and loads computed from 2005-2009 data and 2x2 simulated flows will not increase in the future.

9) To account for reductions in watershed area associated with STA or FEB construction, source flows and loads are reduced based upon the ratio of the effective treatment area of the project to the existing watershed area in the basin containing the project.

10) For initial planning purposes, the effective treatment area (surface area at normal operating depth) for each STA or FEB is increased by 10% to estimate the total amount of land required. This accounts for the associated infrastructure (pumps, canals, levees, roads, etc). The 10% factor will be adjusted in detailed design depending on the actual site locations and STA/FEB configuration, as long as the effective treatment area of the final project is not less than that specified in the planning scenarios.

11) Each scenario is designed to treat all of the flow discharged from the source basins over the 40-year simulation period (WY 1966-2005). More detailed hydraulic analyses will be needed to design the infrastructure and operations needed to guarantee that there will be no untreated bypasses around the STAS into the Everglades under hydrologic conditions that are reflected in the 40-year simulation period. Infrastructure and operational plans will be provided to divert infrequent extreme event flows that exceed STA treatment capacity to the coast or other locations outside of the Everglades Protection Area.

12) None of the WQBEL scenarios rely on future construction or operation of projects that are outside of the scope of those specified in the scenarios (e.g. CERP or other restoration projects).

13) The selected alternative will not decrease the average inflow to Loxahatchee Refuge or adversely impact water levels, as evaluated with the Refuge water balance model (SRSM) and its associated performance measures. Preliminary analyses indicate that each of the scenarios meets the Refuge water needs according to these criteria. This will be confirmed before selecting a final alternative in the subsequent design phase.

14) The Dynamic Model for Stormwater Treatment Areas (DMSTA, Walker & Kadlec, 2005, http://www.wwwalker.net/dmsta) is used to simulate the hydraulics and phosphorus removal performance of the FEBs and STAs. DMSTA was developed explicitly for this purpose and calibrated to extensive monitoring data from the STAs, test cells, and other treatment wetlands. The model has been used in several feasibility and detailed design studies performed by SFWMD and its contractors over the 2001-2010 period. Despite inherent modeling uncertainties and limitations, the SFWMD, state, and federal agencies have agreed that this is the best available tool for use in design. Summary of model input values is provided in Table 2.

15) Modeling uncertainty is estimated at ± 15% of the predicted LTFWM for each STA. The total forecast uncertainty is likely to be greater because of variability in future climatologic conditions and uncertainty in the assumed source flows and phosphorus loads. In addition to the margin of safety inherent in the specified design target (equivalent to a LTGM = 9.3 vs. 10 ppb), additional measures can be taken to account for performance uncertainty and reduce risk of exceeding the WQBEL (e.g., source controls, further STA optimization, research and monitoring to improve treatment technology).

16) The scenarios (Table 3) include four basic alternatives (A, B, C, D) involving different combinations of expanded STAs, FEBs, and diversion of additional flow into the Everglades from the C51 East Basin. Each scenario is simulated with a final configuration (full-scale operation) and interim configuration (partial construction, accelerated to achieve WQBEL in STA34 and improve performance of the other STAs). For comparison purposes, the scenarios also include the existing STAs with and without Compartments B & C in operation.

17) Table 4 summarizes the water and phosphorus balances for each STA and scenario. WQBEL excursion frequencies are calculated from the yearly outflow FWM time series for each STA. Based upon WQBEL derivation results, the yearly FWM is divided by 1.23 to estimate the outflow geometric mean. Under full operation (Scenarios A, B, C, D), the predicted number of excursion events over the 40 year record ranges from 0 to 3. The results do not account for the inherent uncertainty in climate, source datasets, STA vegetation management, and modeling. Implementing source controls and additional measures not assumed in the design calculations will provide a margin of safety and reduce the risk of exceeding the WQBEL in the context of the uncertainties associated with forecasting project performance.

18) The STA/FEB expansion requirements and outflows to the EPA and Lake Worth for each alternative under full operation are summarized below. The total area requirements vary over a relatively narrow range (41-44 kac). The C51E Diversion/FEB scenarios (C & D) provide significant increase in total flow to the Everglades without substantially increasing the total area requirements relative to Scenarios A & B.

Full Operation	New	New Effective Area kac			Total	Outflow kaf/yr	
Scenario	Inflow	STA	FEB	Total	kac	To Ever	Estuary
A - East & Cent STA	-	30.6	7.0	37.6	41.4	1416	273
B - East STA, Cent FEB	-	28.5	10.0	38.5	42.4	1408	203
C - C51 FEB, Cent STA	C51E	30.0	8.7	38.7	42.5	1584	16
D - C51 FEB, Cent FEB	C51E	27.0	12.7	39.7	43.6	1574	16

Table 1- Source Flows & Phosphorus Loads (Prior to STA Expansion) *

Source	Flow kac-ft/yr	Load mt/yr	Conc ppb
S5A Runoff to WPB	235.4	53.0	182
298 - EBWCD	24.2	14.7	492
S361 Runoff to STA1E	9.7	0.9	73
C51 West + ACME	159.7	32.2	163
L8 Runoff to C51W Canal	25.0	4.2	135
S352 Urban Water Supply	2.3	0.3	103
Total STA-1W+1E	456.3	105.2	187
S5A Runoff to STA2	61.0	16.0	213
S6 Runoff to STA2	181.2	27.8	124
ESWCD & 715 to Hills	31.0	6.3	165
Total STA-2 + Comp B	273.2	50.2	149
S7 Runoff to STA34	121.5	18.1	121
S7 Runoff to Comp B (redirected)	142.2	21.0	120
S8 Runoff to STA34	219.4	28.3	104
298 - SSD	5.2	0.7	112
298 - SFCD	19.1	2.6	112
298 - SSDD	6.9	1.2	139
C139_G136 to STA34	11.7	3.0	209
S354 Lake Urban WS	19.6	3.7	153
S351 Lake Urban WS	6.8	1.5	178
S354 Lake Reg Release	58.5	12.4	172
Total STA-34	611.0	92.5	123
C139 South Runoff	176.6	50.1	230
C139 North Runoff (L1/G136)	2.4	0.7	234
C139 Annex	21.3	2.6	97
STA6 Water Supply	6.8	1.4	171
Total STA 5-6	207.1	54.8	214
Total All Basins	1547.6	302.7	158
C51E Diversion Option			
Total C51E Runoff	202.6	23.9	96
C51E Diverted to STA1W/E	187.1	22.1	96
C51E Discharged to Estuary	15.6	1.9	96

* Assumptions and data developed jointly with SFWMD.

Table 2 – Summary of DMSTA Modeling Assumptions	
Parameter	Comments
General	Except where noted, DMSTA parameters for the existing STA cells are derived from the values assumed in the September 2009 update of the Long-Term Plan and/or updates specified in SFWMD simulations of WQBEL scenarios. Detailed model parameters are specified in the DMSTA input file for each scenario.
Simulation Dates	Start Date: 1/1/1965 (SFWMM Output); Output Dates: 5/1/1965-4/30/2005 (Water Years 1966-2005)
Number of Iterations	1 iteration. The initial P storage in each cell is initialized at the average value predicted from the previous model run; this enables simulation with 1 iteration provided that the each scenario is simulated at least twice in the course of the design process.
Atmospheric Deposition	Assumed in DMSTA calibration and previous design studies. Dry deposition 20 mg/m^2-yr; Rainfall P Concentration = 10 ppb.
Duty Cycle Factor	Duty Cycle = 0.95 for STAs; refers to the portion of time that an STA is offline for major maintenance or rehabilitation activities. A value of 0.95 is meant to correspond to an STA being offline 5% of the time (1 year out of every 20 years). This assumption is consistent with historical STA operations after startup periods. Duty Cycle = 1.0 for FEBs; minimal vegetation management
DMSTA Vegetation Types	EMG: Emergent or unmanaged vegetation on previously farmed or disturbed soils SAV: Cells managed to promote submersed aquatic vegetation (SAV); generally deeper then emergent cells PSTA: Periphyton treatment area on limerock/shellrock substrate PEW: Pre-Existent Wetland; emergent or unmanaged veg. on previous wetland or undisturbed soils RES: Deep (8-44 ft); open water; dominated by algae and floating vegetation, as opposed to emergent or submersed vegetation. Current STAs contain various combinations of emergent and SAV. STA-2 cell 2 is modeled using the PEW calibration (existing). The EMG/SAV split for new cells in the eastern & central basins is 33/67, typical of the existing STAs.

	The EMG/PEW split for new cells in the western basin is 60/40. Downstream cells in each flow path of the existing and expanded STAs in the western basin are modeled using the PEW calibration. Maintenance of SAV in the western basin has proven to be difficult because of high seepage rates, frequent dry-out, and low calcium levels in the basin runoff. The RES calibration is used for FEBs. None of the cells are modeled with the PSTA calibration, although conversion to periphyton communities may be a future management option.
Inflow Fraction	Total cell area in each flow path / total STA area; balances hydraulic loads across flow paths within each STA
Mean Width of Flow Path	As constructed for existing cells. The width of new flow paths is computed from area assuming a 3/1 length to width ratio along each EMG/SAV flow path. A length/width ratio of 1.0 is assumed to FEBs. Performance is insensitive to width assumptions.
Number of Tanks in Series	A TIS value of 1 is used for FEBs. Consistent with previous design assumptions, a TIS value of 3 is used in each new STA cell. This assumes that the cell will be constructed and managed to provide relatively even ground surface and flow distribution across the width of each flow path (minimal short-circuiting) and contain at least one internal levee to separate the emergent and SAV communities.
FEB Release Series	Release to STAs to help maintain water levels in droughts. Computed based upon 30-day antecedent average ET – Rainfall multiplied by the downstream STA area. If ET exceeds rainfall, a proportionate release is made; potential release from C51 FEB for urban water supply; release for maintenance of Refuge stage (minimum total inflow to STA1E+W from all sources = 500 cfs for June-October; not optimized). Minimum drawdown depth = 0.5 ft.
FEB Depth Series	Monthly regulation schedule specified for FEBs. Range from 0% in wet season (to capture storms) to 80% of capacity in dry season (stores water for use in STA irrigation, urban water supply); To be optimized in final design.
FEB Outflow Hydraulic Coefficients	Slope = 1; intercept varied to provide specified mean hydraulic residence time in the FEB (90 days in western FEB, 60 days in central FEB, 30 days in FEB). Values adjusted based upon simulated water levels, flow capture, and flow attenuation; to be optimized in final design.
STA Outflow Control Depth	~1.25 ft. No outflow below this level; typical of existing STA cells
STA Outflow Hydraulic Coefficients	Slope = 4, Intercept = 1; typical values calibrated to existing STA cells

STA Bypass Triggers	Each STA is assumed to treat all of the simulated flow without bypass. Simulated water levels and inflow volumes are generally consistent with that assumption, but will be confirmed in detailed design, which will provide suitable infrastructure to avoid untreated bypass.
FEB Bypass Triggers	Maximum depth varies with design (12 ft for West, 8 ft for Central, 44 ft for Eastern FEB (C51E Project Design)); Maximum inflows (2500, 3000, and 2000 cfs, respectively); to be optimized in final designs.
Seepage Rates	Generally consistent with seepage rates assumed in previous simulations of the existing STAs (.005 – 0.2 cm/d/cm) ; seepage rates in STA-34 are reduced by 75% relative to SFWMD simulations to be more consistent with the observed overall water budget of STA-34. No seepage losses assumed for FEBs; seepage rates to be considered in final design (could be released to STAs or recycled to FEB).
Seepage Recycling	No seepage recycling is included in the simulations. This is conservative with respect to maintaining STA water levels. Any seepage recycling in new cells would depend on cell location and configuration relative to existing cells. Seepage collection and recycling will be optimized in detailed designs.

Table 3 – Scenario Definitions and Results

All Scenarios: Long-Term Flow-Weighted-Mean Design Target = 11.5 ppb (equivalent to LT Geometric Mean ~ 9.3 ppb), 2005-2009 Source TP Concentrations

			Inflow Conc ppb			STA Expan. (Effective)*				FEB Effective Area				FEB Vol.	FEB+STA		Outflow FWM ppb ***					Outflows kac-ft/yr			
ID	Label	Description	West	Cent	East	West	Cent	East	Total	West	Cent	East	Total	kac-ft	Effect	Total	West	34	2+B	East	Total	WCA1	2A+3A	Total	Estuary
1	Current **	Current System without Comp B & C	214	131	187	8.9	24.8	11.8	45.5						45.5	50.0	**29.7**	**25.5**	**33.2**	**34.6**	**30.1**	448	1050	1497	273
2	Current + Comp B & C **	Current System with Comp B & C	214	131	187	13.0	31.7	11.8	56.5						56.5	62.1	**18.3**	**15.7**	**20.3**	**34.1**	**23.0**	448	1042	1490	203
3	A - East & Cent STA	STA Expansion in East & Central; 12-ft FEB in West	219	131	187		15.6	15.0	30.6	7.0			7.0	84	37.6	41.4	11.4	11.5	11.5	11.4	11.5	429	987	1416	273
4	B - East STA, Cent FEB	8-ft FEB in Comp A2, STA in Comp A1,; 12-ft FEB in West; STA expansion in East	219	131	187		13.5	15.0	28.5	7.0	3.0		10.0	108	38.5	42.4	11.5	11.3	11.3	11.4	11.4	429	979	1408	203
5	A/B-Interim (4 yrs)	Interim Plan for Scenarios 3 or 4; A1 Operated as 4 ft FEB; balance flows to achieve WQBEL in STA34; Meanwhile construct A2 8-ft FEB (or STA), Convert A1 FEB to STA, expand STA1W; 12-ft FEB in West	214	132	188						15.0		15.0	60	15.0	16.5	**18.3**	11.2	**18.2**	**31.9**	**20.4**	448	975	1397	228
6	C - C51 FEB, Cent STA	C51E Diversion & 44-ft Rockpit / FEB + STA Expansion in East & Central; 12-ft FEB in West	219	131	160		22.0	8.0	30.0	7.0		1.7	8.7	157	38.7	42.5	11.1	11.5	11.5	11.5	11.5	444	1140	1584	16
7	D - C51 FEB, Cent FEB	C51E Diversion & Rockpit/FEB in East; 8-ft FEB, STA Exp in A1 & A2, 12-ft FEB in West	219	132	160		19.0	8.0	27.0	7.0	4.0	1.7	12.7	189	39.7	43.6	11.5	11.5	11.5	11.5	11.5	444	1130	1574	16
8	C/D - Interim (4 Yrs)	Interim Plan for Scenarios 6 or 7; C51E rockpit partially complete (6 ft vs. 44 ft final); divert L8 flows to coast; some S5A to west; no C51E diversion; A1 Operated as 4 ft FEB; achieve WQBEL in STA34; Meanwhile construct other project components (FEB in Comp A2, Complete C51 Rockpit, STA1W Expansion)	214	132	188						15.0	1.7	16.7	70	16.7	18.4	**18.3**	11.3	**19.2**	**30.4**	**20.0**	389	1004	1393	226

* Preliminary Designs Subject to More Detailed Analysis and Optimization. Approximate Model Uncertainty +/- 15% of Predicted Outflow Concentrations.

** Existing & Planned STA Effective Areas listed for Scenarios 1 & 2; STA Expansion areas listed for other scenarios; West = STA-5, STA-6, Comp C; Central = STA-34, Comp B, STA-2; East = STA-1W & STA-1E.

***** Bold Fonts Indicate STA's Not Achieving 11.5 ppb LTFWM Target (Existing Conditions or Interim Plans)**

Table 4 - STA Mass Balances & Performance

Scenario 1 Existing STAs

	Effect	STA Inflows			STA Outflows			30-Day Hydraulic Load			Depth	Settling	FEB Area	Depth	WQBEL Excursions / 40 Yrs		
	Area	Flow	Load	Conc	Flow	Load	Conc	Mean	Max	CV	Freq	Rate	kac	ft	Yearly	>2 Yrs	Both
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d	-	< 10 cm	m/yr			FWM > 18	GM > 10	Tests
STA1E	5.1	194	37.3	155	185	6.5	28.2	3.2	20.1	0.88	0%	26			29	35	37
STA1W	6.7	262	68.0	210	263	12.7	39.1	3.3	20.6	1.02	0%	26			40	38	40
STA2B	8.2	273	50.2	149	275	11.3	33.2	2.8	14.0	0.98	0%	20			40	38	40
STA34	16.5	611	92.6	123	601	18.9	25.5	3.1	13.1	0.85	1%	23			37	38	40
STA5	6.1	143	37.8	214	125	4.8	30.9	2.0	8.9	0.96	1%	18			40	38	40
STA6	2.8	64	17.0	214	48	1.6	26.5	1.9	8.7	0.96	7%	20			39	38	40
Total	45.5	1548	302.7	158	1497	55.7	30.1										

Scenario 2 Existing STAs + Compartments B & C

	Effect	STA Inflows			STA Outflows			30-Day Hydraulic Load			Depth	Settling	FEB Area	Depth	WQBEL Excursions / 40 Yrs		
	Area	Flow	Load	Conc	Flow	Load	Conc	Mean	Max	CV	Freq	Rate	kac	ft	Yearly	>2 Yrs	Both
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d	-	< 10 cm	m/yr			FWM > 18	GM > 10	Tests
STA1E	5.1	221	44.1	162	211	8.8	34.0	3.6	20.8	0.86	0%	26			38	38	40
STA1W	6.7	236	61.2	210	237	10.0	34.1	2.9	18.6	1.02	0%	26			40	38	40
STA2B	15.1	474	79.9	137	478	12.0	20.3	2.6	13.0	0.99	0%	25			25	38	40
STA34	16.5	410	62.8	124	401	7.8	15.7	2.1	8.5	0.82	1%	23			5	23	24
STA5	7.9	126	33.4	214	106	2.4	18.3	1.3	6.1	0.96	2%	17			18	34	35
STA6	5.1	81	21.4	214	57	1.3	18.3	1.3	6.0	0.96	8%	17			16	34	35
Total	56.5	1548	302.7	158	1490	42.3	23.0										

Scenario 3 A- STA Expansion

	Effect	STA Inflows			STA Outflows			30-Day Hydraulic Load			Depth	Settling	FEB Area	Depth	WQBEL Excursions / 40 Yrs		
	Area	Flow	Load	Conc	Flow	Load	Conc	Mean	Max	CV	Freq	Rate	kac	ft	Yearly	>2 Yrs	Both
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d	-	< 10 cm	m/yr			FWM > 18	GM > 10	Tests
STA1E	5.1	109	20.4	152	102	1.5	11.6	1.8	7.1	0.75	0%	26			0	2	2
STA1W	21.7	321	78.9	199	327	4.6	11.3	1.2	7.0	0.95	0%	21			2	0	2
STA2B	15.1	248	46.1	151	253	3.6	11.5	1.4	6.9	0.98	0%	20			0	0	0
STA34	32.1	602	91.6	123	583	8.3	11.5	1.6	6.6	0.85	1%	21			0	1	1
STA5	7.9	122	24.3	161	101	1.4	11.4	1.3	3.7	0.61	0%	20	7.0	12	0	3	3
STA6	5.1	78	15.5	161	50	0.7	11.5	1.3	3.7	0.61	2%	19			0	2	2
Total	87.1	1479	276.7	152	1416	20.0	11.5										

Scenario 4 B- STA Expansion with A2 FEB

	Effect	STA Inflows			STA Outflows			30-Day Hydraulic Load			Depth	Settling	FEB Area	Depth	WQBEL Excursions / 40 Yrs		
	Area	Flow	Load	Conc	Flow	Load	Conc	Mean	Max	CV	Freq	Rate	kac	ft	Yearly	>2 Yrs	Both
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d	-	< 10 cm	m/yr			FWM > 18	GM > 10	Tests
STA1E	5.1	107	20.1	152	100	1.4	11.4	1.7	7.1	0.75	0%	26			0	1	1
STA1W	21.7	322	79.2	199	328	4.6	11.4	1.2	7.0	0.95	0%	21			2	0	2
STA2B	15.1	252	46.8	150	258	3.6	11.3	1.4	7.0	0.98	0%	21			0	0	0
STA34	30.0	589	85.5	118	570	8.0	11.3	1.6	7.0	0.81	0%	22	3.0	8	0	0	0
STA5	7.9	122	24.3	162	101	1.4	11.4	1.3	3.7	0.61	0%	20	7.0	12	0	3	3
STA6	5.1	78	15.5	162	50	0.7	11.5	1.3	3.7	0.61	2%	19			0	2	2
Total	85.0	1470	271.3	149	1408	19.7	11.4										

Table 4 - STA Mass Balances & Performance (ct.)

Scenario 5 A/B - Interim Plan without C51E Div/FEB

	Effect	STA Inflows			STA Outflows			30-Day Hydraulic Load			Depth	Settling	FEB Area	Depth	WQBEL Excursions / 40 Yrs		
	Area	Flow	Load	Conc	Flow	Load	Conc	Mean	Max	CV	Freq	Rate	kac	ft	Yearly	>2 Yrs	Both
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d	-	< 10 cm	m/yr			FWM > 18	GM > 10	Tests
STA1E	5.1	161	32.2	162	152	3.8	20.5	2.6	9.7	0.74	0%	28			20	35	36
STA1W	6.7	270	68.0	204	270	12.8	38.3	3.4	20.6	0.99	0%	27			40	38	40
STA2B	15.1	425	72.6	139	429	9.6	18.2	2.3	11.7	0.98	0%	25			16	35	37
STA34	16.5	393	47.6	98	383	5.3	11.2	2.0	8.8	0.77	1%	24	15.0	4	0	1	1
STA5	7.9	126	33.4	214	106	2.4	18.3	1.3	6.1	0.96	2%	17			18	34	35
STA6	5.1	81	21.4	214	57	1.3	18.3	1.3	6.0	0.96	8%	17			16	34	35
Total	56.5	1455	275.2	153	1397	35.2	20.4										

Scenario 6 C - C51E Div/FEB, STA Expan

	Effect	STA Inflows			STA Outflows			30-Day Hydraulic Load			Depth	Settling	FEB Area	Depth	WQBEL Excursions / 40 Yrs		
	Area	Flow	Load	Conc	Flow	Load	Conc	Mean	Max	CV	Freq	Rate	kac	ft	Yearly	>2 Yrs	Both
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d	-	< 10 cm	m/yr			FWM > 18	GM > 10	Tests
STA1E	5.1	123	18.7	123	116	1.6	11.5	2.0	7.0	0.70	0%	27	1.7	44	0	1	1
STA1W	14.7	327	63.2	157	328	4.7	11.5	1.9	8.6	0.57	0%	28			1	0	1
STA2B	15.1	291	64.0	178	296	4.2	11.5	1.6	7.0	0.97	0%	26			0	1	1
STA34	38.5	718	110.3	125	693	9.8	11.5	1.6	6.8	0.87	1%	21			0	1	1
STA5	7.9	122	24.2	161	101	1.4	11.4	1.3	3.8	0.61	0%	20	7.0	12	0	3	3
STA6	5.1	78	15.5	161	50	0.7	11.5	1.3	3.7	0.61	2%	19			0	2	2
Total	86.5	1659	296.0	145	1584	22.5	11.5										

Scenario 7 D -C51E Div/FEB, A2 FEB/ STA

	Effect	STA Inflows			STA Outflows			30-Day Hydraulic Load			Depth	Settling	FEB Area	Depth	WQBEL Excursions / 40 Yrs		
	Area	Flow	Load	Conc	Flow	Load	Conc	Mean	Max	CV	Freq	Rate	kac	ft	Yearly	>2 Yrs	Both
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d	-	< 10 cm	m/yr			FWM > 18	GM > 10	Tests
STA1E	5.1	123	18.7	123	116	1.6	11.5	2.0	7.0	0.70	0%	27	1.7	44	0	1	1
STA1W	14.7	327	63.2	157	328	4.7	11.5	1.9	8.6	0.57	0%	28			1	0	1
STA2B	15.1	291	64.0	178	296	4.2	11.5	1.6	7.0	0.97	0%	26			0	1	1
STA34	35.5	706	103.1	118	683	9.7	11.5	1.7	7.4	0.83	0%	22	4.0	8	0	2	2
STA5	7.9	122	24.3	162	101	1.4	11.4	1.3	3.7	0.61	0%	20	7.0	12	0	3	3
STA6	5.1	78	15.5	162	50	0.7	11.5	1.3	3.7	0.61	2%	19			0	2	2
Total	83.5	1647	288.8	142	1574	22.4	11.5										

Scenario 8 C/D - Interim Plan with C51E Div/FEB

	Effect	STA Inflows			STA Outflows			30-Day Hydraulic Load			Depth	Settling	FEB Area	Depth	WQBEL Excursions / 40 Yrs		
	Area	Flow	Load	Conc	Flow	Load	Conc	Mean	Max	CV	Freq	Rate	kac	ft	Yearly	>2 Yrs	Both
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d	-	< 10 cm	m/yr			FWM > 18	GM > 10	Tests
STA1E	5.1	117	21.9	152	110	1.7	12.9	1.9	8.1	0.77	0%	26	1.7	6	2	3	5
STA1W	6.7	281	66.0	190	279	12.8	37.3	3.5	21.6	0.95	0%	27			40	38	40
STA2B	15.1	453	78.7	141	458	10.9	19.2	2.5	12.3	0.98	0%	25			22	35	39
STA34	16.5	393	47.8	98	384	5.3	11.3	2.0	8.8	0.77	1%	24	15.0	4	0	2	2
STA5	7.9	126	33.4	214	106	2.4	18.3	1.3	6.1	0.96	2%	17			18	34	35
STA6	5.1	81	21.4	214	57	1.3	18.3	1.3	6.0	0.96	8%	17			16	34	35
Total	56.5	1451	269.1	150	1393	34.4	20.0										

Evaluation of Alternatives to Achieve Phosphorus WQBELs in Discharges to the Everglades Protection Area

prepared for

U.S. Environmental Protection Agency

By

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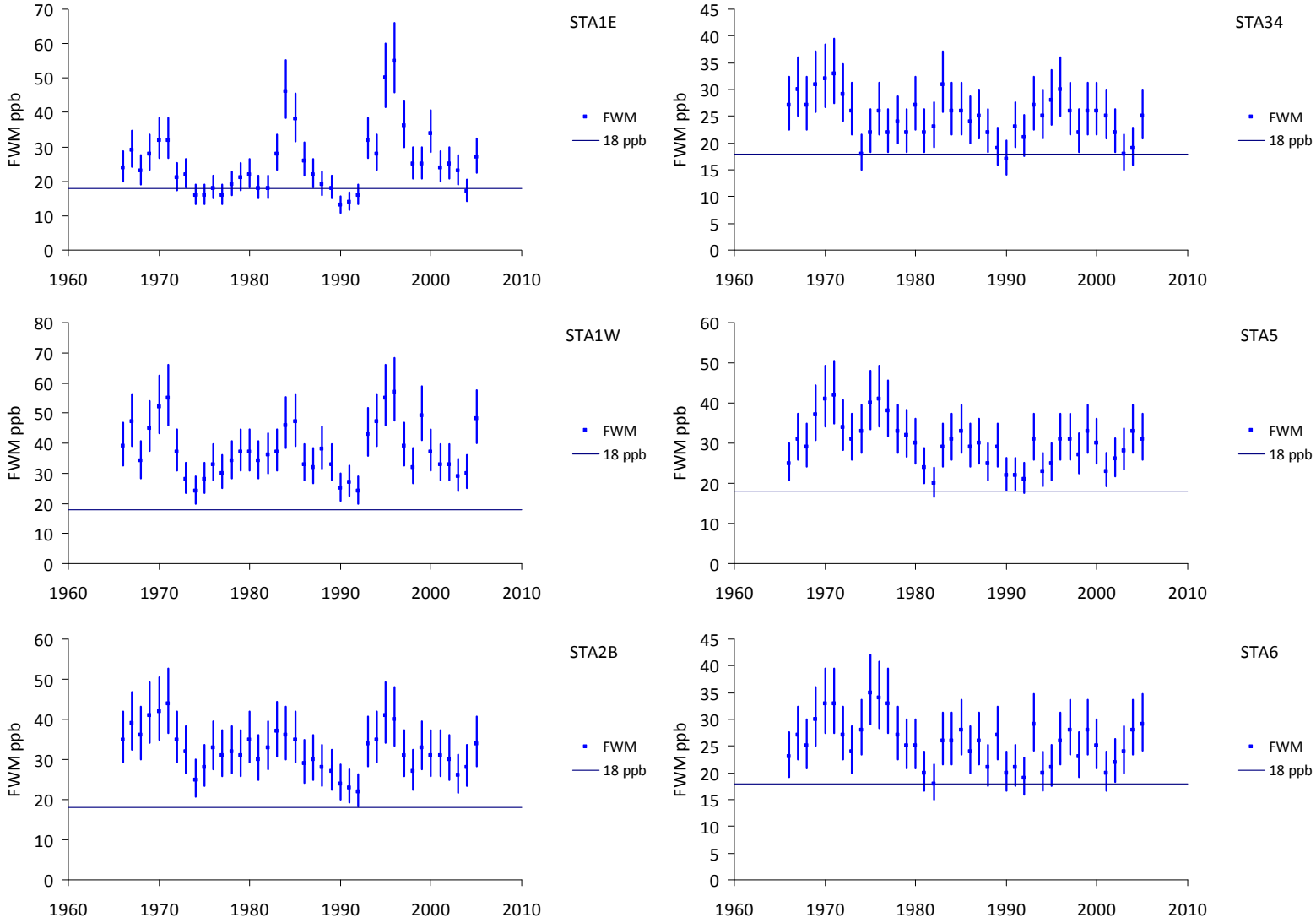
Attachment 1 : Yearly Flow-Weighted Mean Time Series for Each Scenario

Scenario 1 Existing STAs

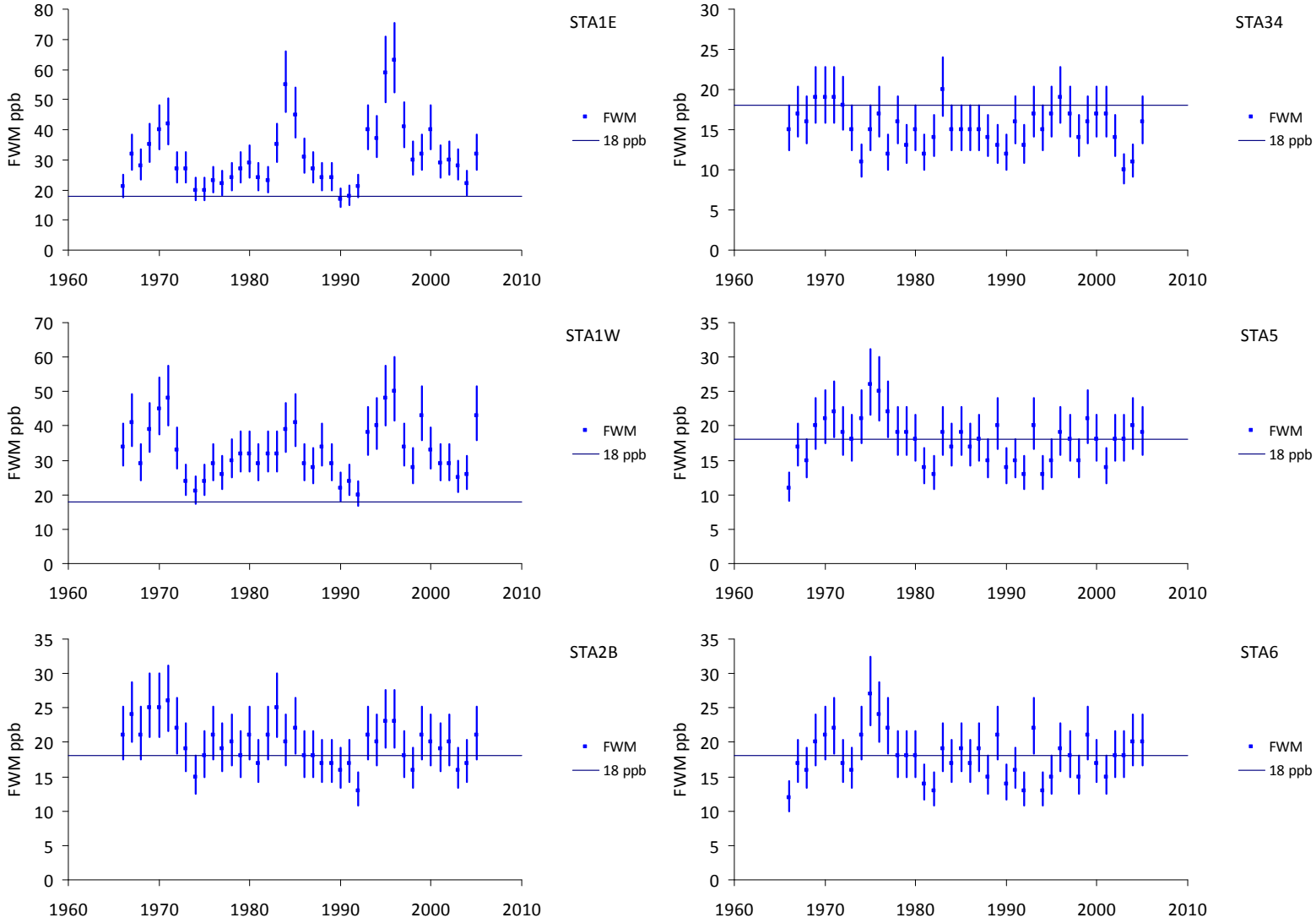
80% Confidence Intervals for Yearly Flow-Weighted Means



Model Predictions +/- 20%; Rounded to nearest ppb. Solid Line = 18 ppb WQBEL.

Scenario 2 Existing STAs + Compartments B & C

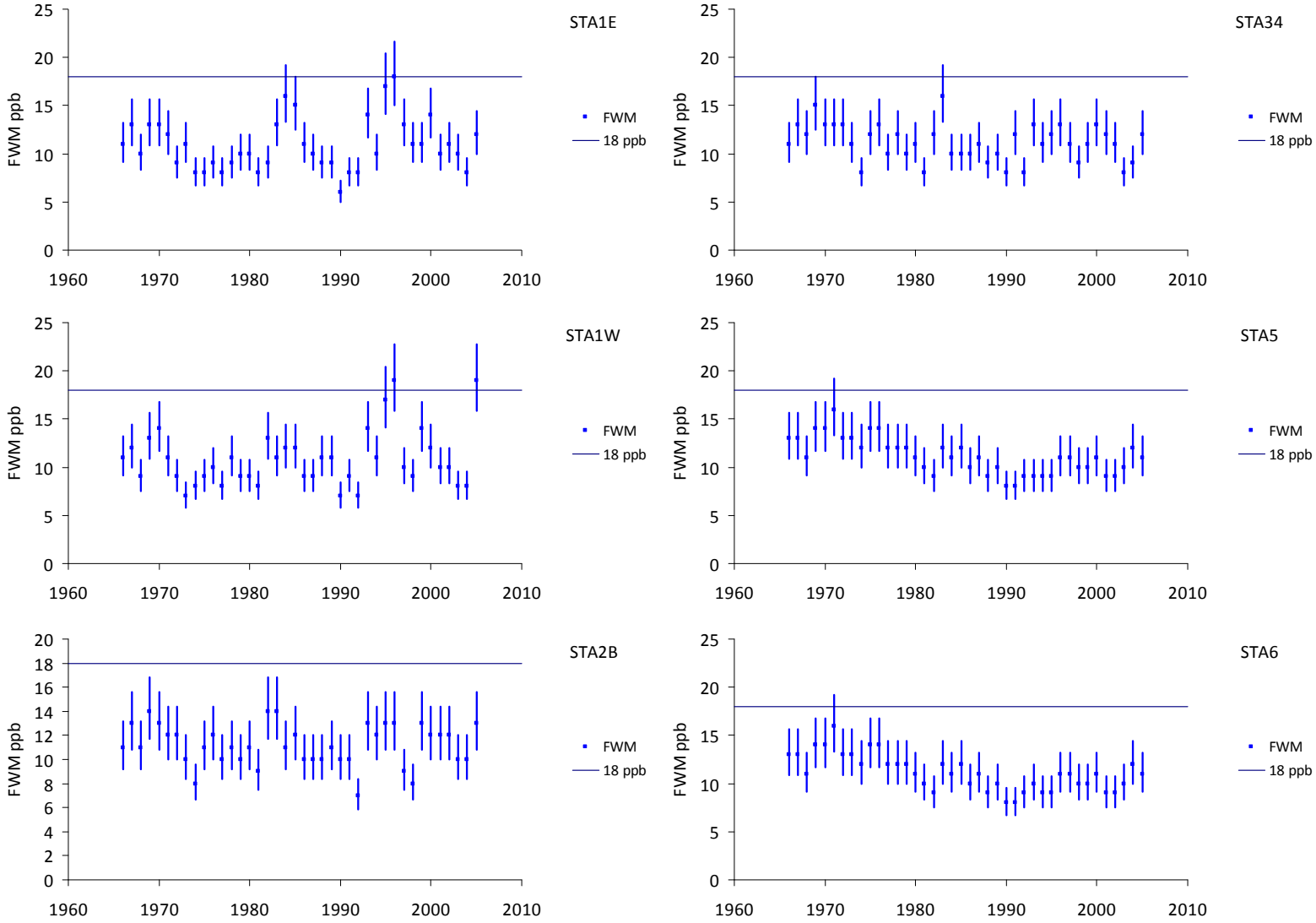
80% Confidence Intervals for Yearly Flow-Weighted Means



Model Predictions +/- 20%; Rounded to nearest ppb. Solid Line = 18 ppb WQBEL.

Scenario 3 A- STA Expansion

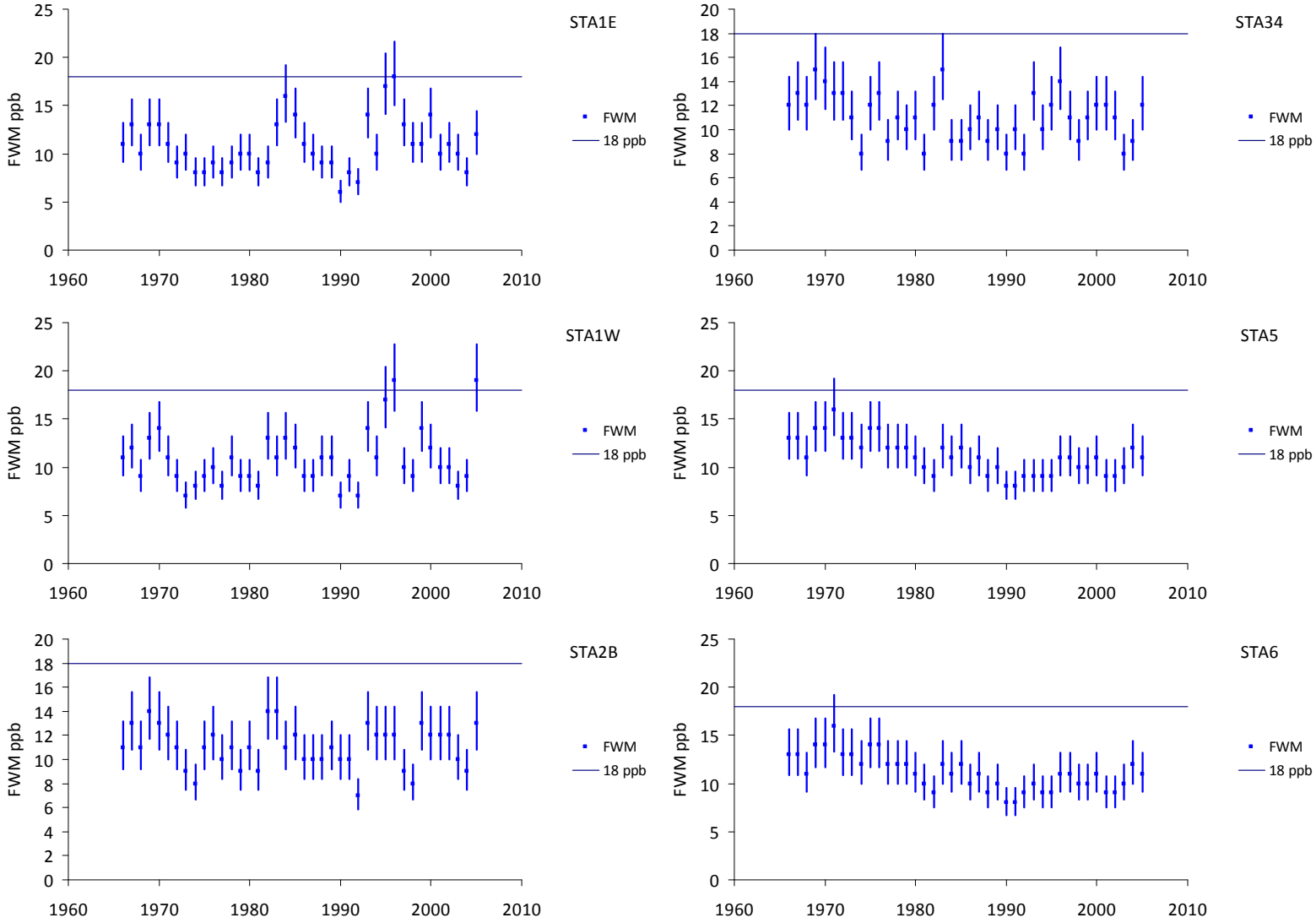
80% Confidence Intervals for Yearly Flow-Weighted Means



Model Predictions +/- 20%; Rounded to nearest ppb. Solid Line = 18 ppb WQBEL.

Scenario 4 B- STA Expansion with A2 FEB

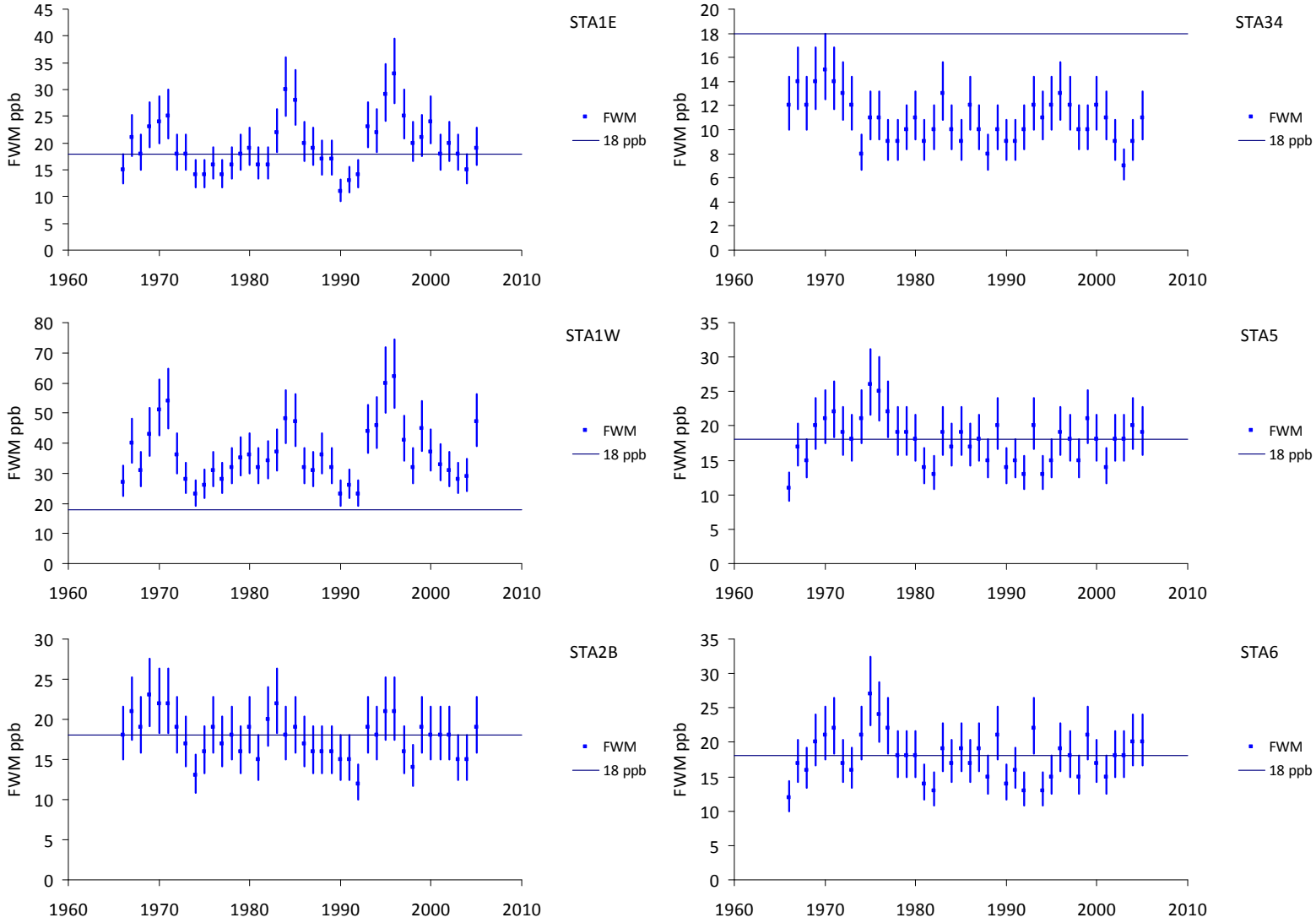
80% Confidence Intervals for Yearly Flow-Weighted Means



Model Predictions +/- 20%; Rounded to nearest ppb. Solid Line = 18 ppb WQBEL.

Scenario 5 A/B - Interim Plan without C51E Div/FEB

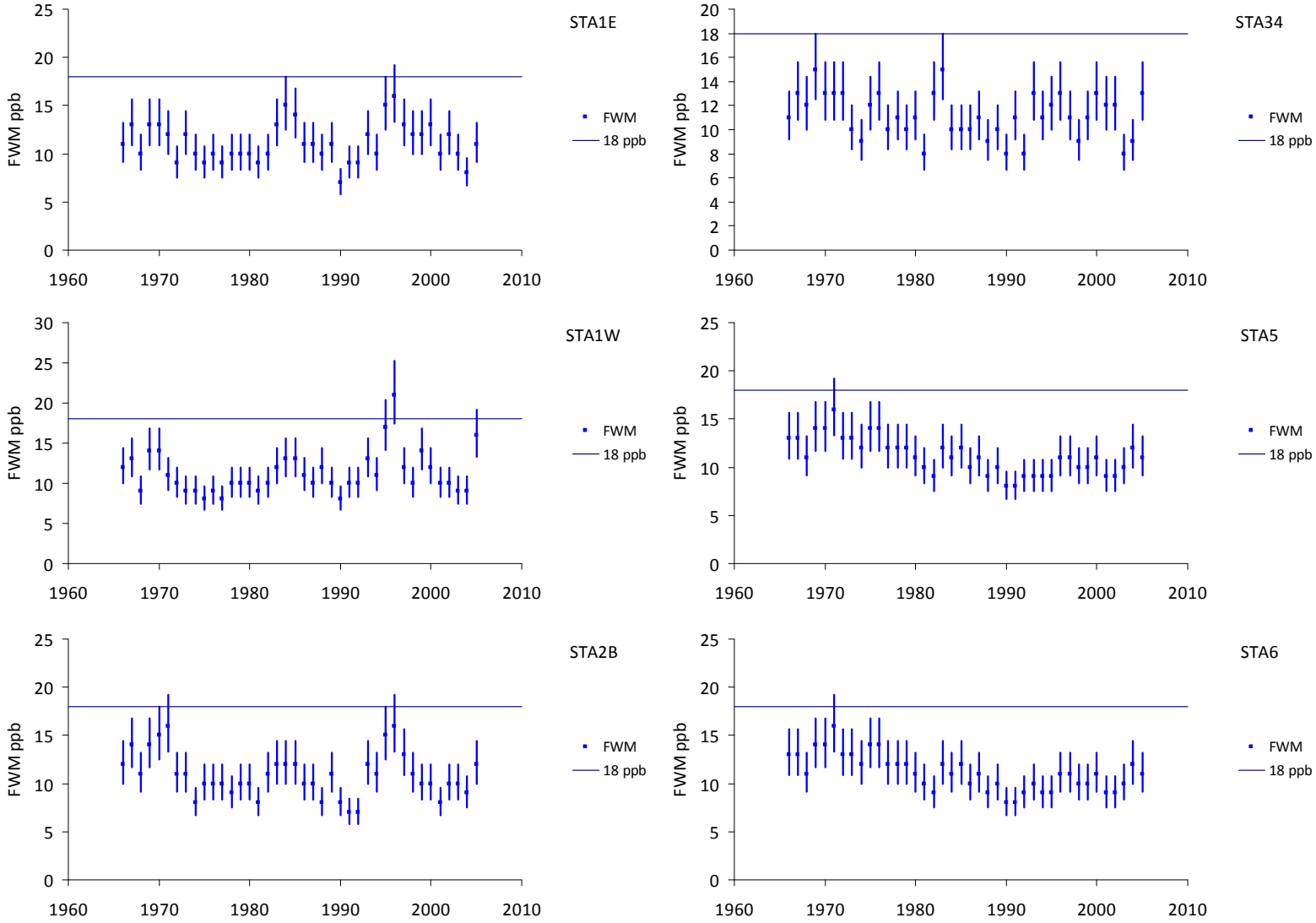
80% Confidence Intervals for Yearly Flow-Weighted Means



Model Predictions +/- 20%; Rounded to nearest ppb. Solid Line = 18 ppb WQBEL.

Scenario 6 C - C51E Div/FEB, STA Expan

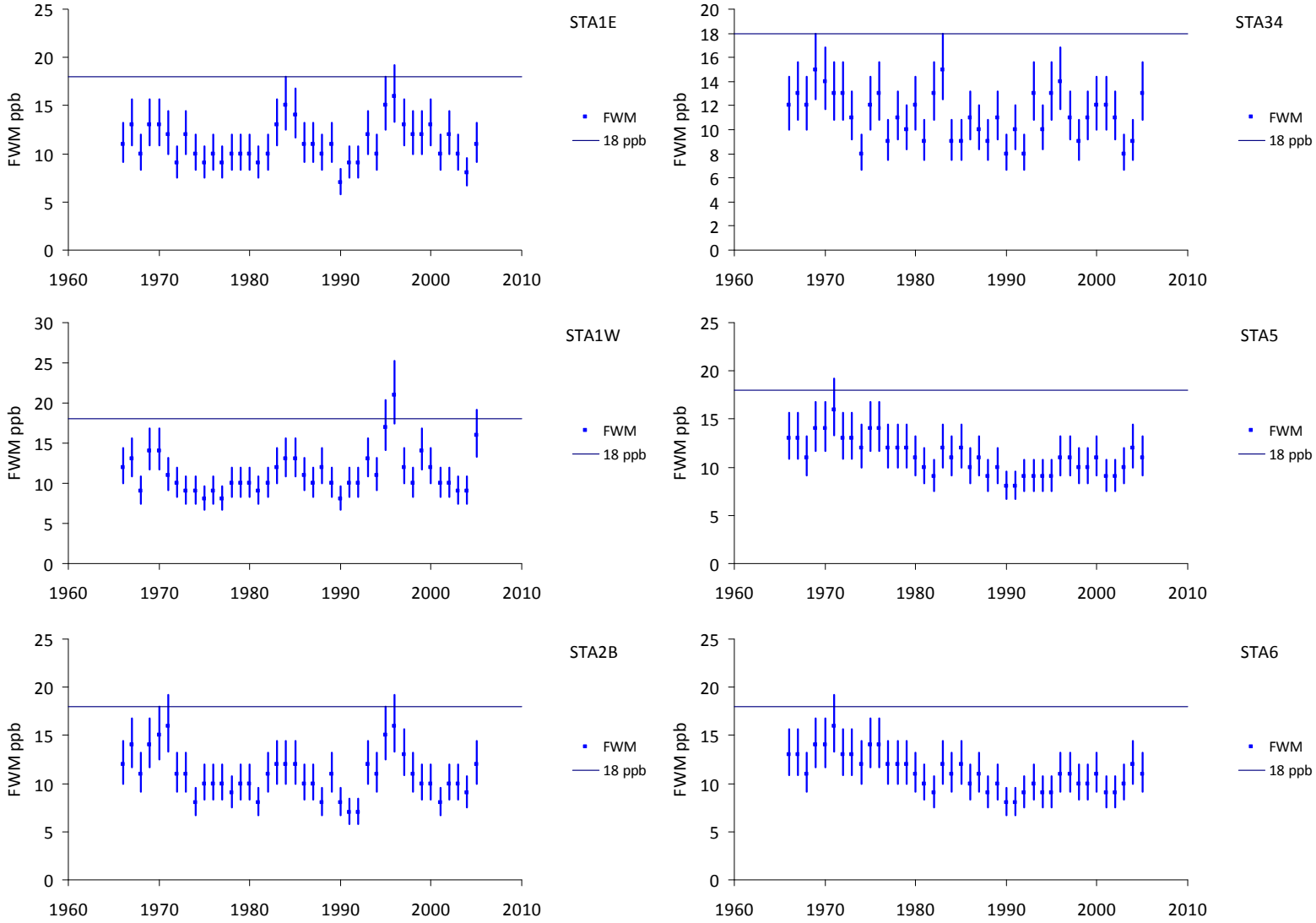
80% Confidence Intervals for Yearly Flow-Weighted Means



Model Predictions +/- 20%; Rounded to nearest ppb. Solid Line = 18 ppb WQBEL.

Scenario 7 D -C51E Div/FEB, A2 FEB/ STA

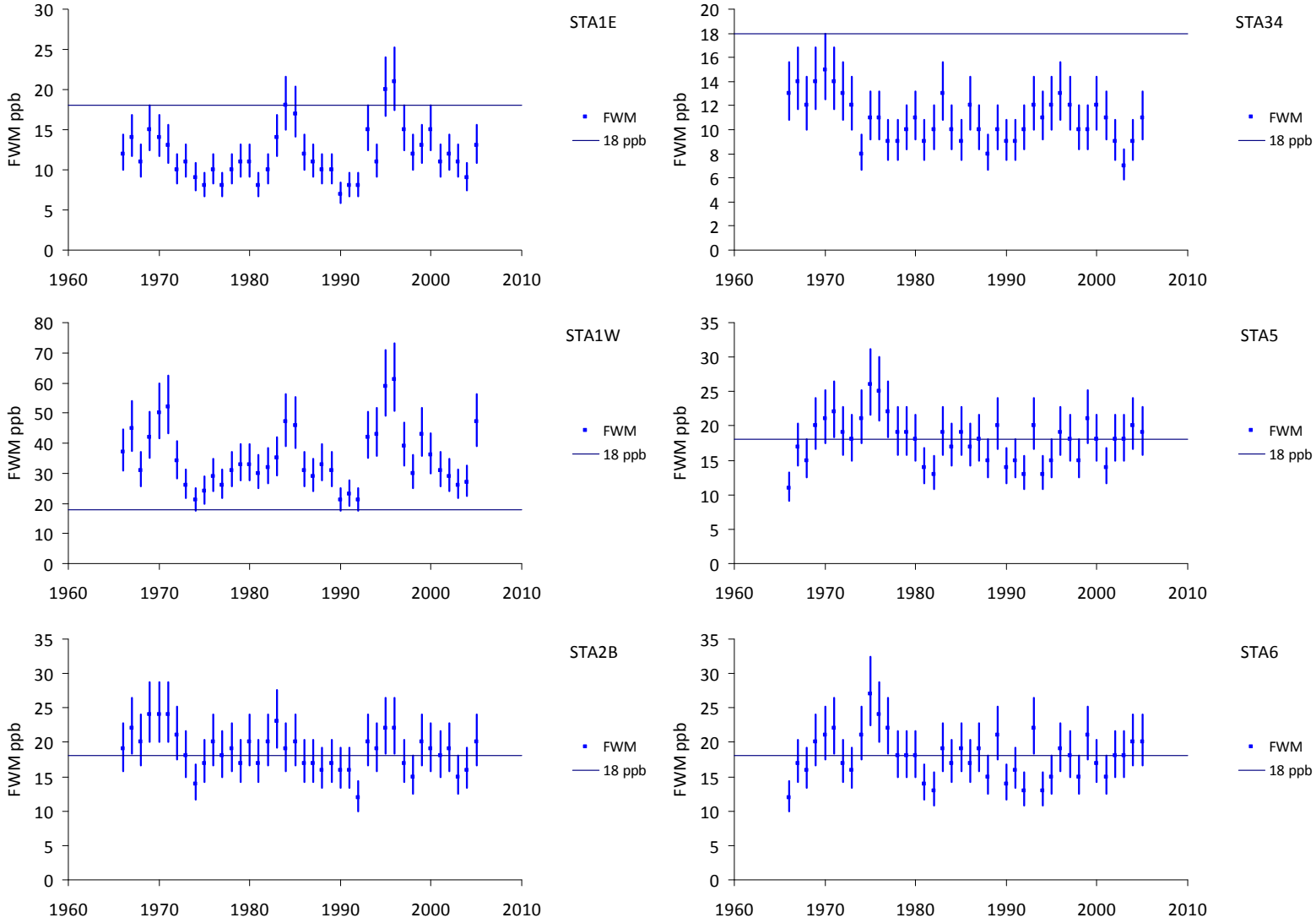
80% Confidence Intervals for Yearly Flow-Weighted Means



Model Predictions +/- 20%; Rounded to nearest ppb. Solid Line = 18 ppb WQBEL.

Scenario 8 C/D - Interim Plan with C51E Div/FEB

80% Confidence Intervals for Yearly Flow-Weighted Means



Model Predictions +/- 20%; Rounded to nearest ppb. Solid Line = 18 ppb WQBEL.

Evaluation of Alternatives to Achieve Phosphorus WQBELs in Discharges to the Everglades Protection Area

prepared for

U.S. Environmental Protection Agency

By

William W. Walker, Jr., Ph.D
Environmental Engineer
Concord, Massachusetts
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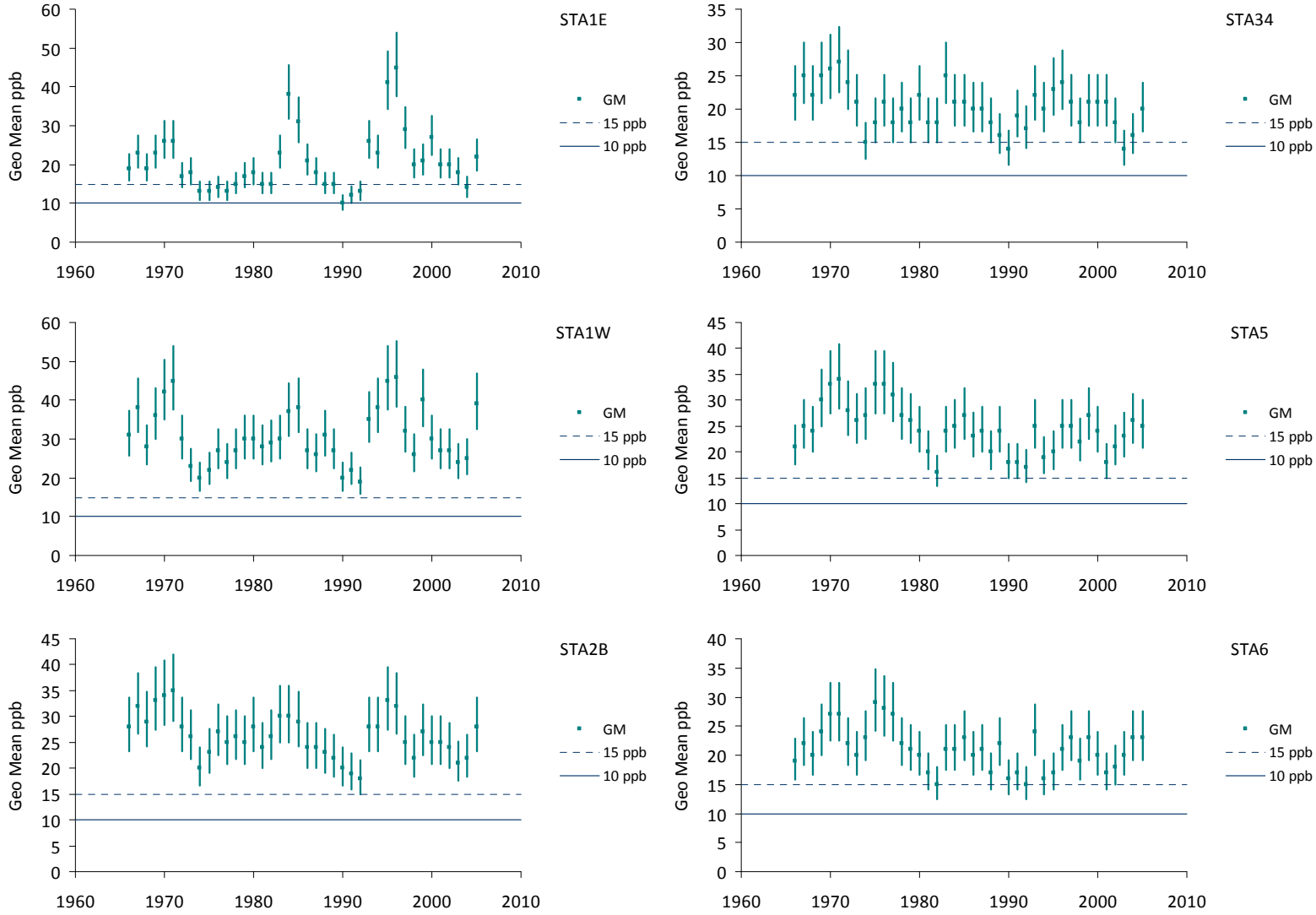
Sept 2, 2010

Attachment 2 : Yearly Geometric Mean Time Series for Each Scenario

Scenario 1 Existing STAs

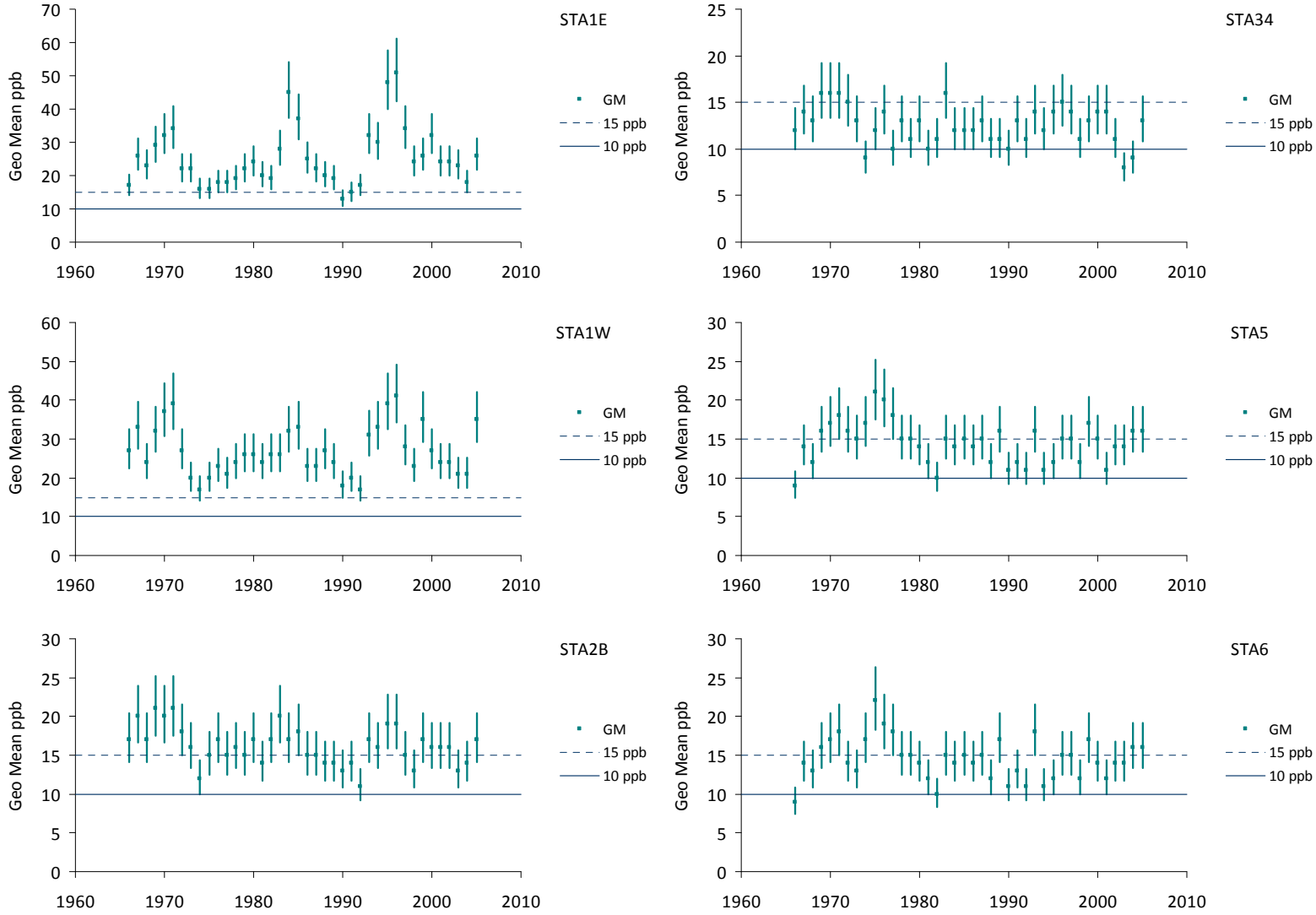
80% Confidence Intervals for Yearly Geometric Means



Model Predictions +/- 20%; Yearly Geo Mean = FWM / 1.23. Solid Line = 10 ppb criterion. Dotted Line = 15 ppb limit for marsh sites in 4-Part Test

Scenario 2 Existing STAs + Compartments B & C

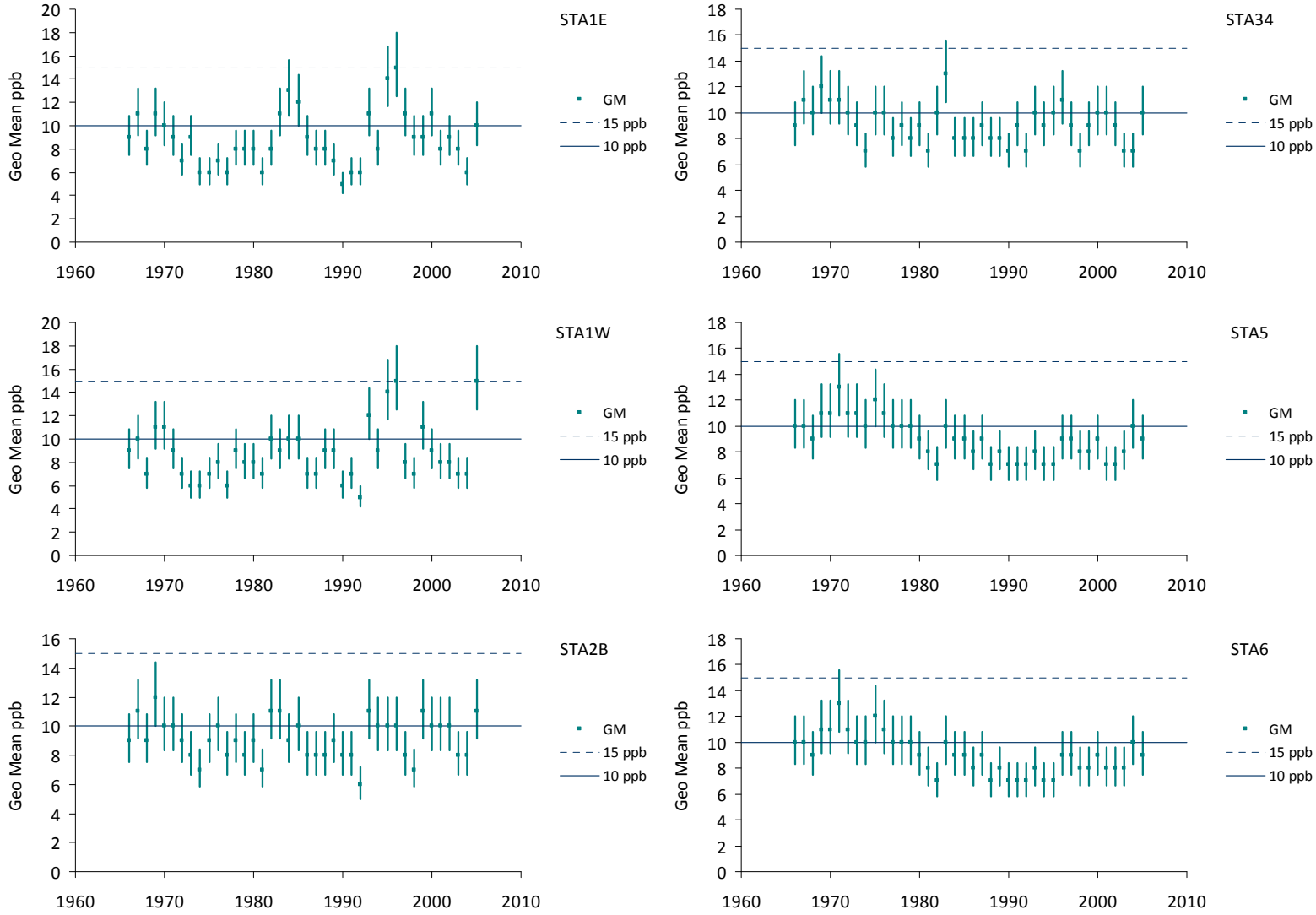
80% Confidence Intervals for Yearly Geometric Means



Model Predictions +/- 20%; Yearly Geo Mean = FWM / 1.23. Solid Line = 10 ppb criterion. Dotted Line = 15 ppb limit for marsh sites in 4-Part Test

Scenario 3 A- STA Expansion

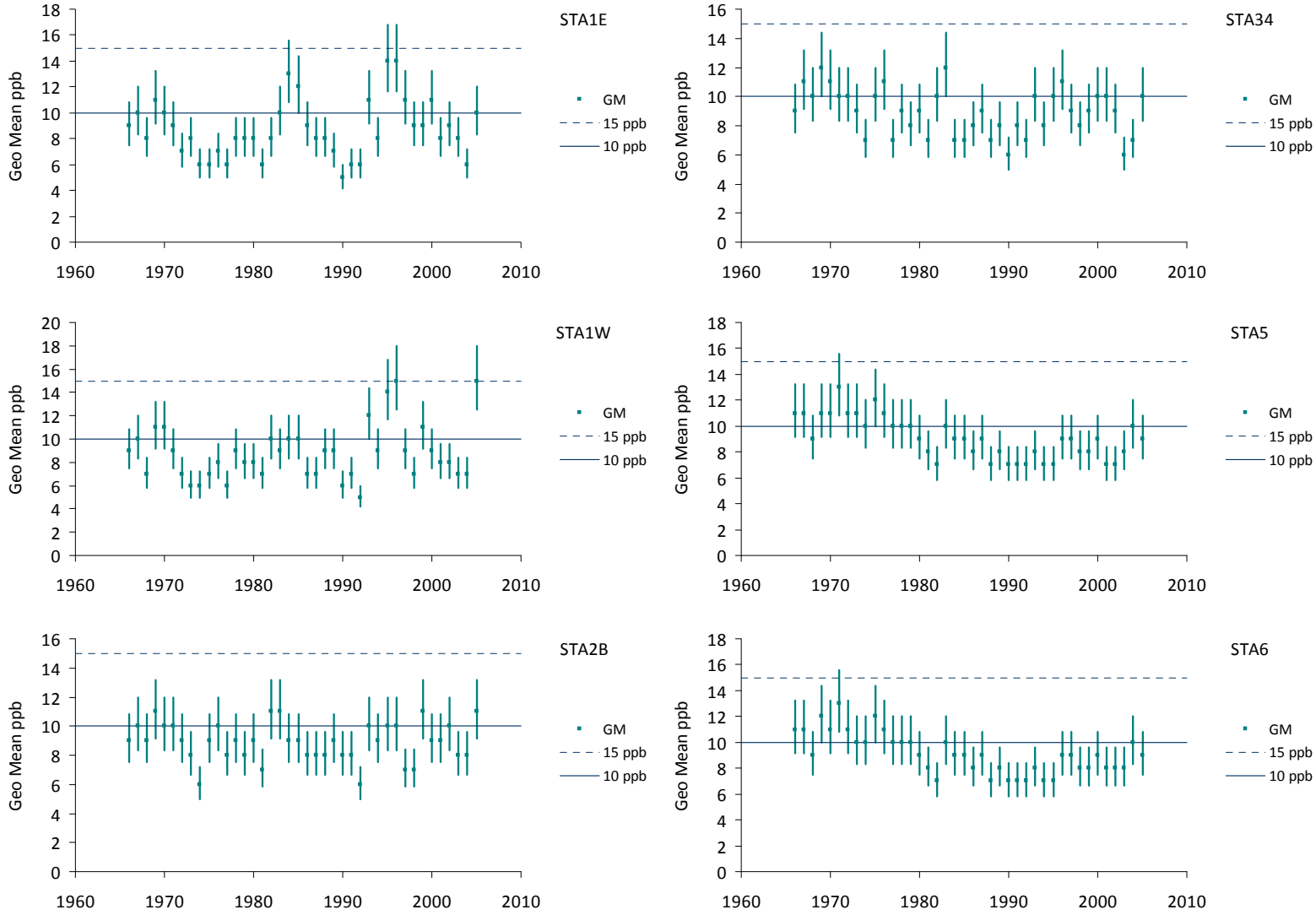
80% Confidence Intervals for Yearly Geometric Means



Model Predictions +/- 20%; Yearly Geo Mean = FWM / 1.23. Solid Line = 10 ppb criterion. Dotted Line = 15 ppb limit for marsh sites in 4-Part Test

Scenario 4 B- STA Expansion with A2 FEB

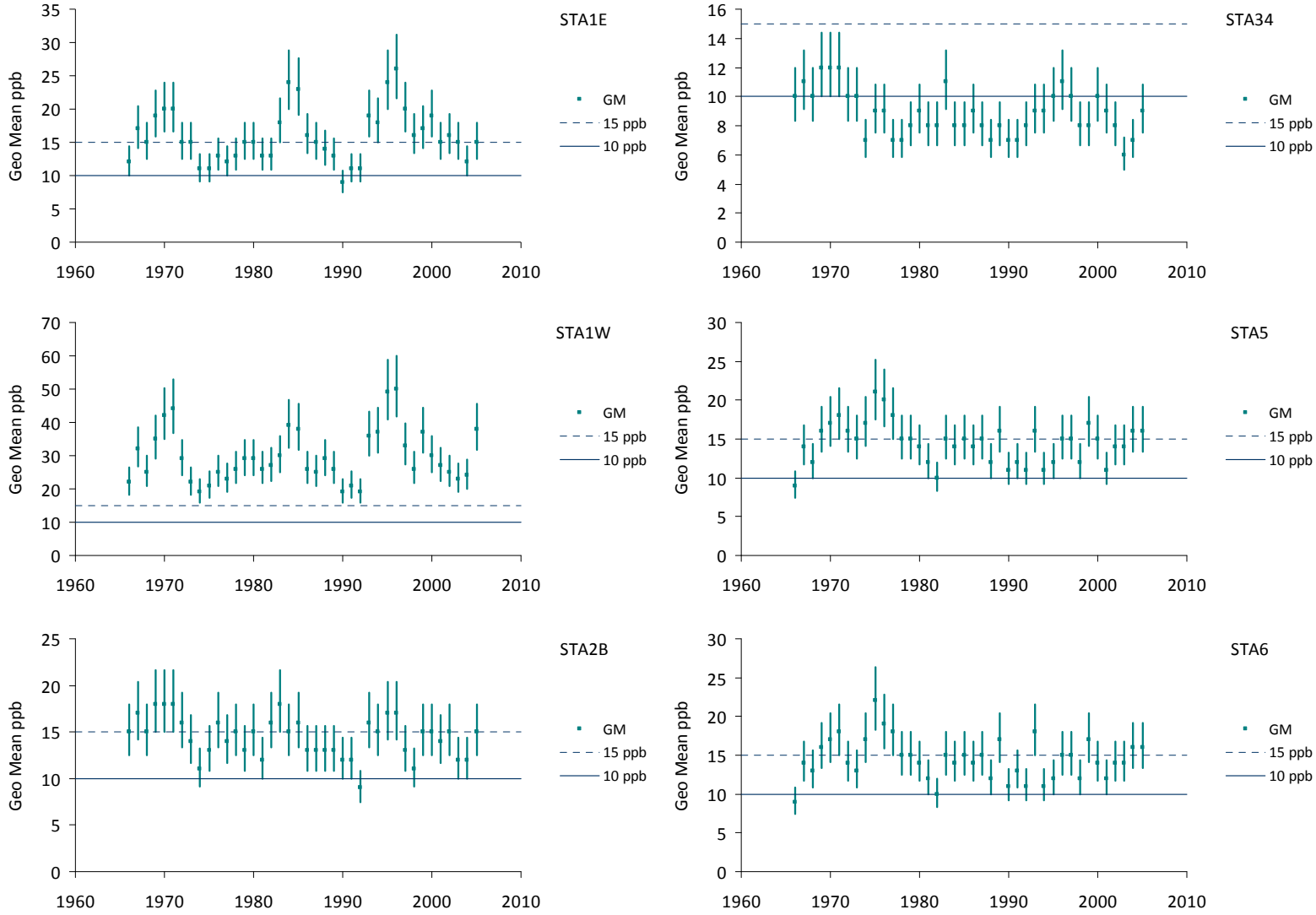
80% Confidence Intervals for Yearly Geometric Means



Model Predictions +/- 20%; Yearly Geo Mean = FWM / 1.23. Solid Line = 10 ppb criterion. Dotted Line = 15 ppb limit for marsh sites in 4-Part Test

Scenario 5 A/B - Interim Plan without C51E Div/FEB

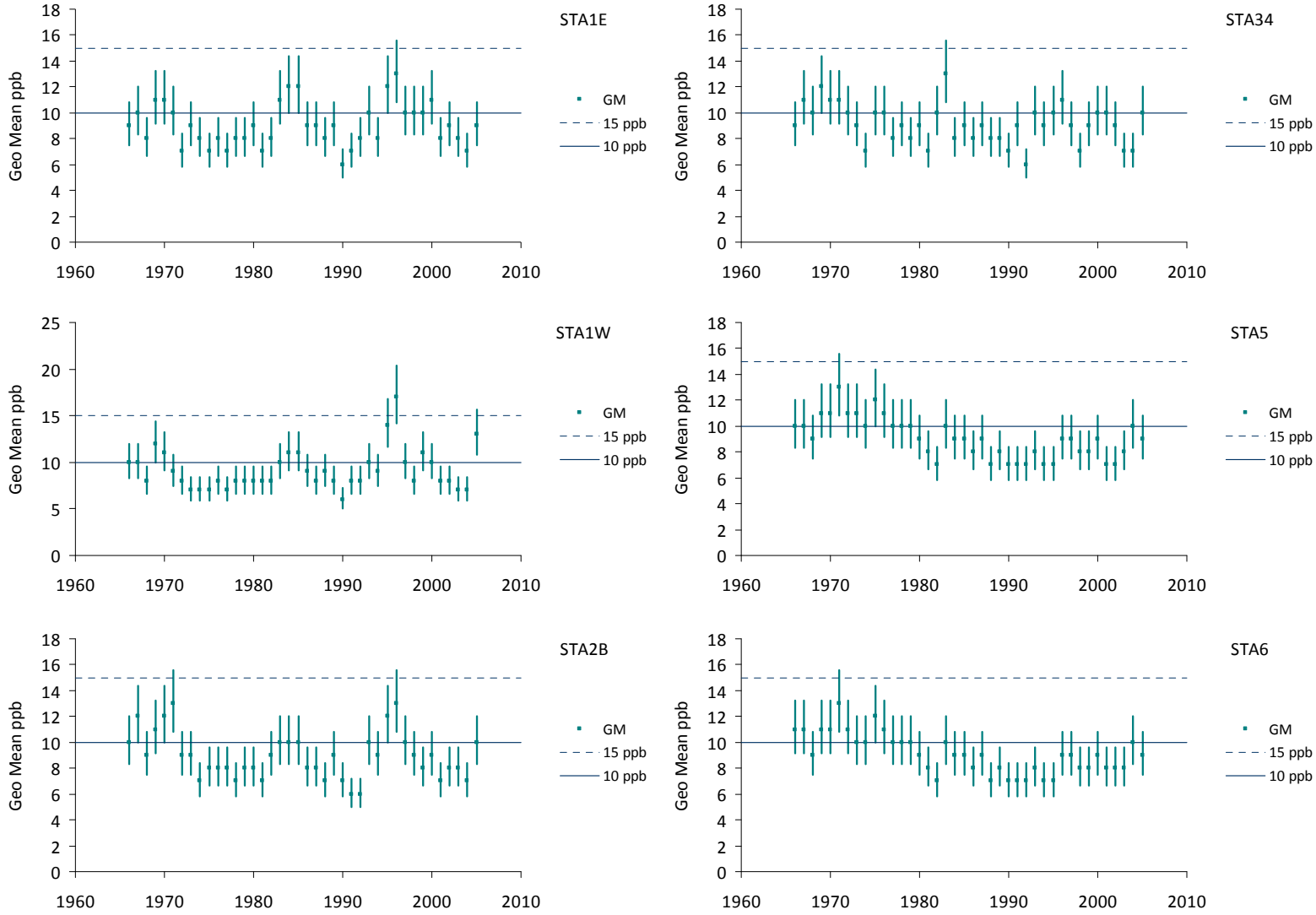
80% Confidence Intervals for Yearly Geometric Means



Model Predictions +/- 20%; Yearly Geo Mean = FWM / 1.23. Solid Line = 10 ppb criterion. Dotted Line = 15 ppb limit for marsh sites in 4-Part Test

Scenario 6 C - C51E Div/FEB, STA Expan

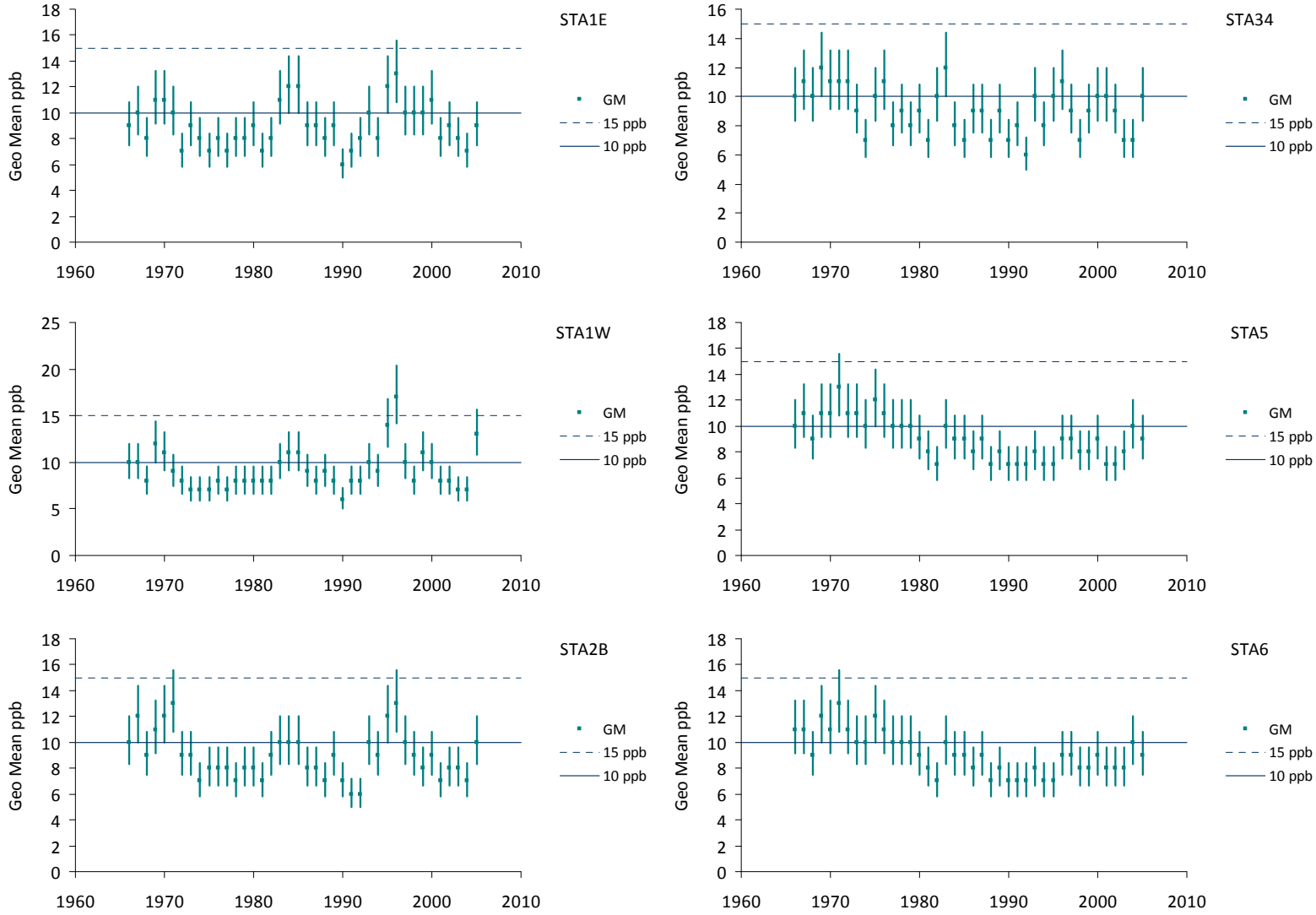
80% Confidence Intervals for Yearly Geometric Means



Model Predictions +/- 20%; Yearly Geo Mean = FWM / 1.23. Solid Line = 10 ppb criterion. Dotted Line = 15 ppb limit for marsh sites in 4-Part Test

Scenario 7 D -C51E Div/FEB, A2 FEB/ STA

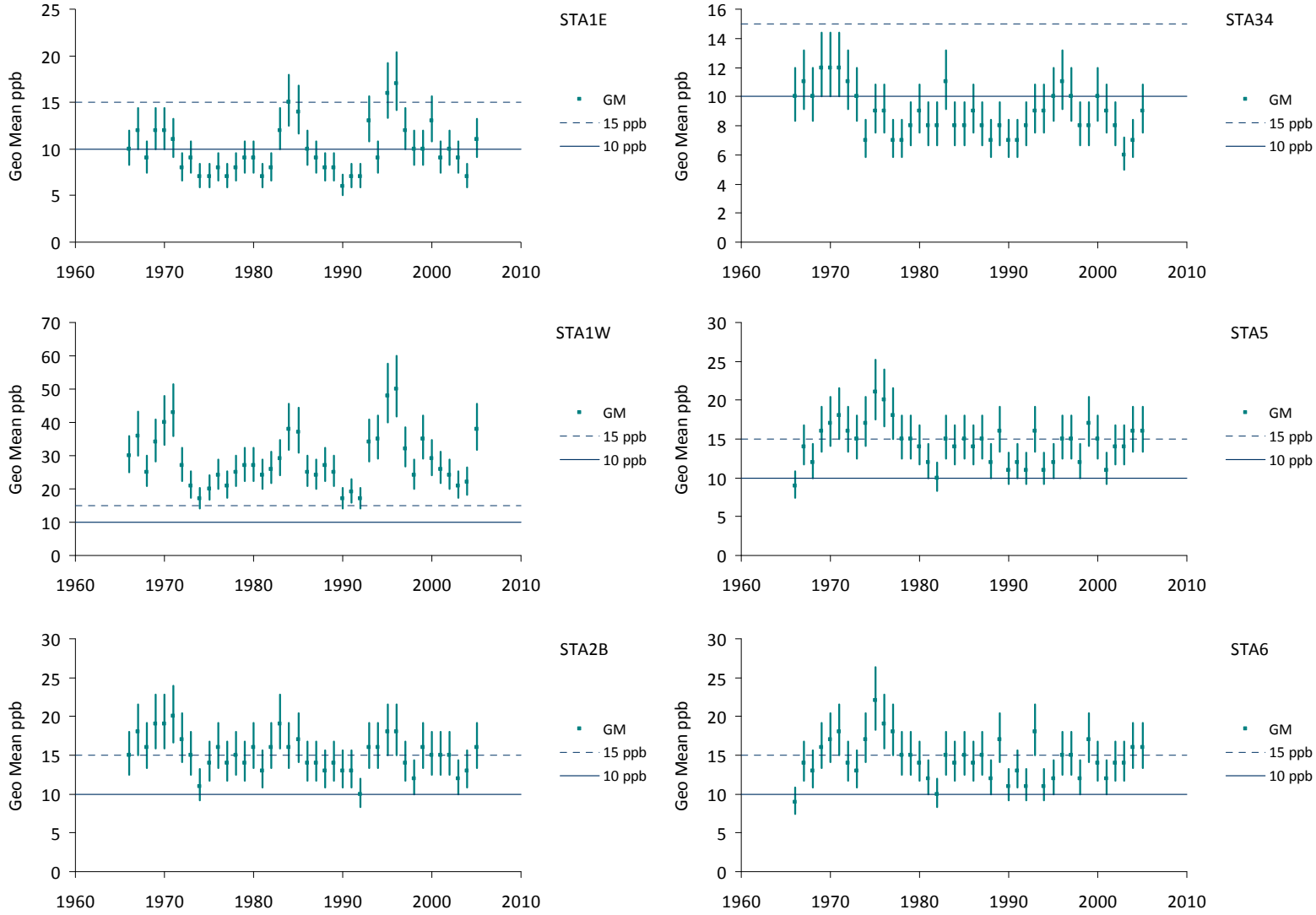
80% Confidence Intervals for Yearly Geometric Means



Model Predictions +/- 20%; Yearly Geo Mean = FWM / 1.23. Solid Line = 10 ppb criterion. Dotted Line = 15 ppb limit for marsh sites in 4-Part Test

Scenario 8 C/D - Interim Plan with C51E Div/FEB

80% Confidence Intervals for Yearly Geometric Means



Model Predictions +/- 20%; Yearly Geo Mean = FWM / 1.23. Solid Line = 10 ppb criterion. Dotted Line = 15 ppb limit for marsh sites in 4-Part Test

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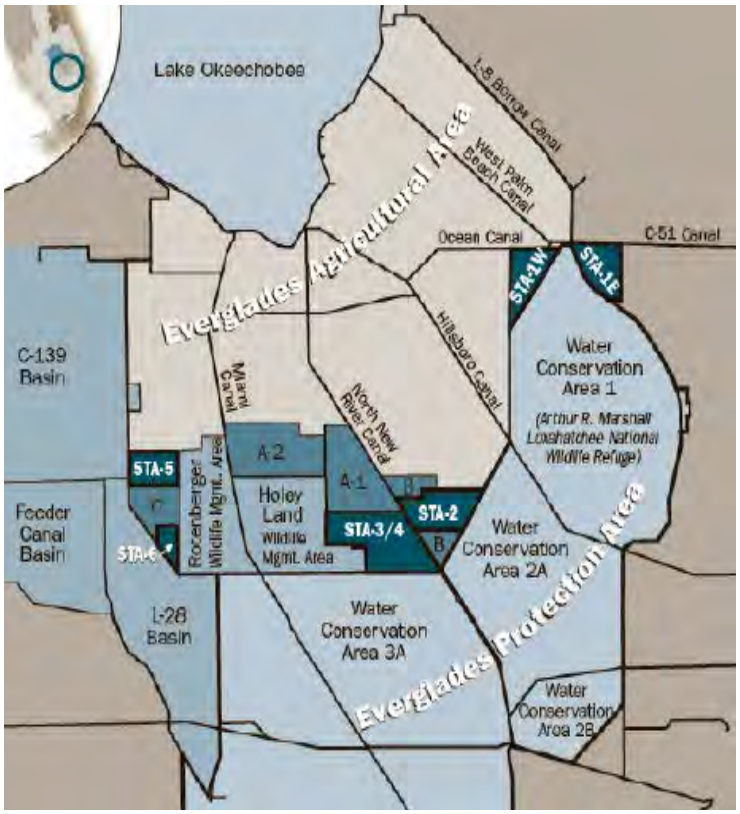
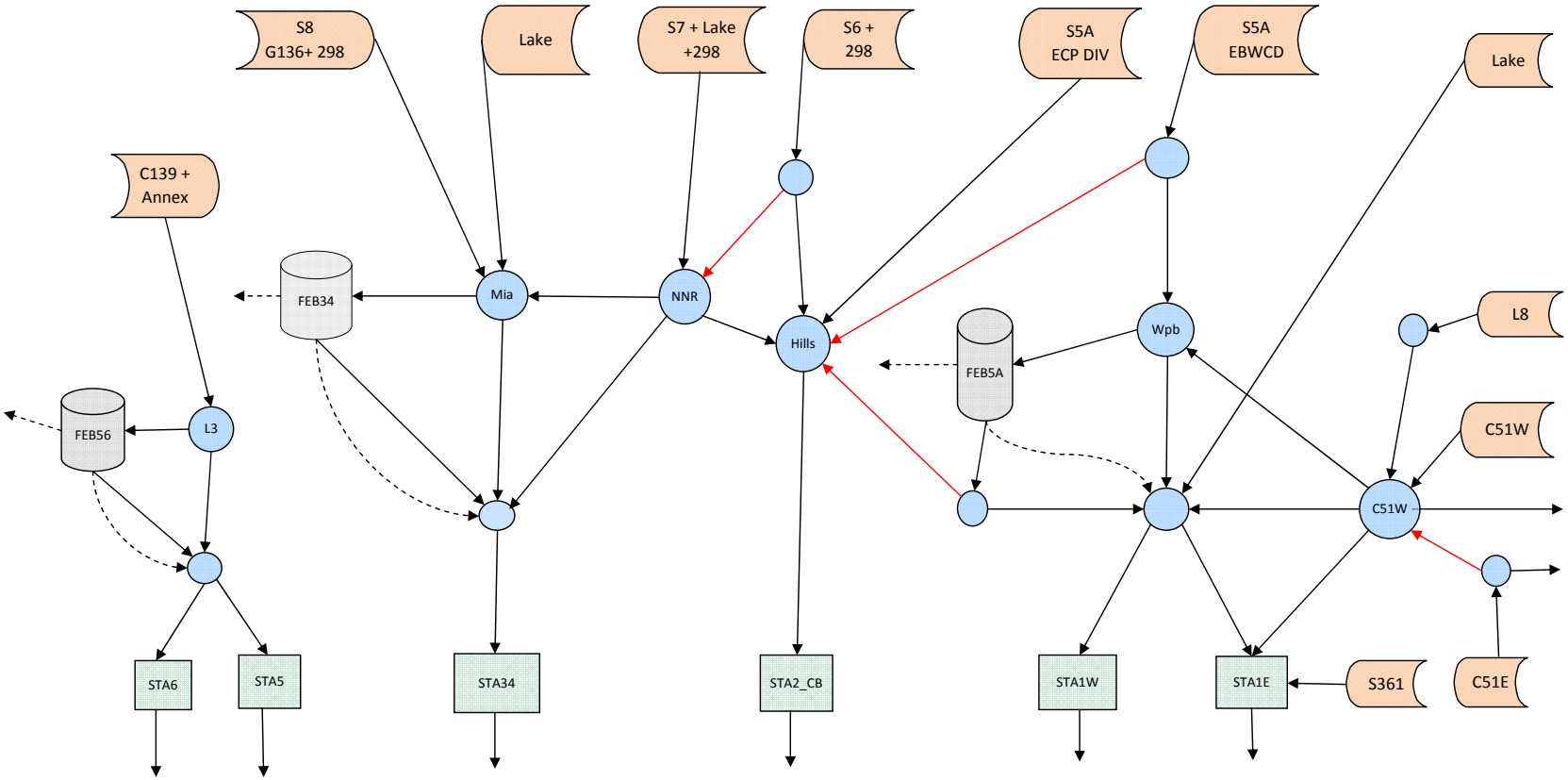
Attachment 3 : Scenario Flow Charts

Scenario	Description
0	Generalized Project Schematic
1	Existing STAs
2	Existing STAs + Compartments B & C
3	A- STA Expansion Only
4	B- STA Expansion with A1 STA & A2 FEB
5	A/B - Interim Plan with Temporary A1 FEB & Balance STA-34 Inflow
6	C - C51E Diversion /FEB, STA Expansion
7	D - C51E Diversion/FEB, A2 FEB+STA, A1 STA
8	C/D - Interim Plan with Temporary A1 FEB, Balance STA-34 Inflow, C51E Div/FEB



Generalized Flow Chart for WQBEL Scenarios



Flow Path

New Diversion

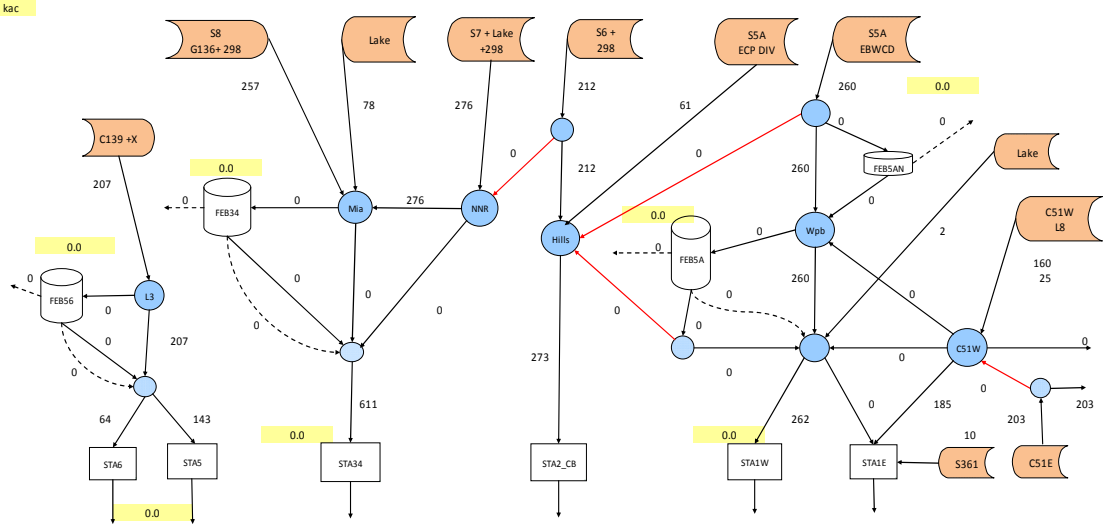
FEB Releases for STA Irrigation, Urban Water Supply (S5A), or Farm Irrigation (None Assumed)

Schematic reflects the general logic of the flow network, not specific locations of the project components

Expanded STA's are modeled as additional flow paths for STA-6, STA-34, and STA-1W.

Scenario: 1 Existing STAs Mean Flow kac-ft/yr

STA Expansion kac



							Totals
STA Outflow TP ppb	26.5	30.9	25.5	33.2	39.1	28.2	30.1
STA Expansion kac	0.0		0.0		0.0		0.0
STA Total Area kac	2.8	6.1	16.5	8.2	6.7	5.1	45.5
STA Outflow kacf/yr	48	125	601	275	263	185	1497
WCA Inflow kacft			774	275		448	1497

Inputs for Scenario EvenLess No Expansion or Source Control, Before Comp B & Comp C Operating

Diversion Rules

Diversion	Default	Diverted to	Fraction	Qmax	Description
C51E Diversion	C51W Canal	EAST	0	1000	
S5A Div (ECART)	S5A Div	HILLS_C	0	800	divert to hills
S5A Div (ECART)	S5A Div	HILLS_C	0	200	low-flow bypass to WPB
S5A Div to FEB	FEBS5A	FEBS5A_N	0		northern STA.FEB
FEB S5A Outflow	STA1DW	HILLS_C	0		diversion to Hills
C51W Outflow	EAST	STA1E	1		direct to STA1E
C51W Outflow	EAST	STA1_DW	1		direct to STA1DW
C51W Outflow	EAST	FEB_S5A	1		remainder to East
STA1W Distrib	STA1W	STA1E	0		WPB C STA1E
S6 Runoff	STA2CB	NNRC	0		S6 divert to NNR
NNR Canal	FEB34	STA34	0		NNR LowQ Bypass to STA34
STA56 Distrib	STA5	STA6	0.31		Balance STA56 Loads, Hint= 0.314

Mass Balance Summary EvenLess project_evenless.xls Run Date 9/1/10 19:58

	Inflows			Outflows					
STA	Area kac	Flow kac-ft	Load mt	Conc ppb	Flow kac-ft	Load mt	Conc ppb	HLR cm/d	HLR Max cm/d
STA1E	5.1	194	37.3	155	185	6.5	28.2	3.16	20.1
STA1W	6.7	262	68.0	210	263	12.7	39.1	3.28	20.6
STA2B	8.2	273	50.2	149	275	11.3	33.2	2.77	14.0
STA34	16.5	611	92.6	123	601	18.9	25.5	3.08	13.1
STA5	6.1	143	37.8	214	125	4.8	30.9	1.96	8.9
STA6	2.8	64	17.0	214	48	1.6	26.5	1.92	8.7
Total STA	45.5	1548	302.7	158	1497	55.7	30.1	2.84	

FEB Calculations	FEB_S5A	FEB_34	FEB_56	FEBS5A_N
DMSTA calibration	RES_3	RES_3	RES_3	RES_3
Area kac				
HRT days	60	30	30	30
Bypass Depth ft	44	8	4	4
LowQ Bypass cfs	100	100	100	200
Max Qin cfs	2000	4000	2000	1000
Max Qout cfs	1000	500	500	100
Control Depth ft	0.5	0.5	0.5	0.5
Min Release Depth ft	0.5	0.5	0.5	0.5

blank to ignore FEB

FEBs	Area kac	Flow kac-ft	Load mt	Conc ppb	Flow kac-ft	Load mt	Conc ppb	Depth cm Mean	Min
FEBS5A_N	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_S5A	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_34	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_56	0.0	0	0.0	108	0	0.0	#N/A	0	0
Total FEB	0.0	0	0.0	#N/A	0	0.0	#N/A		

Regulation Schedule	
STA WS Release	not implemented
Farm WS Release	not implemented
Farm Irrig kac	not implemented

Input Time Series	Flow kac-ft	Load mt	Conc ppb	Flow cfs	Flow CV -	Flow Max cfs
TS_FEBS5A_N	0.0	0.0	0	0	#N/A	0
TS_FEBS5A	259.5	67.7	211	358	1.87	5153
TS_STA1DW	2.3	0.3	103	3	9.50	666
TS_STA1W	0.0	0.0	0	0	#N/A	0
TS_STA1E	194.4	37.3	155	268	1.07	3318
TS_STA2B	273.2	50.2	149	377	1.94	3931
TS_FEB34	0.0	0.0	0	0	#N/A	0
TS_STA34	611.0	92.6	123	843	1.80	8891
TS_FEB56	207.1	54.8	214	286	1.20	4806
Total	1547.6	302.7	158	0	0.00	0

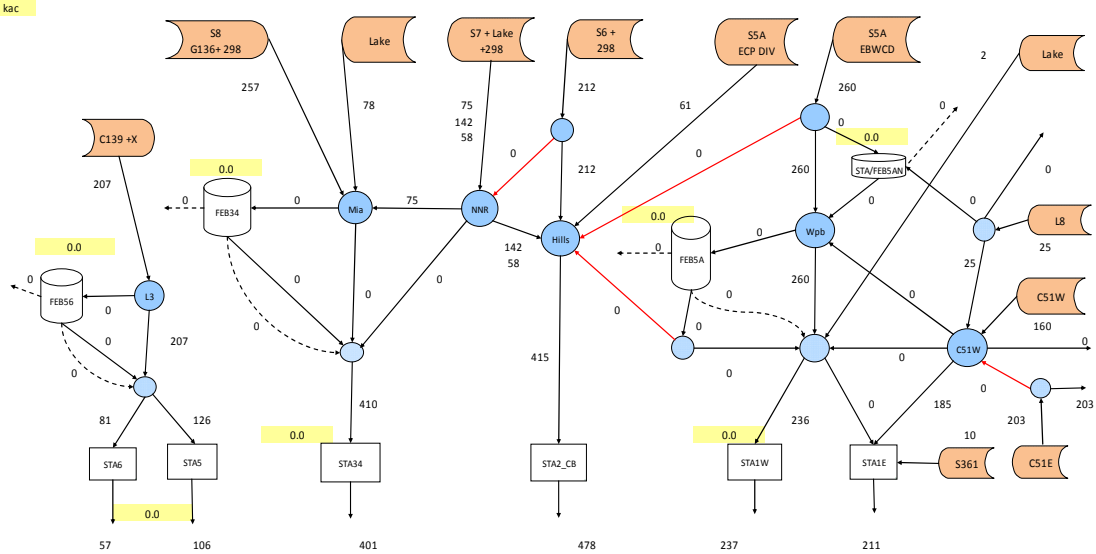
STA Expansion	STA1WX	STA34X	STA56X
Area kac			
Fraction SAV	0.67	0.67	0.4
Ehnanced	SAV_3	SAV_3	PEW_3

Base Period for Concs	1	1= 2005-2009,2 = 1995-2009		
Use Lake P Concs	TRUE	for S354 & S351	Lake Rleases	
C139 Load Reduc	0%	Max TP ppb	0	
STA Duty Cycle	0.95	New Lake Rel ka	0	
Target Conc ppb	12	Iterations	1	use iter=1 for testing, 2 for final
Output Interval Days	30	Other		
S5A Load Reduc	0%	Other		
Other		Other		

Watershed Areas	Land kac	Fraction	New STA kac	FEB kac	Runoff Rescale
Scale_s5A	133	1	0.0	0.0	1.00
Scale_S6	105	1			1.00
Scale_s7	120	1	0.0	0.0	1.00
Scale_s8	120	0			1.00
Scale_Annex	18	1	0.0	0.0	1.00

Scenario: 2 Existing STAs + Compartments B & C Mean Flow kac-ft/yr

STA Expansion kac



							Totals
STA Outflow TP ppb	18.3	18.3	15.7	20.3	34.1	34.0	23.0
STA Expansion kac	0.0		0.0		0.0		0.0
STA Total Area kac	5.1	7.9	16.5	15.1	6.7	5.1	56.5
STA Outflow kacf/yr	57	106	401	478	237	211	1490
WCA Inflow kacft			564	478		448	1490

Inputs for Scenario Nothing Existing Treatment Capacity; Comp B & Comp C Complete

Diversion Rules

Diversion	Default	Diverted to	Fraction	Qmax	Description
C51E Diversion	C51W Canal	EAST	0		
S5A Div (ECART)	S5A Div	HILLS_C	0		divert to hills up to qmax
S5A Div (ECART)	S5A Div	HILLS_C	0		low-flow bypass to WPB
S5A Div to FEB North	FEBS5A	FEBS5A_N	0		northern STA.FEB
FEB S5A Outflow	HILLS_C	STA1DW	0		diversion to Hills
C51W Outflow	EAST	STA1E	1		direct to STA1E
C51W Outflow	EAST	STA1_DW	0		direct to STA1DW
C51W Outflow	EAST	FEB_S5A	0		remainder to East
STA1W Distrib	STA1W	STA1E	0.1		WPB C STA1E
S6 Runoff	STA2CB	NNRC	0		S6 divert to NNR
NNR Canal	FEB34	STA34	0		NNR LowQ Bypass to STA34
STA56 Distrib	STA5	STA6	0.39		Balance STA56 Loads, Hint=
L8 to STA1N	C51W	FEBS5A_N	0		To FEB S5AN (Rest to C51W)
L8 to North	C51W	North	0		CERP
NNR to CB	STA34	Comp B	1		Original Design for Comp B =1
NNR to CB 2	STA34	Comp B	0.48		Additional NNR Diversion to CB

Mass Balance Summary Nothing project_nothing.xls Run Date 9/1/10 19:32

	Inflows			Outflows					
	Area	Flow	Load	Conc	Flow	Load	Conc	HLR	HLR Ma
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d
STA1E	5.1	221	44.1	162	211	8.8	34.0	3.59	20.8
STA1W	6.7	236	61.2	210	237	10.0	34.1	2.95	18.6
STA2B	15.1	474	79.9	137	478	12.0	20.3	2.61	13.0
STA34	16.5	410	62.8	124	401	7.8	15.7	2.07	8.5
STA5	7.9	126	33.4	214	106	2.4	18.3	1.34	6.1
STA6	5.1	81	21.4	214	57	1.3	18.3	1.32	6.0
Total STA	56.5	1548	302.7	158	1490	42.3	23.0	2.29	
				STA1W+E	448.0	18.8	34.1		
0.394				STA2+34+B	879.3	19.8	18.2		
				STA5+6	163.1	3.7	18.3		

FEB Calculations	FEB_S5A	FEB_34	FEB_56	FEBS5A_N
DMSTA calibration	RES_3	RES_3	RES_3	EMG_3
Area kac				
HRT days	14	14	30	30
Bypass Depth ft	26.4	4	12	4
LowQ Bypass cfs	200	400	50	100
Max Qin cfs	2000	2775	2500	2000
Max Qout cfs	1000	1000	500	500
Control Depth ft	0.5	0.5	0.5	0.5
Min Release Depth ft	0.5	0.5	0.5	0.5
Regulation Schedule	FEB_REG	FEB_REG	FEB_REG	
STA WS Release	REL_STA	REL_STA	REL_STA	
Farm WS Release				REL_FARM
Frac Irrig Demand	0.5			0.25
Frac C51 Urban WS	1			
STA Expansion	STA1WX	STA34X	STA56X	
Area kac	0	0	0	
Fraction SAV	0.67	0.67	0.4	
Ehnanced	SAV_3	SAV_3	PEW_3	

FEBs	Area kac	Flow kac-ft	Load mt	Conc ppb	Flow kac-ft	Load mt	Conc ppb	Depth cm Mean	Min
FEBS5A_N	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_S5A	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_34	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_56	0.0	0	0.0	68	0	0.0	#N/A	0	0
Total FEB	0.0	0	0.0	#N/A	0	0.0	#N/A		

Optional:
See FEB_Design Sheet
See input series sheet
""

Input Time Series	Flow kac-ft	Load mt	Conc ppb	Flow cfs	Flow CV -	Flow Max cfs
TS_FEBS5A_N	0.0	0.0	0	0	#N/A	0
TS_FEBS5A	259.5	67.7	211	358	1.87	5153
TS_STA1DW	2.3	0.3	103	3	9.50	666
TS_STA1W	0.0	0.0	0	0	#N/A	0
TS_STA1E	194.4	37.3	155	268	1.07	3318
TS_STA2B	473.7	79.9	137	654	2.02	6863
TS_FEB34	0.0	0.0	0	0	#N/A	0
TS_STA34	410.5	62.8	124	567	1.75	5959
TS_FEB56	207.1	54.8	214	286	1.20	4806
Total	1547.6	302.7	158	0	0.00	0

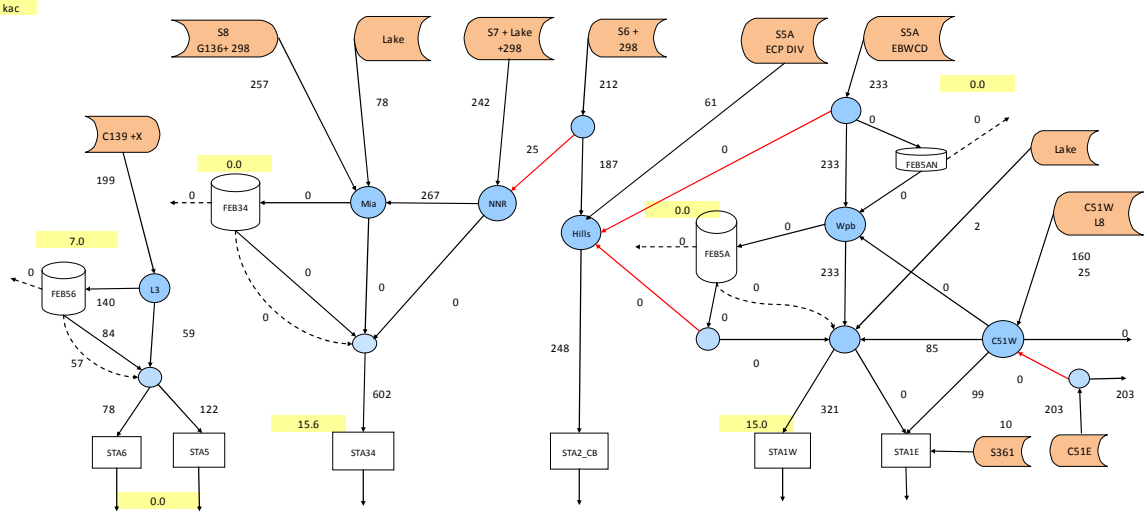
Base Period for Concs	1	1= 2005-2009,2 = 1995-2009	
Use Lake P Concs	TRUE	for S354 & S351	Lake Rleases
C139 Load Reduc	0%	Max TP ppb	0
STA Duty Cycle	0.95	New Lake Rel ka	0
Target Conc ppb	11.5	Iterations	1
Output Interval	30	S5A/C51 Cmax	0
S5A Load Reduc	0%	S678 Cmax	0
Other		C139 Cmax	0

use iter=1 for testing, 2 for final

Watershed Areas	Land kac	Fraction	New STA kac	FEB kac	Runoff Rescale
Scale_s5A	133	1	0.0	0.0	1.00
Scale_S6	105	1			1.00
Scale_s7	120	1	0.0	0.0	1.00
Scale_s8	120	0			1.00
Scale_Annex	18	1	0.0	0.0	1.00

Scenario: 3 A- STA Expansion Only Mean Flow kac-ft/yr

STA Expansion kac



							Totals
STA Outflow TP ppb	11.5	11.4	11.5	11.5	11.3	11.6	11.5
STA Expansion kac	0.0		15.6		15.0		30.6
STA Total Area kac	5.1	7.9	32.1	15.1	21.7	5.1	87.1
STA Outflow kacf/yr	50	101	583	253	327	102	1416
WCA Inflow kacft			734	253	429		1416

Inputs for Scenario Base_11_5 11.5 ppb Designs, 12 ft FEB in WB, STA Expansion in Other Basins

Diversion Rules

Diversion	Default	Diverted to	Fraction	Qmax	Description
C51E Diversion	C51W Canal	EAST	0	1000	
S5A Div (ECART)	S5A Div	HILLS_C	0	800	divert to hills
S5A Div (ECART)	S5A Div	HILLS_C	0	200	low-flow bypass to WPB
S5A Div to FEB	FEBS5A	FEBS5A_N	0		northern STA.FEB
FEB S5A Outflow	STA1DW	HILLS_C	0		diversion to Hills
C51W Outflow	EAST	STA1E	0.56	600	direct to STA1E
C51W Outflow	EAST	STA1_DW	1		direct to STA1DW
C51W Outflow	EAST	FEB_S5A	1		remainder to East
STA1W Distrib	STA1W	STA1E	0		WPB C STA1E
S6 Runoff	STA2CB	NNRC	0.12		S6 divert to NNR
NNR Canal	FEB34	STA34	0	100	NNR LowQ Bypass to STA34
STA56 Distrib	STA5	STA6	0.39		Balance STA56 Loads, Hint= 0.394

Mass Balance Summary Base_11_5 project_base_11_5.xls Run Date 9/1/10 21:42

	Inflows				Outflows				
	Area	Flow	Load	Conc	Flow	Load	Conc	HLR	HLR Max
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d
STA1E	5.1	109	20.4	152	102	1.5	11.6	1.77	7.1
STA1W	21.7	321	78.9	199	327	4.6	11.3	1.24	7.0
STA2B	15.1	248	46.1	151	253	3.6	11.5	1.37	6.9
STA34	32.1	602	91.6	123	583	8.3	11.5	1.56	6.6
STA5	7.9	122	24.3	161	101	1.4	11.4	1.29	3.7
STA6	5.1	78	15.5	161	50	0.7	11.5	1.27	3.7
Total STA	87.1	1479	276.7	152	1416	20.0	11.5	1.42	

FEB Calculations	FEB_S5A	FEB_34	FEB_56	FEBS5A_N
DMSTA calibration	RES_3	RES_3	RES_3	RES_3
Area kac			7	
HRT days	60	30	90	30
Bypass Depth ft	44	12	12	4
LowQ Bypass cfs	100	100	100	200
Max Qin cfs	2000	4000	2500	1000
Max Qout cfs	1000	500	500	100
Control Depth ft	0.5	0.5	0.5	0.5
Min Release Depth ft	0.5	0.5	0.5	0.5
Regulation Schedule			FEB_REG	
STA WS Release			REL_STA	
Farm WS Release				
Farm Irrig kac				

not implemented		
not implemented		
not implemented		
not implemented		

	Treated Inflow				Outflows				
	Area	Flow	Load	Conc	Flow	Load	Conc	Depth cm	
FEBs	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	Mean	Min
FEBS5A_N	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_S5A	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_34	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_56	7.0	140	39.9	231	84	15.6	151	155	1
Total FEB	0.0	0	0.0	#N/A	0	0.0	#N/A		

Input Time Series	Flow	Load	Conc	Flow	Flow CV	Flow Max
	kac-ft	mt	ppb	cfs	-	cfs
TS_FEBS5A_N	0.0	0.0	0	0	#N/A	0
TS_FEBS5A	233.0	61.7	214	322	1.87	4621
TS_STA1DW	87.8	17.2	158	121	1.38	2679
TS_STA1W	0.0	0.0	0	0	#N/A	0
TS_STA1E	108.9	20.4	152	150	0.89	644
TS_STA2B	247.7	46.1	151	342	1.93	3531
TS_FEB34	0.0	0.0	0	0	#N/A	0
TS_STA34	602.3	91.6	123	831	1.79	8698
TS_FEB56	198.8	53.8	219	274	1.20	4647
Total	1478.5	290.7	159	0	0.00	0

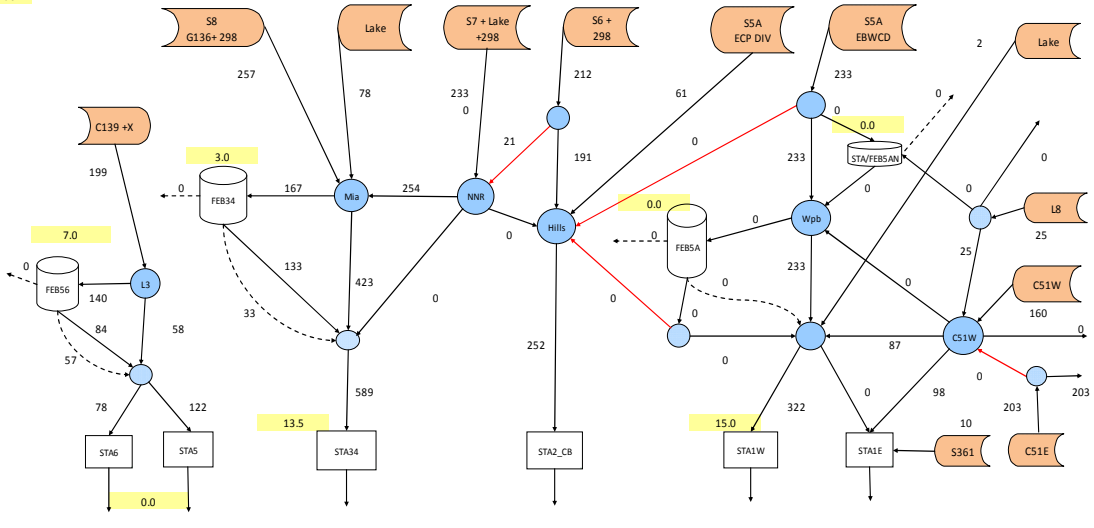
STA Expansion	STA1WX	STA34X	STA56X
Area kac	15	15.6	0
Fraction SAV	0.67	0.67	0.4
Ehnanced	SAV_3	SAV_3	PEW_3

Base Period for Concs	1	1= 2005-2009,2 = 1995-2009		
Use Lake P Concs	TRUE	for S354 & S351 Lake Rleases		
C139 Load Reduc	0%	Max TP ppb	0	
STA Duty Cycle	0.95	New Lake Rel ka	0	
Target Conc ppb	11.5	Iterations	1	use iter=1 for testing, 2 for final
Output Interval Days	30	Other		
S5A Load Reduc	0%	Other		
Other		Other		

Watershed Areas	Land kac	Fraction	New STA kac	FEB kac	Runoff Rescale
Scale_s5A	133	1	15.0	0.0	0.89
Scale_S6	105	1			1.00
Scale_s7	120	1	15.6	0.0	0.87
Scale_s8	120	0			1.00
Scale_Annex	18	1	0.0	7.0	0.61

Scenario: 4 B- STA Expansion with A1 STA & A2 FEB Mean Flow kac-ft/yr

STA Expansion kac



																								Totals
STA Outflow TP ppb			11.5		11.4				11.3				11.3				11.4				11.4			11.4
STA Expansion kac			0.0						13.5								15.0							28.5
STA Total Area kac			5.1		7.9				30.0				15.1				21.7				5.1			85.0
STA Outflow kacf/yr			50		101				570				258				328				100			1408
WCA Inflow kacft								721					258						429					1408

Inputs for Scenario Base_A1_RES_2 STA in A1, 8-ft FEB in A2,. 12-ft FEB in C139

Diversion Rules

Diversion	Default	Diverted to	Fraction	Qmax	Description
C51E Diversion	C51W Canal	EAST	0	1000	
S5A Div (ECART)	S5A Div	HILLS_C	0		divert to hills up to qmax
S5A Div (ECART)	S5A Div	HILLS_C	0		low-flow bypass to WPB
S5A Div to FEB North	FEBS5A	FEBS5A_N	0		northern STA.FEB
FEB S5A Outflow	HILLS_C	STA1DW	0		diversion to Hills
C51W Outflow	EAST	STA1E	0.55	600	direct to STA1E
C51W Outflow	EAST	STA1_DW	1		direct to STA1DW
C51W Outflow	EAST	FEB_S5A	0		remainder to East
STA1W Distrib	STA1W	STA1E	0		WPB C STA1E
S6 Runoff	STA2CB	NNRC	0.1		S6 divert to NNR
NNR Canal	FEB34	STA34	0		NNR LowQ Bypass to STA34
STA56 Distrib	STA5	STA6	0.39		Balance STA56 Loads, Hint=
L8 to STA1N	C51W	FEBS5A_N	0		To FEB S5AN (Rest to C51W)
L8 to North	C51W	North	0		CERP
NNR to CB	STA34	Comp B	0		Original Design for Comp B =1
NNR to CB 2	STA34	Comp B	0		Additional NNR Diversion to CB

Mass Balance Summary Base_A1_RES_;project_base_a1_res_2.xls Run Date 9/1/10 20:21

STA	Inflows Area kac	Inflows Flow kac-ft	Inflows Load mt	Inflows Conc ppb	Outflows Flow kac-ft	Outflows Load mt	Outflows Conc ppb	HLR cm/d	HLR M cm/c
STA1E	5.1	107	20.1	152	100	1.4	11.4	1.74	7.1
STA1W	21.7	322	79.2	199	328	4.6	11.4	1.24	7.0
STA2B	15.1	252	46.8	150	258	3.6	11.3	1.39	7.0
STA34	30.0	589	85.5	118	570	8.0	11.3	1.64	7.0
STA5	7.9	122	24.3	162	101	1.4	11.4	1.29	3.7
STA6	5.1	78	15.5	162	50	0.7	11.5	1.27	3.7
Total STA	85.0	1470	271.3	149	1408	19.7	11.4	1.44	
				STA1W+E	428.8	6.0	11.4		
0.394				STA2+34+B	828.0	11.6	11.3		
				STA5+6	150.9	2.1	11.5		

Other

FEB Calculations	FEB_S5A	FEB_34	FEB_56	FEBS5A_N
DMSTA calibration	RES_3	RES_3	RES_3	EMG_3
Area kac		3	7	
HRT days	30	30	90	30
Bypass Depth ft	44	8	12	4
LowQ Bypass cfs	200	400	100	100
Max Qin cfs	2000	3000	2500	2000
Max Qout cfs	1000	1000	500	500
Control Depth ft	0.5	0.5	0.5	0.5
Min Release Depth ft	0.5	0.5	0.5	0.5
Regulation Schedule	FEB_REG	FEB_REG	FEB_REG	
STA WS Release	REL_STA	REL_STA	REL_STA	
Farm WS Release	REL_URB+FARM			REL_FARM
Frac Irrig Demand	0.5			0.25
Frac C51 Urban WS	1			
STA Expansion	STA1WX	STA34X	STA56X	
Area kac	15	13.5	0	
Fraction SAV	0.67	0.67	0.4	
Ehnanced	SAV_3	SAV_3	PEW_3	

FEBs	Treated Inflow Area kac	Treated Inflow Flow kac-ft	Treated Inflow Load mt	Treated Inflow Conc ppb	Outflows Flow kac-ft	Outflows Load mt	Outflows Conc ppb	Depth cm Mean	Depth cm Min
FEBS5A_N	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_S5A	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_34	3.0	167	24.8	121	133	16.4	100	165	2
FEB_56	7.0	140	40.0	231	84	15.7	151	155	1
Total FEB	3.0	167	24.8	121	133	16.4	100		

Optional:

Base Period for Concs	1
Use Lake P Concs	TRUE
C139 Load Reduc	0%
STA Duty Cycle	0.95
Target Conc ppb	11.5
Output Interval	30
S5A Load Reduc	0%
Other	

1= 2005-2009,2 = 1995-2009
for S354 & S351 Lake Rleases

Max TP ppb	0	
New Lake Rel ka	0	
Iterations	1	use iter=1 for testing, 2 for final
S5A/C51 Cmax	0	
S678 Cmax	0	
C139 Cmax	0	

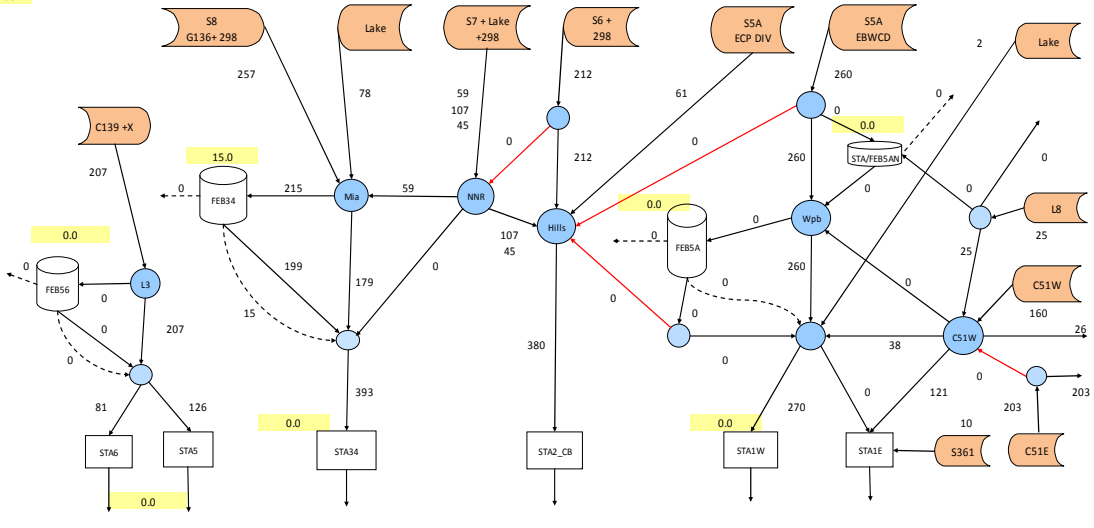
See FEB_Design Sheet	
See input series sheet	
""	

Input Time Series	Flow kac-ft	Load mt	Conc ppb	Flow cfs	Flow CV -	Flow Max cfs
TS_FEBS5A_N	0.0	0.0	0	0	#N/A	0
TS_FEBS5A	233.0	61.7	214	322	1.87	4621
TS_STA1DW	89.4	17.5	158	123	1.36	2679
TS_STA1W	0.0	0.0	0	0	#N/A	0
TS_STA1E	107.3	20.1	152	148	0.89	644
TS_STA2B	252.0	46.8	150	348	1.93	3598
TS_FEB34	589.5	89.6	123	814	1.79	8494
TS_STA34	0.0	0.0	0	0	#N/A	0
TS_FEB56	198.8	53.8	219	274	1.20	4647
Total	1470.0	289.4	159	0	0.00	0

Watershed Areas	Land kac	Fraction	New STA kac	FEB kac	Runoff Rescale
Scale_s5A	133	1	15.0	0.0	0.89
Scale_S6	105	1			1.00
Scale_s7	120	1	16.5	3.0	0.84
Scale_s8	120	0			1.00
Scale_Annex	18	1	0.0	7.0	0.61

Scenario: 5 A/B - Interim Plan with Temporary A1 FEB & Balance STA-34 Inflow Mean Flow kac-ft/yr

STA Expansion kac



							Totals
STA Outflow TP ppb	18.3	18.3	11.2	18.2	38.3	20.5	20.4
STA Expansion kac	0.0		0.0		0.0		0.0
STA Total Area kac	5.1	7.9	16.5	15.1	6.7	5.1	56.5
STA Outflow kacf/yr	57	106	383	429	270	152	1397
WCA Inflow kacft		546		429	422		1397

Inputs for Scenario Base_A1_FEB Interim Plan: A1 as FEB, No Additional STA in Central Basin

Diversion Rules

Diversion	Default	Diverted to	Fraction	Qmax	Description
C51E Diversion	C51W Canal	EAST	0	1000	
S5A Div (ECART)	S5A Div	HILLS_C	0		divert to hills up to qmax
S5A Div (ECART)	S5A Div	HILLS_C	0		low-flow bypass to WPB
S5A Div to FEB North	FEBS5A	FEBS5A_N	0		northern STA.FEB
FEB S5A Outflow	HILLS_C	STA1DW	0		diversion to Hills
C51W Outflow	EAST	STA1E	0.7	600	direct to STA1E
C51W Outflow	EAST	STA1_DW	0.6	1200	direct to STA1DW
C51W Outflow	EAST	FEB_S5A	0		remainder to East
STA1W Distrib	STA1W	STA1E	0.1		WPB C STA1E
S6 Runoff	STA2CB	NNRC	0		S6 divert to NNR
NNR Canal	FEB34	STA34	0		NNR LowQ Bypass to STA34
STA56 Distrib	STA5	STA6	0.39		Balance STA56 Loads, Hint=
L8 to STA1N	C51W	FEBS5A_N	0		To FEB S5AN (Rest to C51W)
L8 to North	C51W	North	0		CERP
NNR to CB	STA34	Comp B	1		Original Design for Comp B =1
NNR to CB 2	STA34	Comp B	0.49		Additional NNR Diversion to CB

Mass Balance Summary Base_A1_FEB project_base_a1_feb.xls Run Date 8/31/10 22:08

		Inflows			Outflows				
	Area	Flow	Load	Conc	Flow	Load	Conc	HLR	HLR Max
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d
STA1E	5.1	161	32.2	162	152	3.8	20.5	2.61	9.7
STA1W	6.7	270	68.0	204	270	12.8	38.3	3.38	20.6
STA2B	15.1	425	72.6	139	429	9.6	18.2	2.34	11.7
STA34	16.5	393	47.6	98	383	5.3	11.2	1.98	8.8
STA5	7.9	126	33.4	214	106	2.4	18.3	1.34	6.1
STA6	5.1	81	21.4	214	57	1.3	18.3	1.32	6.0
Total STA	56.5	1455	275.2	153	1397	35.2	20.4	2.15	
				STA1W+E	422.1	16.6	31.9		
0.394				STA2+34+B	812.3	14.9	14.9		
				STA5+6	163.1	3.7	18.3		

FEB Calculations	FEB_S5A	FEB_34	FEB_56	FEBS5A_N
DMSTA calibration	RES_3	RES_3	RES_3	EMG_3
Area kac		15	0	
HRT days	30	14	90	30
Bypass Depth ft	44	4	12	4
LowQ Bypass cfs	200	400	100	100
Max Qin cfs	2000	2775	2500	2000
Max Qout cfs	1000	1000	500	500
Control Depth ft	0.5	0.5	0.5	0.5
Min Release Depth ft	0.5	0.5	0.5	0.5
Regulation Schedule	FEB_REG	FEB_REG	FEB_REG	
STA WS Release	REL_STA	REL_STA	REL_STA	
Farm WS Release	REL_URB+FARM			REL_FARM
Frac Irrig Demand	0.5			0.25
Frac C51 Urban WS	1			
STA Expansion	STA1WX	STA34X	STA56X	
Area kac	0	0	0	
Fraction SAV	0.67	0.67	0.4	
Ehnanced	SAV_3	SAV_3	PEW_3	

Base Period for Concs	1	1= 2005-2009,2 = 1995-2009	
Use Lake P Concs	TRUE	for S354 & S351 Lake Rleases	
C139 Load Reduc	0%	Max TP ppb	0
STA Duty Cycle	0.95	New Lake Rel ka	0
Target Conc ppb	11.5	Iterations	1
Output Interval	30	S5A/C51 Cmax	0
S5A Load Reduc	0%	S678 Cmax	0
Other		C139 Cmax	0

use iter=1 for testing, 2 for final

	Treated Inflow				Outflows			
	Area	Flow	Load	Conc	Flow	Load	Conc	Depth cm
FEBs	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	Mean	Min
FEBS5A_N	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_S5A	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_34	15.0	215	29.6	112	199	15.7	64	44	1
FEB_56	0.0	0	0.0	108	0	0.0	#N/A	0	0
Total FEB	15.0	215	29.6	112	199	15.7	64		

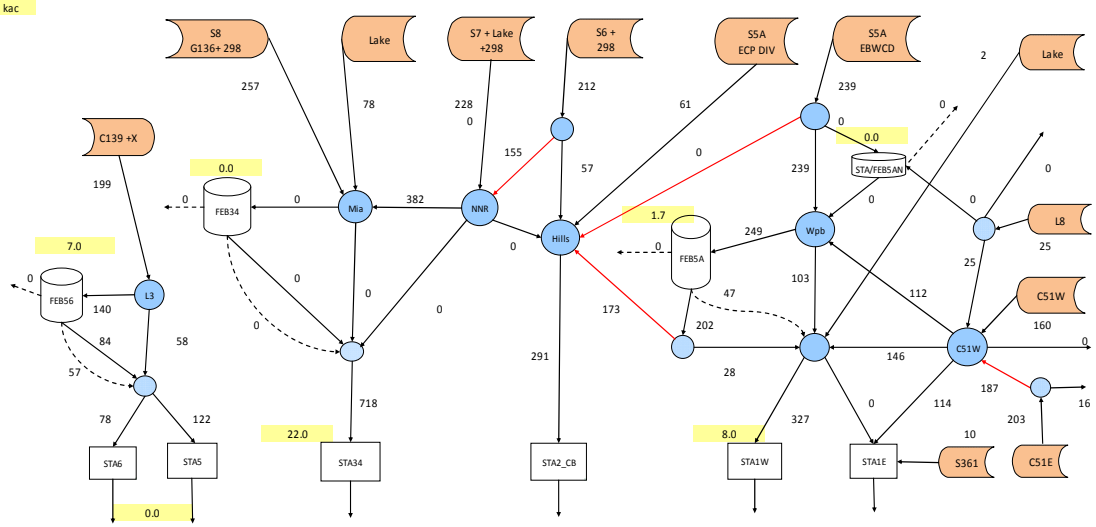
Optional:

See FEB_Design Sheet	Input Time Series	Flow	Load	Conc	Flow	Flow CV	Flow Max
See input series sheet		kac-ft	mt	ppb	cfs	-	cfs
""	TS_FEBS5A_N	0.0	0.0	0	0	#N/A	0
	TS_FEBS5A	259.5	67.7	211	358	1.87	5153
	TS_STA1DW	40.6	7.9	157	56	1.74	1200
	TS_STA1W	0.0	0.0	0	0	#N/A	0
	TS_STA1E	130.5	24.6	153	180	0.85	644
	TS_STA2B	424.6	72.6	139	586	2.00	6153
	TS_FEB34	393.8	60.4	124	544	1.73	5579
	TS_STA34	0.0	0.0	0	0	#N/A	0
	TS_FEB56	207.1	54.8	214	286	1.20	4806
	Total	1456.2	287.9	160	0	0.00	0

Watershed Areas	Land kac	Fraction	New STA kac	FEB kac	Runoff Rescale
Scale_s5A	133	1	0.0	0.0	1.00
Scale_S6	105	1			1.00
Scale_s7	120	1	15.0	15.0	0.75
Scale_s8	120	0			1.00
Scale_Annex	18	1	0.0	0.0	1.00

Scenario: 6 C - C51E Diversion /FEB, STA Expansion Mean Flow kac-ft/yr

STA Expansion kac



							Totals
STA Outflow TP ppb	11.5	11.4	11.5	11.5	11.5	11.5	11.5
STA Expansion kac	0.0		22.0		8.0		30.0
STA Total Area kac	5.1	7.9	38.5	15.1	14.7	5.1	86.5
STA Outflow kacf/yr	50	101	693	296	328	116	1584
WCA Inflow kacft			844	296		444	1584

Inputs for Scenario C51E_AA C51E Diversion, STA exp in CB, FEB in C139

Diversion Rules

Diversion	Default	Diverted to	Fraction	Qmax	Description
C51E Diversion	C51W Canal	EAST	1	1000	
S5A Div (ECART)	S5A Div	HILLS_C	0	300	divert to hills up to qmax
S5A Div (ECART)	S5A Div	HILLS_C	0	200	low-flow bypass to WPB
S5A Div to FEB North	FEBS5A	FEBS5A_N	0		northern STA.FEB
FEB S5A Outflow	HILLS_C	STA1DW	1	75	diversion to Hills
C51W Outflow	EAST	STA1E	0.31	600	direct to STA1E
C51W Outflow	EAST	STA1_DW	1	300	direct to STA1DW
C51W Outflow	EAST	FEB_S5A	1	0	remainder to East
STA1W Distrib	STA1W	STA1E	0		WPB C STA1E
S6 Runoff	STA2CB	NNRC	0.73		S6 divert to NNR
NNR Canal	FEB34	STA34	0		NNR LowQ Bypass to STA34
STA56 Distrib	STA5	STA6	0.39		Balance STA56 Loads, Hint=
L8 to STA1N	C51W	FEBS5A_N	0		To FEB S5AN (Rest to C51W)
L8 to North	C51W	North	0		CERP
NNR to CB	STA34	Comp B	0		Original Design for Comp B =1

Mass Balance Summary C51E_AA project_c51e_aa.xls Run Date 8/31/10 22:34

	Inflows			Outflows					
STA	Area kac	Flow kac-ft	Load mt	Conc ppb	Flow kac-ft	Load mt	Conc ppb	HLR cm/d	HLR M cm/d
STA1E	5.1	123	18.7	123	116	1.6	11.5	2.00	7.0
STA1W	14.7	327	63.2	157	328	4.7	11.5	1.86	8.6
STA2B	15.1	291	64.0	178	296	4.2	11.5	1.61	7.0
STA34	38.5	718	110.3	125	693	9.8	11.5	1.55	6.8
STA5	7.9	122	24.2	161	101	1.4	11.4	1.29	3.8
STA6	5.1	78	15.5	161	50	0.7	11.5	1.27	3.7
Total STA	86.5	1659	296.0	145	1584	22.5	11.5	1.60	
				STA1W+E	444.0	6.3	11.5		
0.394				STA2+34+B	989.4	14.0	11.5		
				STA5+6	150.9	2.1	11.4		

FEB Calculations	FEB_S5A	FEB_34	FEB_56	FEBS5A_N
DMSTA calibration	RES_3	RES_3	RES_3	EMG_3
Area kac	1.67		7	
HRT days	30	14	90	30
Bypass Depth ft	44	4	12	4
LowQ Bypass cfs	200	400	100	100
Max Qin cfs	2000	4000	2500	2000
Max Qout cfs	1000	1000	500	500
Control Depth ft	0.5	0.5	0.5	0.5
Min Release Depth ft	0.5	0.5	0.5	0.5
Regulation Schedule	FEB_REG	FEB_REG	FEB_REG	
STA WS Release	URB+STA+REF	REL_STA	REL_STA	
Farm WS Release				REL_FARM
Frac Irrig Demand	0.5			0.25
Frac C51 Urban WS	1			
STA Expansion	STA1WX	STA34X	STA56X	
Area kac	8	22	0	
Fraction SAV	0.67	0.67	0.4	
Ehnanced	SAV_3	SAV_3	PEW_3	
Base Period for Concs	1	1= 2005-2009,2 = 1995-2009		
Use Lake P Concs	TRUE	for S354 & S351 Lake Rleases		
C139 Load Reduc	0%	Max TP ppb	0	
STA Duty Cycle	0.95	New Lake Rel ka	0	
Target Conc ppb	11.5	Iterations	1	use iter=1 for testing, 2 for final
Output Interval	30	S5A/C51 Cmax	0	
S5A Load Reduc	0%	S678 Cmax	0	
Refuge Min Flow	500	C139 Cmax	0	See FEB_STA Sheet, Provision to direct more flow to refuge in dry years.

Optional:
See FEB_Design Sheet
See input series sheet
""

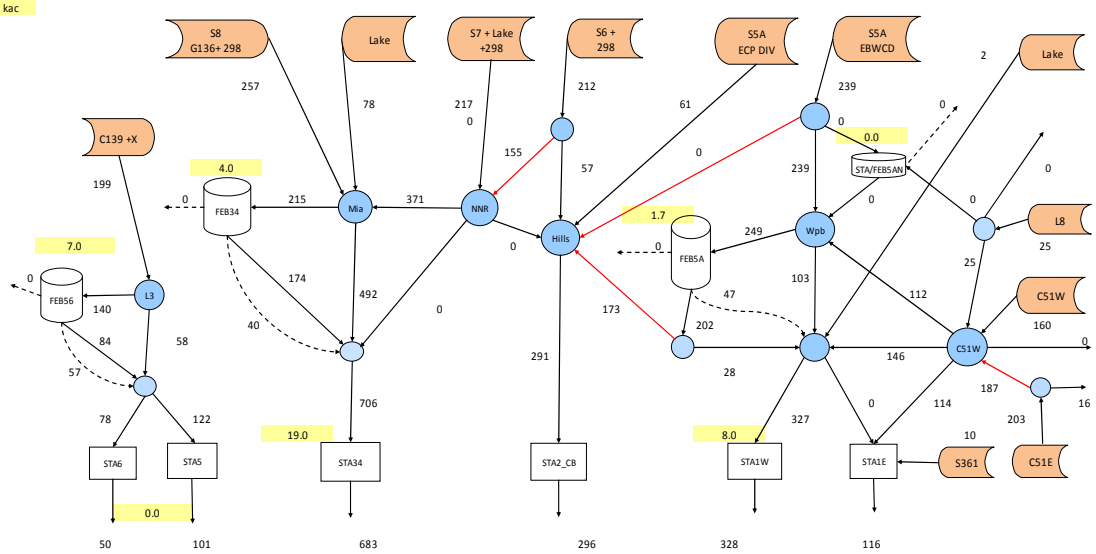
FEBs	Area kac	Flow kac-ft	Load mt	Conc ppb	Flow kac-ft	Load mt	Conc ppb	Depth cm Mean	Min
FEBS5A_N	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_S5A	1.7	249	57.7	188	202	45.1	181	561	1
FEB_34	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_56	7.0	140	40.0	231	84	15.7	151	153	1
Total FEB	1.7	249	57.7	188	202	45.1	181		

Input Time Series	Flow kac-ft	Load mt	Conc ppb	Flow cfs	Flow CV -	Flow Max cfs
TS_FEBS5A_N	0.0	0.0	0	0	#N/A	0
TS_FEBS5A	351.5	80.9	186	485	1.67	8130
TS_STA1DW	148.5	23.2	127	205	0.49	829
TS_STA1W	0.0	0.0	0	0	#N/A	0
TS_STA1E	123.3	18.7	123	170	0.88	644
TS_STA2B	118.3	25.2	173	163	1.80	1499
TS_FEB34	0.0	0.0	0	0	#N/A	0
TS_STA34	717.7	110.3	125	991	1.82	10491
TS_FEB56	198.8	53.8	219	274	1.20	4647
Total	1658.0	312.1	153	0	0.00	0

Watershed Areas	Land kac	Fraction	New STA kac	FEB kac	Runoff Rescale
Scale_s5A	133	1	9.7	1.7	0.91
Scale_S6	105	1			1.00
Scale_s7	120	1	22.0	0.0	0.82
Scale_s8	120	0			1.00
Scale_Annex	18	1	0.0	7.0	0.61

Scenario: 7 D - C51E Diversion/FEB, A2 FEB+STA, A1 STA Mean Flow kac-ft/yr

STA Expansion kac



							Totals
STA Outflow TP ppb	11.5	11.4	11.5	11.5	11.5	11.5	11.5
STA Expansion kac	0.0		19.0		8.0		27.0
STA Total Area kac	5.1	7.9	35.5	15.1	14.7	5.1	83.5
STA Outflow kacf/yr	50	101	683	296	328	116	1574
WCA Inflow kacft			834	296	444		1574

Inputs for Scenario C51E_A1_RES_3 C51E Div + FEB, A2 8 ft FEB + STA Exp, A1 STA, C139 12 ft FEB

Diversion Rules

Diversion	Default	Diverted to	Fraction	Qmax	Description
C51E Diversion	C51W Canal	EAST	1	1000	
S5A Div (ECART)	S5A Div	HILLS_C	0	300	divert to hills up to qmax
S5A Div (ECART)	S5A Div	HILLS_C	0	200	low-flow bypass to WPB
S5A Div to FEB North	FEBS5A	FEBS5A_N	0		northern STA.FEB
FEB S5A Outflow	HILLS_C	STA1DW	1	75	diversion to Hills
C51W Outflow	EAST	STA1E	0.31	600	direct to STA1E
C51W Outflow	EAST	STA1_DW	1	300	direct to STA1DW
C51W Outflow	EAST	FEB_S5A	1	0	remainder to East
STA1W Distrib	STA1W	STA1E	0		WPB C STA1E
S6 Runoff	STA2CB	NNRC	0.73		S6 divert to NNR
NNR Canal	FEB34	STA34	0		NNR LowQ Bypass to STA34
STA56 Distrib	STA5	STA6	0.39		Balance STA56 Loads, Hint=
L8 to STA1N	C51W	FEBS5A_N	0		To FEB S5AN (Rest to C51W)
L8 to North	C51W	North	0		CERP
NNR to CB	STA34	Comp B	0		Original Design for Comp B =1

Mass Balance Summary C51E_A1_RES_: project_c51e_a1_res_3.xls Run Date 9/1/10 21:15

	Inflows				Outflows				
	Area	Flow	Load	Conc	Flow	Load	Conc	HLR	HLR Ma
	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d
STA	0.394								
STA1W		327	63.2	157	328	4.7	11.5	1.86	8.6
STA2B		291	64.0	178	296	4.2	11.5	1.61	7.0
STA34		706	103.1	118	683	9.7	11.5	1.66	7.4
STA5		122	24.3	162	101	1.4	11.4	1.29	3.7
STA6		78	15.5	162	50	0.7	11.5	1.27	3.7
Total STA		1647	288.8	142	1574	22.4	11.5	1.65	
STA1W+E					444.0	6.3	11.5		
STA2+34+B					979.4	13.9	11.5		
STA5+6					150.9	2.1	11.5		

FEB Calculations	FEB_S5A	FEB_34	FEB_56	FEBS5A_N
DMSTA calibration	RES_3	RES_3	RES_3	EMG_3
Area kac	1.67	4	7	
HRT days	30	30	90	30
Bypass Depth ft	44	8	12	4
LowQ Bypass cfs	200	400	100	100
Max Qin cfs	2000	2500	2500	2000
Max Qout cfs	1000	1000	500	500
Control Depth ft	0.5	0.5	0.5	0.5
Min Release Depth ft	0.5	0.5	0.5	0.5
Regulation Schedule	FEB_REG	FEB_REG	FEB_REG	
STA WS Release	URB+STA+REF	REL_STA	REL_STA	
Farm WS Release				REL_FARM
Frac Irrig Demand	0.5			0.25
Frac C51 Urban WS	1			
STA Expansion	STA1WX	STA34X	STA56X	
Area kac	8	19	0	
Fraction SAV	0.67	0.67	0.4	
Ehnanced	SAV_3	SAV_3	PEW_3	

FEBs	Area kac	Flow kac-ft	Load mt	Conc ppb	Flow kac-ft	Load mt	Conc ppb	Depth cm Mean	Min
FEBS5A_N	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_S5A	1.7	249	57.7	188	202	45.1	181	561	1
FEB_34	4.0	215	32.4	122	174	21.6	101	163	2
FEB_56	7.0	140	40.0	231	84	15.7	151	155	1
Total FEB	5.7	463	90.1	158	376	66.7	144		

Optional:

See FEB_Design Sheet	Input Time Series	Flow	Load	Conc	Flow	Flow CV	Flow Max
See input series sheet		kac-ft	mt	ppb	cfs	-	cfs
""	TS_FEBS5A_N	0.0	0.0	0	0	#N/A	0
	TS_FEBS5A	351.5	80.9	186	485	1.67	8130
	TS_STA1DW	148.5	23.2	127	205	0.49	829
	TS_STA1W	0.0	0.0	0	0	#N/A	0
	TS_STA1E	123.3	18.7	123	170	0.88	644
	TS_STA2B	118.3	25.2	173	163	1.80	1499
	TS_FEB34	706.7	108.7	125	976	1.81	10310
	TS_STA34	0.0	0.0	0	0	#N/A	0
	TS_FEB56	198.8	53.8	219	274	1.20	4647
	Total	1647.1	310.5	153	0	0.00	0

Base Period for Concs	1	1= 2005-2009,2 = 1995-2009	
Use Lake P Concs	TRUE	for S354 & S351 Lake Rleases	
C139 Load Reduc	0%	Max TP ppb	0
STA Duty Cycle	0.95	New Lake Rel ka	0
Target Conc ppb	11.5	Iterations	1
Output Interval	30	S5A/C51 Cmax	0
S5A Load Reduc	0%	S678 Cmax	0
Refuge Min Flow	500	C139 Cmax	0

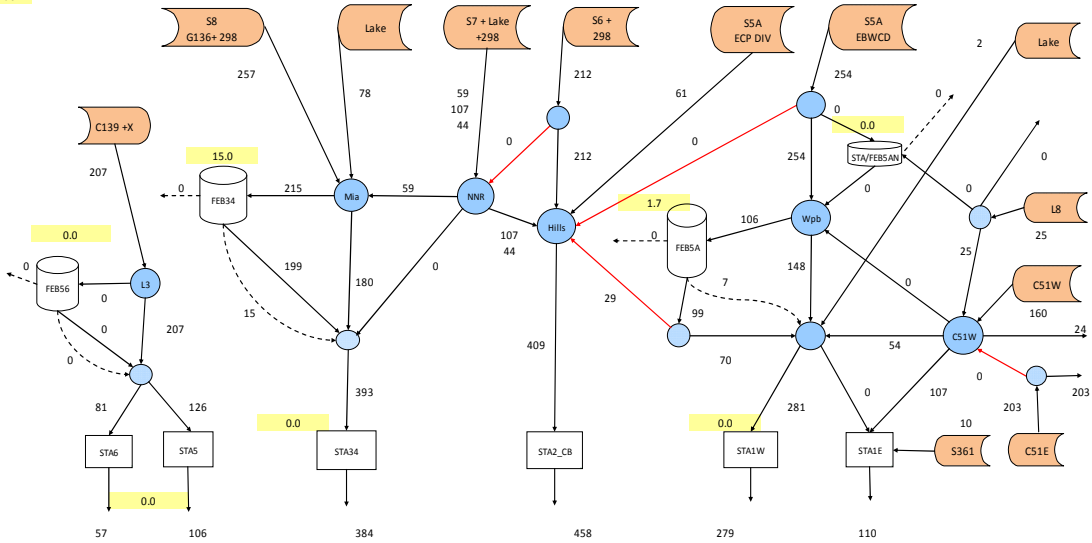
use iter=1 for testing, 2 for final

See FEB_STA Sheet, Provision to direct more flow to refuge in dry years.

Watershed Areas	Land kac	Fraction	New STA kac	FEB kac	Runoff Rescale
Scale_s5A	133	1	9.7	1.7	0.91
Scale_S6	105	1			1.00
Scale_s7	120	1	23.0	4.0	0.78
Scale_s8	120	0			1.00
Scale_Annex	18	1	0.0	7.0	0.61

Scenario: 8 C/D - Interim Plan with Temporary A1 FEB, Balance STA-34 Inflow, C51E Div/FEB Mean Flow kac-ft/yr

STA Expansion kac



								Totals
STA Outflow TP ppb	18.3	18.3	11.3	19.2	37.3	12.9		20.0
STA Expansion kac	0.0		0.0		0.0			0.0
STA Total Area kac	5.1	7.9	16.5	15.1	6.7	5.1		56.5
STA Outflow kacf/yr	57	106	384	458	279	110		1393
WCA Inflow kacft			547	458		389		1393

Inputs for Scenario C51E_Interim Phase 1 - A1 as 4 ft FEB, C51 Rockpit 10 kacf (6/44 ft), 3 yrs), No STA expansion; Partial Diversion to West

Diversion Rules

Diversion	Default	Diverted to	Fraction	Qmax	Description
C51E Diversion	C51W Canal	EAST	0	1000	
S5A Div (ECART)	S5A Div	HILLS_C	0		divert to hills up to qmax
S5A Div (ECART)	S5A Div	HILLS_C	0		low-flow bypass to WPB
S5A Div to FEB North	FEBS5A	FEBS5A_N	0		northern STA.FEB
FEB S5A Outflow	HILLS_C	STA1DW	1	200	diversion to Hills
C51W Outflow	EAST	STA1E	0.6	700	direct to STA1E
C51W Outflow	EAST	STA1_DW	0.7	1000	direct to STA1DW
C51W Outflow	EAST	FEB_S5A	0		remainder to East
STA1W Distrib	STA1W	STA1E	0		WPB C STA1E
S6 Runoff	STA2CB	NNRC	0		S6 divert to NNR
NNR Canal	FEB34	STA34	0		NNR LowQ Bypass to STA34
STA56 Distrib	STA5	STA6	0.39		Balance STA56 Loads, Hint=
L8 to STA1N	C51W	FEBS5A_N	0		To FEB S5AN (Rest to C51W)
L8 to North	C51W	North	0		CERP
NNR to CB	STA34	Comp B	1		Original Design for Comp B =1
NNR to CB 2	STA34	Comp B	0.48		Additional NNR Diversion to CB

Mass Balance Summary — Run Date 8/31/10 20:26

	Inflows Area	Inflows Flow	Inflows Load	Inflows Conc	Outflows Flow	Outflows Load	Outflows Conc	HLR	HLR Ma
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d
STA1E	5.1	117	21.9	152	110	1.7	12.9	1.90	8.1
STA1W	6.7	281	66.0	190	279	12.8	37.3	3.51	21.6
STA2B	15.1	453	78.7	141	458	10.9	19.2	2.50	12.3
STA34	16.5	393	47.8	98	384	5.3	11.3	1.98	8.8
STA5	7.9	126	33.4	214	106	2.4	18.3	1.34	6.1
STA6	5.1	81	21.4	214	57	1.3	18.3	1.32	6.0
Total STA	56.5	1451	269.1	150	1393	34.4	20.0	2.14	
				STA1W+E	388.6	14.6	30.4		
0.394				STA2+34+B	841.3	16.2	15.6		
				STA5+6	163.1	3.7	18.3		

FEB Calculations	FEB_S5A	FEB_34	FEB_56	FEBS5A_N
DMSTA calibration	RES_3	RES_3	RES_3	EMG_3
Area kac	1.7	15	0	
HRT days	14	14	90	30
Bypass Depth ft	5.9	4	12	4
LowQ Bypass cfs	200	400	50	100
Max Qin cfs	2000	2775	2500	2000
Max Qout cfs	1000	1000	500	500
Control Depth ft	0.5	0.5	0.5	0.5
Min Release Depth ft	0.5	0.5	0.5	0.5
Regulation Schedule	FEB_REG	FEB_REG	FEB_REG	
STA WS Release	REL_STA	REL_STA	REL_STA	
Farm WS Release				REL_FARM
Frac Irrig Demand	0.5			0.25
Frac C51 Urban WS	1			
STA Expansion	STA1WX	STA34X	STA56X	
Area kac	0	0	0	
Fraction SAV	0.67	0.67	0.4	
Ehnanced	SAV_3	SAV_3	PEW_3	
Base Period for Concs	1	1= 2005-2009,2 = 1995-2009		
Use Lake P Concs	TRUE	for S354 & S351 Lake Rleases		
C139 Load Reduc	0%	Max TP ppb	0	
STA Duty Cycle	0.95	New Lake Rel ka	0	
Target Conc ppb	11.5	Iterations	1	use iter=1 for testing, 2 for final
Output Interval	30	S5A/C51 Cmax	0	
S5A Load Reduc	0%	S678 Cmax	0	
Other		C139 Cmax	0	

Optional:
See FEB_Design Sheet
See input series sheet
""

FEBs	Treated Inflow Area	Treated Inflow Flow	Treated Inflow Load	Treated Inflow Conc	Outflows Flow	Outflows Load	Outflows Conc	Depth cm Mean	Depth cm Min
	kac	kac-ft	mt	ppb	kac-ft	mt	ppb		
FEBS5A_N	0.0	0	0.0	#N/A	0	0.0	#N/A	0	0
FEB_S5A	1.7	106	27.5	210	99	20.9	171	108	5
FEB_34	15.0	215	29.7	112	199	15.7	64	45	1
FEB_56	0.0	0	0.0	68	0	0.0	#N/A	0	0
Total FEB	16.7	321	57.2	144	298	36.6	99		

Input Time Series	Flow kac-ft	Load mt	Conc ppb	Flow cfs	Flow CV -	Flow Max cfs
TS_FEBS5A_N	0.0	0.0	0	0	#N/A	0
TS_FEBS5A	253.5	66.3	212	350	1.87	5032
TS_STA1DW	56.3	10.9	157	78	1.34	1000
TS_STA1W	0.0	0.0	0	0	#N/A	0
TS_STA1E	116.8	21.9	152	161	0.91	744
TS_STA2B	423.7	72.5	139	585	2.00	6132
TS_FEB34	394.7	60.5	124	545	1.73	5600
TS_STA34	0.0	0.0	0	0	#N/A	0
TS_FEB56	207.1	54.8	214	286	1.20	4806
Total	1452.2	286.9	160	0	0.00	0

Watershed Areas	Land kac	Fraction	New STA kac	FEB kac	Runoff Rescale
Scale_s5A	133	1	1.7	1.7	0.97
Scale_S6	105	1			1.00
Scale_s7	120	1	15.0	15.0	0.75
Scale_s8	120	0			1.00
Scale_Annex	18	1	0.0	0.0	1.00

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Modeling Phosphorus Dynamics in Everglades Wetlands and Stormwater Treatment Areas

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Abstract

Longitudinal gradients in phosphorus (P) stored in the water column, vegetation, and soils develop in the wetlands where inflow P concentrations exceed background levels. Prior to the mid 1990's, the Everglades regional P gradient ranged from 100-200 $\mu g\ L^{-1}$ in marsh inflows to background levels of 4-8 $\mu g\ L^{-1}$. Subsequent implementation of P controls, including agricultural Best Management Practices (BMPs) and Stormwater Treatment Areas (STAs), reduced the average inflow concentration along the northern edge of the Water Conservations Areas (WCAs) to approximately 33 $\mu g\ L^{-1}$ in 2007-2009. Additional P controls are being implemented and further measures beyond those currently planned will be required to restore the entire marsh. This paper describes the evolution and application of relatively simple mass-balance models to simulate P storage and cycling processes along P gradients in the STAs and downstream marsh. The models are practical engineering tools that have been extensively applied to the design of Everglades regional P control plans involving combinations of source controls, water management, reservoirs, and STAs, as well as in simulating P dynamics in natural marshes immediately downstream of treated and untreated discharges.

Key Words

Everglades, phosphorus, modeling, marsh, engineering, wetland treatment areas

Introduction

As water with elevated phosphorus (P) moves through a wetland ecosystem, P is removed and a gradient of decreasing P concentration is produced along the flow path (Reddy et al., 1993; Craft et al., 1993a; Craft et al, 1993b; Walker, 1995; Kadlec & Walker, 1999). The water-column P gradient is typically accompanied by gradients of P storage in vegetation and soils (Figure 1). Phosphorus originating in inflows and atmospheric deposition is cycled within the marsh and ultimately stored in accreting peat or transported downstream. Historically, the water-column P gradient in the Everglades marsh ranged from 100-200 $\mu g\ L^{-1}$ at the inflows to background levels of 4-8 $\mu g\ L^{-1}$ (Figure 2). Nearly two decades of monitoring and research by the South Florida Water Management District (SFWMD) and other agencies have established that Everglades wetland ecosystems change dramatically along the P gradient and that native slough and sawgrass communities are viable only at P concentrations below 10 $\mu g\ L^{-1}$, expressed as a long-term geometric mean (Payne et al, 2003). With sheet flow hydraulics, water quality at the edge of the marsh is determined by the quality of the inflows. Restoring and protecting the entire marsh is likely to require inflow P concentrations equivalent to the marsh P criterion (Payne et al, 2008). This is in contrast to lakes or other well-mixed water bodies where inflows with concentrations exceeding water quality standards do not trigger violations of ambient standards because they are rapidly dispersed, diluted, and/or assimilated in receiving waters.

Spatial and temporal variations in the Everglades regional P gradient over the past three decades are shown in Figure 2. Substantial progress has been made since 1993 in reducing P concentrations in the inflows to the Water Conservation Areas (WCAs) through implementation of agricultural Best Management Practices (BMPs) and construction of Stormwater Treatment Areas (STAs) (SFWMD, 2009b). As these control

measures were implemented, the combined WCA inflow concentration decreased from ~170 μg L^{-1} in 1980-1989 to ~61 μg L^{-1} in 2000-2009. Within the last decade, the three-year rolling-average inflow concentration decreased from ~64 μg L^{-1} in 2001-2004 to ~33 μg L^{-1} in 2007-2009. The historical reductions in inflow concentration have cascaded through the networks of canals and marshes to cause P concentration reductions in the outflows from each WCA (Figure 2). Further reductions in WCA inflow and outflow concentrations are expected to result from implementation of additional source-control and treatment measures.

The effect of the P control program is to displace the P gradient upstream of the marsh so that most of it occurs within STAs constructed on formerly agricultural land (Figure 1). At the same time, elevated P concentrations driving the gradient are reduced through implementation of BMPs. When long-term restoration objectives are achieved, the marsh gradient will be substantially reduced relative to historical conditions and have long-term geometric mean P concentrations ranging from 10 μg L^{-1} to background levels of 4-8 μg L^{-1}.

This paper describes the evolution of relatively simple mass-balance models to simulate P storage and cycling processes along P gradients in the STAs and marsh. In the context of the Everglades restoration effort, the models and associated software have provided practical engineering tools for designing P control measures involving combinations of source controls, regional water management, reservoirs, and STAs, as well as for simulating marsh responses to variations in flow and P load in transects downstream of WCA inflow points.

Model Evolution

The models described below were developed to support evaluation of multiple STA design alternatives by engineering professionals without requiring site-specific calibration data or specialized expertise in wetland modeling. Model simplicity results

from aggregation of key variables and processes controlling phosphorus storage and cycling. The simplifying assumptions are supported by calibration and testing against several dozen datasets that describe phosphorus removal in experimental prototypes, field-scale test cells, full-scale STAs, and natural wetlands (Walker & Kadlec, 2001; 2005). These datasets provide bases for calibration and testing under a wide range of conditions (e.g. size, water depth, P concentration, P load, velocity, vegetation types, inflow variability) and for estimating uncertainty associated with model forecasts. While the modeling effort was initiated to support STA design, the fundamental concepts (mass balance, hydraulics, P cycling mechanisms) operating along a P gradient (Figure 1) also apply to natural wetlands. Differences between the STAs and naural marsh related such factors as water depth, hydraulic loads, antecedent soils, and vegetation are considered by explicitly including those factors in the model(s) or by defining limits of application consistent with calibration datasets.

Figure 3 shows P storage compartments and fluxes associated with four models that evolved over the 1995-2008 period (Kadlec, 1994; Walker, 1995; Walker & Kadlec, 1999; Walker & Kadlec, 2005; Kadlec, 2006). They involve different combinations of three fundamental storage compartments (water column, biota, soil) and associated net fluxes between compartments. While P generally moves in both directions between compartments via different mechanisms, the aggregated models simulate the net fluxes that ultimately drive the mass balance. Model structures represent P storage and net fluxes per unit area of marsh. These are coupled with hydraulic models to predict water movement and P transport. Excel spreadsheet software developed to support model applications is limited to relatively simple one-dimensional hydraulic models representing sheet flow along a marsh transect or STAs with individual treatment cells connected in series and/or parallel. The P cycling variables and equations can be translated to more complex hydraulic models capable of predicting two-dimensional flow and mass transport in an STA or marsh. For example, Chen et al (2009) have included DMSTA's P cycling algorithms in a two-dimensional hydraulic model of WCA-1.

Models with greater complexity have been developed for describing water and phosphorus movement in STAs (Guardo and Tomasello 1995; HydroQual, 1998 Moustafa and Hamrick, 2000) and Everglades marsh (Fitz and Trimbel, 2006; Munson et al, 2002; Jawitz et al., 2008). They generally account for two-dimensional spatial and temporal variability and have several state variables and adjustable parameters. Most require enhanced computers, long run times, site-specific calibration data, and special expertise to calibrate and apply. These requirements generally preclude engineering applications to STA design. The Everglades Landscape Model (ELM, Fitz and Trimbel,2006) has been extensively used in the Everglades restoration effort. It simulates system-wide variations in marsh hydrology, water quality, soils, and vegetation in response to variations in marsh inflows and other factors projected to occur in response to long-term restoration efforts. The models described below can be used to evaluate localized impacts of discharges and to provide inflow boundary conditions for ELM applications to the entire Everglades marsh.

Steady-State STA Design Model (STADM)

The STA design model (STADM) (Walker, 1995) was used to develop initial designs for ~29,000 hectares of STAs to achieve a long-term flow-weighted mean outflow concentration of 50 $\mu g\ L^{-1}$ (Burns and McDonnell, 1994). A modified version that places a lower bound on P concentration (Kadlec, 1994; Kadlec and Wallace, 2009) was used in the initial design of STA-3/4 (Burns and McDonnell, 1999). Knowledge and experience gained through research, operation, and monitoring of these initial STAs subsequently provided a technical basis for optimizing and expanding the STAs to achieve lower P concentrations, as well as for improving the models to support that effort (SFWMD, 2009b).

The STADM simulates the long-term-average water-column P gradient along a marsh transect as a function of the average inflow volume, inflow load, flow-path width, and atmospheric deposition. The model includes one P storage compartment (water column) and three P fluxes: inflow, outflow, and net removal in the accreting peat (Figure 3).

hort-term variations in P storage and cycling in vegetation and soils are essentially embedded in the calibration. Because the design objective was expressed as a long-term flow-weighted mean, predictions of short-term variations in P concentration were not required to support the 50 μg L^{-1} STA designs. A steady-state model is not sufficient, however, for designing STAs to achieve lower P concentrations driven by highly pulsed inflows (see DMSTA, below)

The STADM assumes that the average net P removal rate per unit area is proportional to the average water-column concentration. No P removal is assumed to occur when the marsh is nearly dry (water depth < 30 cm). The proportionality constant ("net settling rate" = 10.2 +/- 1.4 meters/yr) was calibrated to peat accretion measurements along the P gradient in the WCA-2A marsh downstream of outflows from WCA-1 (Figure 2). The peat data provided an integral measure of net P removal over a 26-year period. Global distribution of fallout from nuclear bomb testing in 1963 placed a layer of radioactive Cesium-127 in the soil profile. The accumulated soil P was estimated by vertically integrating from the peak in Cesium-127 content to the surface using soil cores collected at 24 monitoring sites (Reddy et al., 1991, 1993; Craft and Richardson, 1993ab). The model was tested against limited water-column concentration data along the same marsh transects (Walker, 1995). Because of the limited quantity and the high spatial and temporal variability in the water column data, the integrated peat accretion data provided a preferred basis for calibrating the model to predict long-term P removal rates. Data from wetland treatment areas sufficient to support calibration were not available at the time of STADM development.

Effects of variability in the inflows, water depth, hydraulics, and vegetation types were embedded in the STADM calibration to the marsh. In applying the model to design the 50 μg L^{-1} STAs, it was assumed that STA vegetation types and P cycling processes would be similar to those in the upper portion of the P gradient in the WCA-2A marsh used for calibration (predominantly cattail). Potentials for regulating STA inflow volumes, flow distribution, water depths, and vegetation to optimize treatment suggested that the model calibrated to a natural wetland would generate conservative forecasts of

STA performance. Subsequent data from full-scale treatment cells with primarily emergent vegetation indicated an average net settling rate of 11.4 m/yr as compared with the STADM calibrated value of 10.2 m/yr (Walker & Kadlec, 2005). Average net settling rates computed for entire STAs with both emergent and submerged vegetation operated in design ranges have ranged from ~10 to ~25 m/yr.

Everglades Phosphorus Model (EPGM)

The Everglades Phosphorus Gradient Model (EPGM) (Walker & Kadlec, 1996; Kadlec & Walker, 1999) tracks P accumulation in soils along marsh transects downstream of inflows with P concentrations above marsh background levels (Figure 1, Figure 3). While not required for STA design, predictions of soil P variations in the marsh are useful because some ecosystem components are driven more by soil P content (cattails, other rooted vegetation) than by water-column concentration (periphyton, algae, invertebrates). There is substantially greater uncertainty associated with modeling the soil P compartment, as compared with modeling the water column. This uncertainty reflects inherent complexities of soil interactions with vegetation and water column, as well as limitations in soils data related to sampling artifacts and high spatial variability (Grunwald et al., 2004; Cohen et al., 2009). EPGM provides the simplest representation of the soil P compartment consistent with the data available for calibration.

The water-column component of EPGM is identical to the STA design model. Both assume sheet-flow hydraulics and are calibrated to data primarily from WCA-2A. Vertical mixing within the soil profile is assumed to be minimal. This assumption is supported by substantial vertical and longitudinal gradients in soil P content observed in the WCA-2A soil cores used for calibrating the STADM (Kadlec & Walker, 1999). The accumulation of soil mass in EPGM is driven by a correlation between soil mass accretion rate and soil P accretion rate calibrated to dated soil cores in WCA-2A and tested against limited data from other WCAs. This correlation determines a relationship between the average P content of accreting peat and the average P concentration in the

water column (Kadlec & Walker, 1999). EPGM calibration to WCA-2A transect data indicates that soil accretion rates vary from 0.1 to 1.0 kg/m^2-yr and the P content of accreting peat varies from 500 to 1400 mg/kg as the average water column P varies from 5 to 100 μg L^{-1}.

EPGM has been applied to evaluate the potential impacts of distributing STA outflows with a P concentration of 50 μg L^{-1} into previously un-impacted marsh areas along the northern edge of the WCAs (Walker & Kadlec, 1996). Impacts are expressed in terms of marsh areas exceeding water-column and soil P criteria as a function of time as the soil P gradient (Figure 1) develops downstream of the STA outflows. Cattail densities are also predicted based upon an empirical correlation with soil P contents. The development of steady-state soil P profiles requires one or more decades, depending on the inflow concentration, initial soil P content, depth of soil being tracked, and marsh hydroperiod. Once the soil P profile is fully developed, the EPGM calibration to WCA-2A indicates that marsh areas with water-column P concentrations exceeding 10 μg L^{-1} correspond to areas with steady-state soil P contents exceeding ~650 mg/kg.

Dynamic Model for Stormwater Treatment Areas (DMSTA)

DMSTA (Walker & Kadlec, 2001-2005; Kadlec, 2006) was developed to support design of STAs to achieve outflow TP concentrations approaching the 10 μg L^{-1} criterion. Achieving low P levels requires designing an STA to operate within limited ranges of inflow P concentrations and loads, as well as optimizing vegetation types, water depths, and hydraulics to treat highly pulsed basin runoff. Consideration of these factors requires a dynamic model with an additional P storage compartment to represent labile phosphorus stored in vegetation and litter (Figure 4). This compartment regulates P uptake, recycling, and generation of stable P residuals stored in accreting peat. The initial structure and equations were similar to the autobiotic wetland P model described by Kadlec (1997). Those equations have been refined and calibrated to various emergent

and submerged vegetation types (described below) based upon data from South Florida wetlands and treatment areas.

Whereas the STA design model assumed simple sheet-flow hydraulics downstream of the inflows, DMSTA allows simulation of full STA designs involving multiple treatment cells in series and/or parallel with seepage, bypass constraints based upon water depth or pump capacity, and outlet hydraulic controls (Figure 4). Design optimization generally involves specification of cell areas, configurations, depth regimes, hydraulic features, and target vegetation communities to achieve treatment objectives in a cost-effective manner. The model also has a capability for simulating regional networks of STAs and reservoirs, driven by 35-year daily flow time series generated by SFWMD's regional hydrologic models (SFWMD, 2005). Marsh responses downstream of the STAs can also be simulated using the appropriate calibrations. The spreadsheet interface and limited input data requirements facilitate development and comparison of alternative STA designs.

The first version of DMSTA (Walker & Kadlec, 2001) was calibrated to data from approximately 70 treatment cells and wetlands ranging in size from 10^{-1} to 10^{7} m^2. Most of the treatment cell datasets were from experimental tanks and small-scale test cells with different vegetation types operated with constant inflows and water depths over periods of one to three years. Data from a treatment wetland (Boney Marsh) and a full-scale test facility (Everglades Nutrient Removal Project, Chimney et al, 2006) provided the primary bases for calibration. Calibrations were developed for periphyton, emergent vegetation, and submerged vegetation based upon data from the largest prototype in each category. A fourth category represented a transition from submerged vegetation to periphyton over a decreasing P gradient. Data from the smaller experimental platforms were used for testing calibrations in each vegetation category. This version of DMSTA was used in initial feasibility studies for enhanced STA designs (Burns and McDonnell, 2002; Brown and Caldwell, 2002).

With operation and intensive monitoring of the STAs by SFWMD, substantially more data from full-scale treatment cells and wetlands with dynamic inflows and water depths

were available to support development of the second version of DMSTA (Walker and Kadlec, 2005). This most recent version includes calibrations for four wetland types (emergent, submerged, periphyton, and mixed vegetation on natural wetland soils), as well as a calibration for open-water reservoirs. The reservoir calibration is based upon data from shallow lakes in Florida (Burns & McDonnell, 2004) and developed to support evaluation regional plans involving networks of STAs and storage reservoirs planned for hydrologic restoration purposes (USACE, 2009).

Steady-state solutions of DMSTA's P cycling equations are mathematically equivalent to the K/C* model (Kadlec, 1994), which is similar to the STA Design Model (Figure 3). Calibrated settling rates are 13-22 m/yr for emergent vegetation, 43-64 m/yr for submerged vegetation, 18-31 $\mu g\ L^{-1}$ for periphyton, 27-46 m/yr for mixed vegetation on natural wetland soils, and 3-9 m/yr for reservoirs. The wetland calibrations (first three categories) are in the 60th to 90th percentile range of the global distribution of settling rates, based upon data from 282 treatment wetlands (Kadlec and Wallace (2009). Each calibration is applicable under specific ranges of depth, velocity, and concentration, as determined by the calibration datasets. DMSTA is applicable to treatment cells that have reached a stable operational phase, a process that typically requires one to three years after construction to allow time for the establishment of vegetation and associated P cycles, depending on antecedent soils, water depths, and vegetation.

The second version of DMSTA has been applied in several feasibility and design studies providing treatment of additional flows and phosphorus loads from the source basins, as well as integration of STAs and storage reservoirs south and north of Lake Okeechobee (Burns and McDonnell. 2002, 2003; ADA, 2005; Brown and Caldwell, 2002,2005,2007; Black and Veatch, 2006; URS Inc, 2005; HDR Inc, 2006; Camp Dresser and McKee, 2007; Tetra Tech, 2008). While developed primarily for use in STA design and optimization, DMSTA can also be used as a diagnostic tool to facilitate interpretation of real-time monitoring data from the STAs. Variations in measured STA outflow concentrations reflect variations in inflow volumes, inflow P loads, water depths, climate, management, P cycling within wetland communities, measurement errors, and other

random factors. It is difficult to evaluate the inherent P removal performance of the STA wetland community in the context of data variations induced by the other factors. DMSTA factors out the effects of hydrologic variations and STA operations that distribute inflows across cells and regulate water depths. This filtering provides a clearer signal of vegetation function and long-term performance relative to design simulations and management expectations.

DMSTA's structure assumes that flow through each treatment cell is uniformly distributed across its width (sheet flow). While that assumption is consistent with typical design recommendations, hydraulic inefficiencies (short-circuiting, dead zones) can result from spatial variations in ground elevation and remnant farm canals that were not sufficiently filled or plugged at the time of construction (Guardo and Tomasello 1995; Dierberg et al., 2005; DB Environmental Labs, 2006). To some extent, the effects of these factors are embedded in the DMSTA calibrations and in the tanks-in-series model used to represent each cell (Kadlec and Wallace, 2009). DMSTA incorporates a depth-dependent P uptake function that reflects spatial variations in topography (typically +/- 30 cm relative to the mean ground elevation) and the resulting impacts on hydraulic efficiency. To account for extreme variations in topography, the design engineer has the option to adjust the effective treatment area, typically defined as the area flooded at normal operating depth (40 – 60 cm). Future refinements to include explicit consideration of topographic variations within each cell may improve model performance, particularly when water levels are relatively low and risk of short-circuiting is relatively high. While data requirements would limit applicability, the P cycling algorithm can also be superimposed on a full 2-dimensional hydraulic simulation of the STAs, as has been done for WCA-1 (Chen et al., 2009),

With continued operation and monitoring of the STAs, the database to support further refinement of DMSTA expanded more than three-fold between 2005 and 2009, measured in terms of cell-years. Future versions will provide updated calibrations and additional features useful for design and diagnostic applications.

Coupled DMSTA and EPGM

A fourth model under development links DMSTA and EPGM to simulate three aggregated P storage compartments (water column, vegetation, and soil, Figure 3). In the initial version, the structures and calibrations of the DMSTA and EPGM components are unchanged. The soil P compartment is driven by the predicted net accretion from the vegetation P storage compartment of DMSTA. The accretion rates are time-variable, as compared with the original EPGM driven by the steady-state water column concentration profile generated by the STADM.

The long-term decreasing trends in WCA inflow and outflow concentrations (Figure 2) suggest that water column P concentrations respond relatively rapidly to reductions in inflow P, despite the substantial of amounts of P stored in the soils of impacted marsh areas, release of which would delay the water column response. DMSTA testing results also indicate that explicit simulation of the soil P compartment may not be necessary for predicting water-column P variations in the natural marsh or in treatment cell outflows in response to trends in the inflow volumes or concentrations once STA vegetation (DMSTA P storage pool) is stabilized. Effects of soil P storage and exchanges with the water column and vegetation are currently embedded in DMSTA calibrations. Further testing against data in lower P ranges will be possible as STA performance improves and the natural marsh responds to decreasing P loads. Despite greater uncertainty and data limitations, explicit consideration of soil P may improve water-column P simulations in dry periods, which the effects of soil P reflux would be greatest (Pant and Reddy, 2003). While less important for STA design, explicit simulation of soil P levels may be useful for forecasting the spatial and temporal scales associated with restoration of rooted vegetation and other ecosystem components that respond more to soil P variations than to water column P variations.

The existing calibrations of DMSTA and EPGM provide a basis for estimating the time scales required for P stored in each compartment to equilibrate following a change in the long-term average water column P concentration (Figure 5). These scales depend upon

the ratio of stored phosphorus to the average input P flux to each compartment computed from a steady-state solution of the P cycling model. Starting from a given set of initial conditions, time scales are expressed as the number of years required for 90% of the shift to new equilibrium distribution of stored P. Equilibration of storage compartments to an ambient P concentration of 10 $\mu g\ L^{-1}$ involves time scales ranging from ~1 to 3 years for the vegetation P storage compartment, ~10 years for the 0-2 cm soil horizon, and ~50 years for the 0-10 cm soil horizon. Response times are shorter at higher P concentrations because of increases in the P cycling and soil accretion rates.

The temporal and spatial scales of marsh response to increasing or decreasing P loads are further illustrated in Figure 6. The preliminary model has been applied to simulate variations in P concentration and storage along the WCA-2A marsh transect in response to variations in inflow volume and P load over a 100 year period. The 1963-1995 period represents historical conditions when the marsh P gradient developed in response to increases in P load starting 1960's. P loads gradually decreased between 1995 and 2007 period with implementation of upstream P controls and flow diversions. A hypothetical reduction of inflow concentration to a long-term flow-weighted mean of 12 $\mu g\ L^{-1}$ (approximately equivalent to a geometric mean of 10 $\mu g\ L^{-1}$) is imposed in 2008-2062 simulation period. Year-to-year variations in inflow volume and concentration around 12 $\mu g\ L^{-1}$ have been estimated from variations in the historical time series. Soil P content in 1963 is initialized at 350 mg/kg based upon vertical soil P profiles in WCA-2A. Marsh response is expressed as areas exceeding various water column P and soil P criteria in each compartment. Areas are computed from the simulated distance along the transect and an average transect width of 10.5 km (Walker, 1995). As expected based upon the steady-state analysis (Figure 5), labile P storage in vegetation responds within a few years to the reduction in inflow concentration, whereas the soil compartments respond over several decades.

Processes not directly reflected in the existing model, such as soil P recycling induced by peat oxidation or mining of soil phosphorus by rooted vegetation, may decrease response times for P stored in the soil but increase the time scales for P stored in the vegetation and

water column. One limitation of the EPGM component is that it was calibrated to soils cores collected in 1990-1991 and reflected marsh response to an increase in P load over the 1963-1990 period, when inflow P loads were generally increasing. Substantial data collected since then provide a basis for refining the structure and calibration in the coupled EPGM/DMSTA model. Recent data also provide a basis for testing the model in a recovery mode as the WCA2A marsh responds to further decreases in inflow P load. Data from soil and water column transects in other WCAs are also available to support further refinements (SFWMD, 2009b).

Future Applications to Everglades Restoration

Restoring the Everglades will require delivery of water with sufficient volume, timing, and quality to achieve hydrologic and water quality objectives. Implementation of hydrologic restoration measures will alter the quantities and timing of marsh inflows (USACE, 2009). Changes in timing could have positive or negative impacts on STA performance, depending on how they affect peak inflow volumes and P loads. DMSTA can play continued roles in engineering solutions to achieve both hydrologic and water quality goals. These solutions are likely to involve combinations of the following measures:

1. Additional BMPs to further reduce runoff P concentrations
2. Diversions to balance flows and P loads across STAs
3. Integration of reservoirs to attenuate peak inflows to the STAs
4. Further optimization of the hydraulics, vegetation, and operation of existing STAs
5. Additional STA expansion

Further refinement of the modeling tools will be possible with continued research and monitoring conducted under Florida's Long-Term Plan (B&M, 2003; SFWMD, 2009b).

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Walker & Kadlec, GEER 2008 Figures

Figure 1 Phosphorus Gradient in Wetland Vegetation, Water, and Soils under Historical and Restored Conditions

Figure 2 Long-Term Trends in the Everglades Regional Phosphorus Gradient

Figure 3 Evolution of Phosphorus Mass Balance Models with Increasing Complexity

Figure 4 Components of DMSTA

Figure 5 Time Scales of Phosphorus Storage in Marsh Soils and Vegetation

Figure 6 Simulation of WCA-2A Response to Reductions in Inflow P Concentration

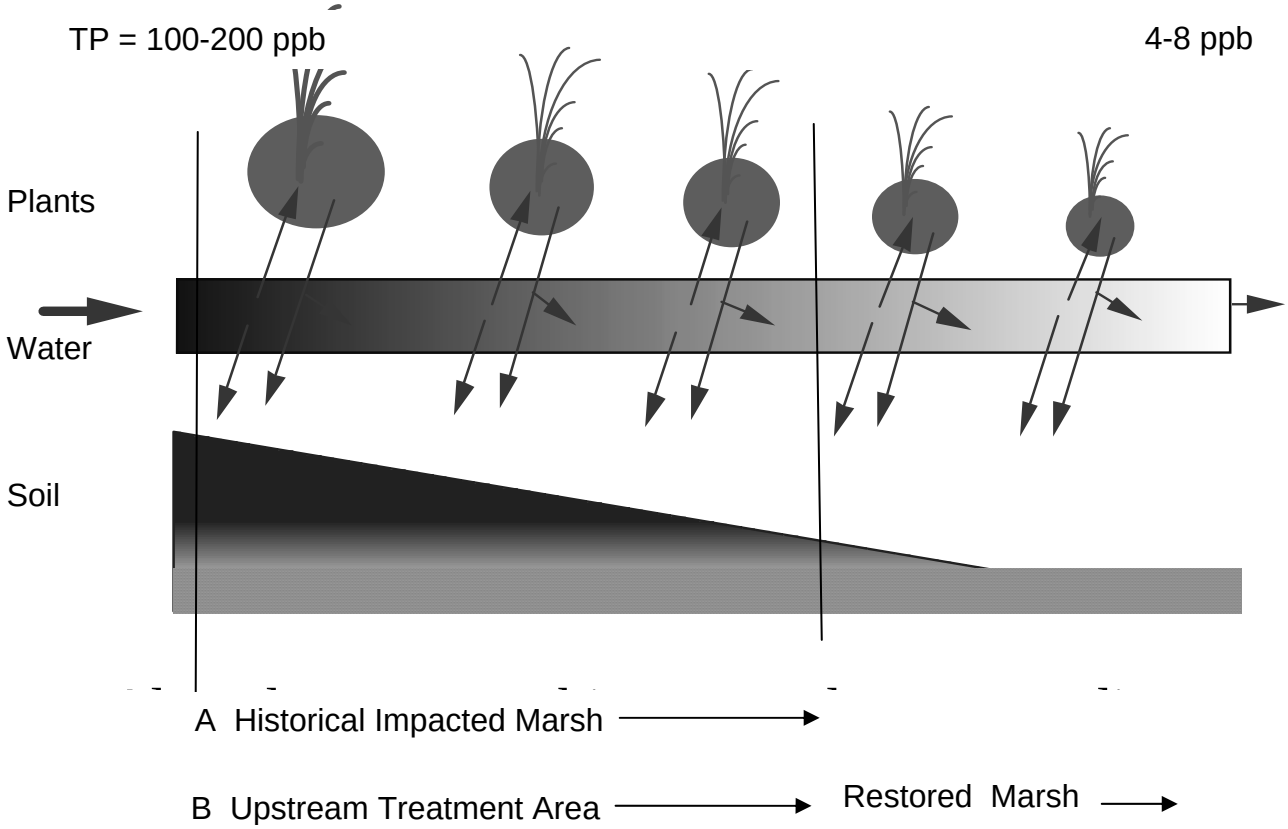

Figure 1

Phosphorus Gradient in Wetland Vegetation, Water Column, and Soils under Historical and Restored Conditions.

A - Historical conditions (before implementation of phosphorus controls). The P gradient is located entirely with the impacted natural marsh.

B - Future restored conditions (after full implementation of P controls). Most of the P gradient is moved upstream out of the natural marsh and located with wetland stormwater treatment areas constructed on adjacent agricultural lands. The remaining gradient within the marsh extends from 10 ppb in the treatment area outflows to marsh background levels.

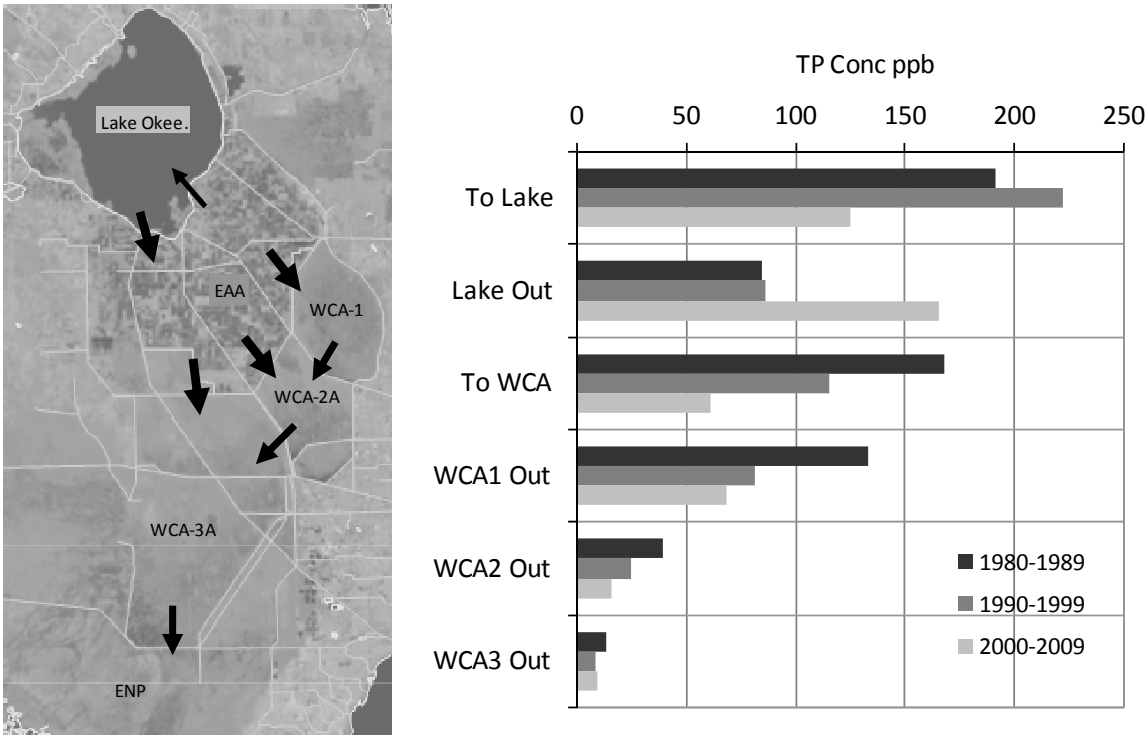

Figure 2

Long-Term Trends in the Everglades Regional Phosphorus Gradient

Phosphorus concentrations are flow-weighted means. Flow and concentration data are from DBHYDRO (SFWMD, 2009a)

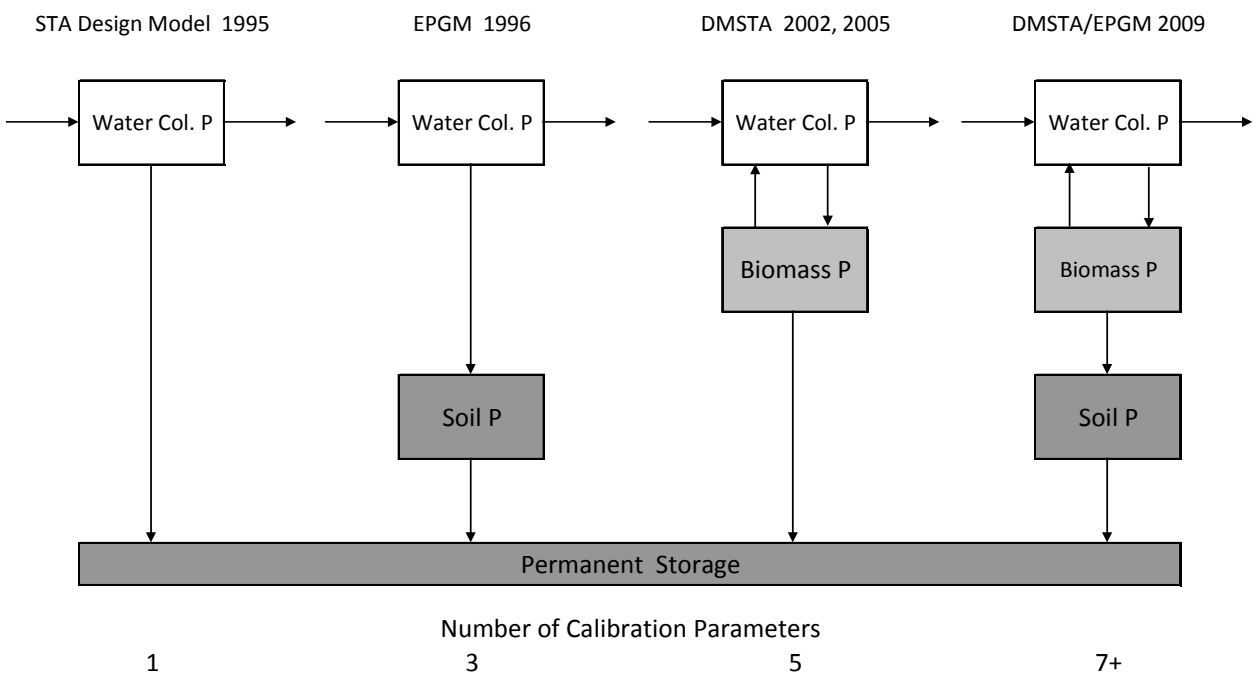

Figure 3

Evolution of Phosphorus Mass Balance Models with Increasing Complexity

Aggregated P compartments and net fluxes are shown for four mass balance models developed over the 1995-2009 period. Permanent storage represents burial of stable P forms in accreting peat. The number of calibrated parameters increases with model complexity.

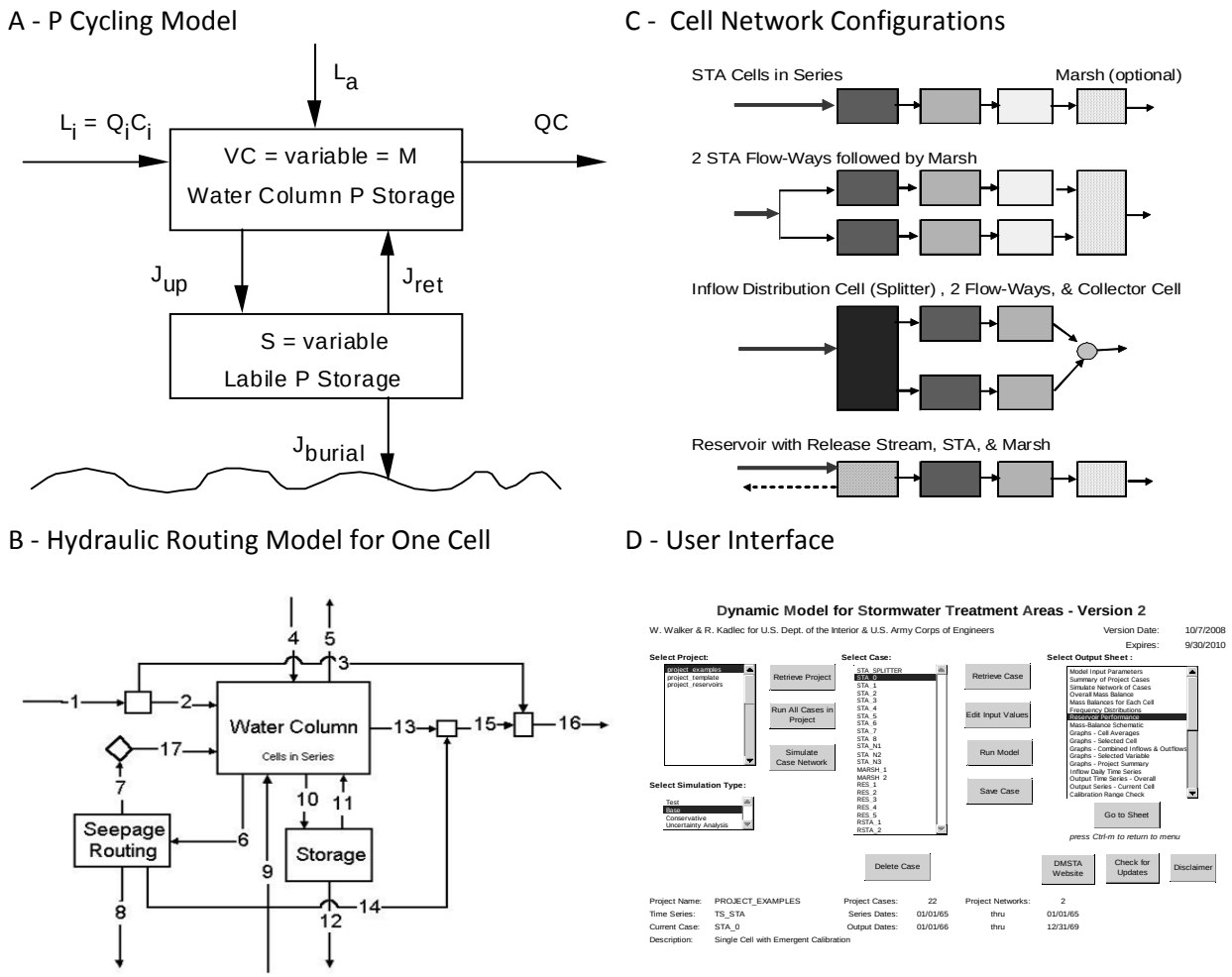

Figure 4

Components of DMSTA

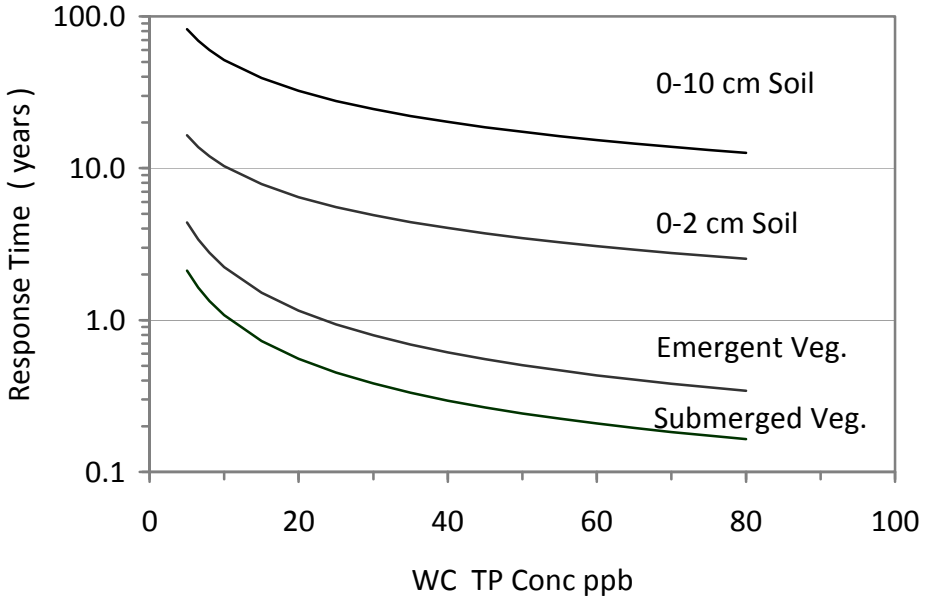

Figure 5

Time Scales of Phosphorus Storage in Wetland Soils and Vegetation

Represent approximate time required for P storage compartments to adjust to a change in the long-term average water-column P concentration. Computed from EPGM and DMSTA calibrations.

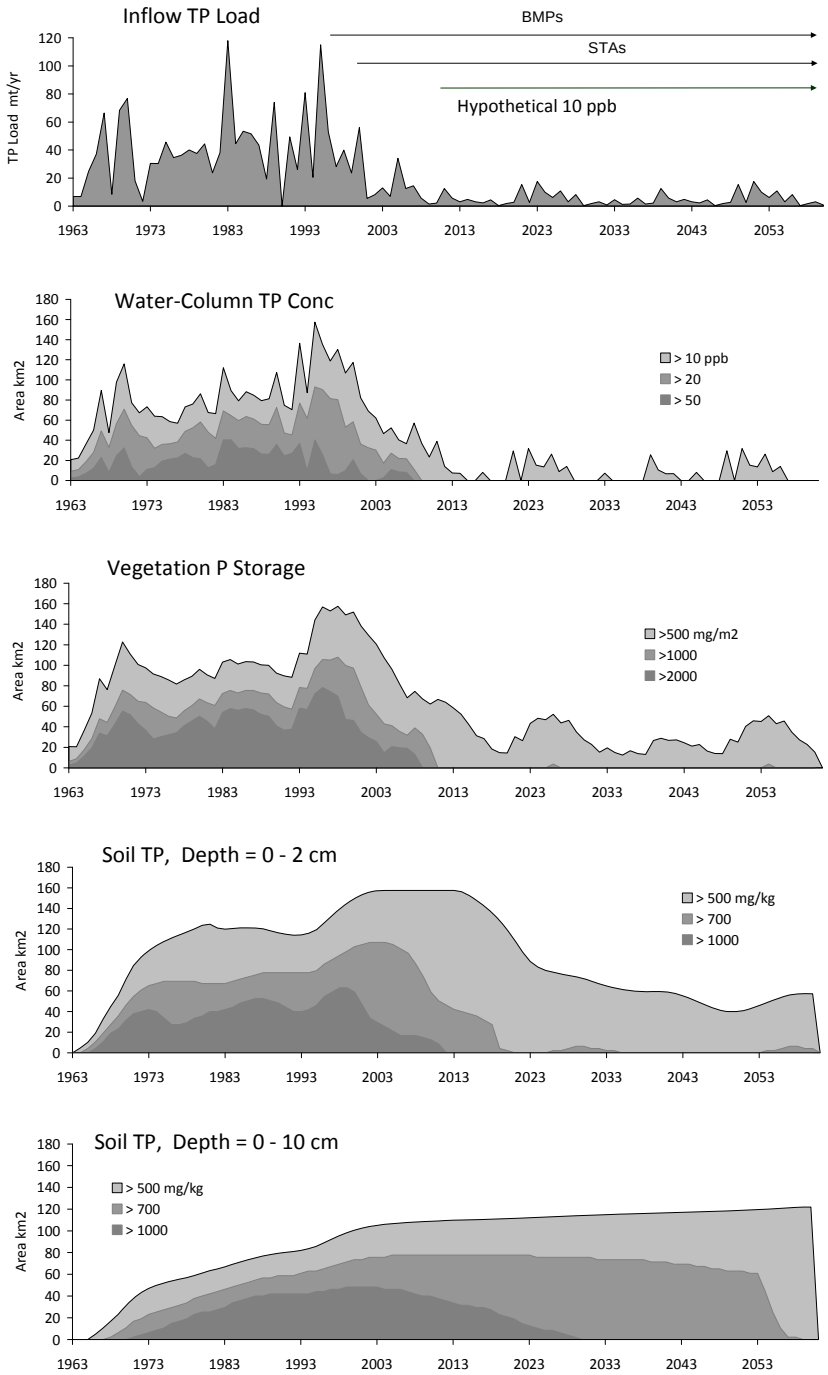

Figure 6

Simulation of WCA-2A Response to Reductions in Inflow P Concentration using the Coupled EPGM/DMSTA Models

United States Environmental Protection Agency
Amended Determination

Executive Summary

On April 14, 2010, the United States District Court, Southern District of Florida, issued an order (the 2010 Order) directing specific steps that the United States Environmental Protection Agency (USEPA) and the Florida Department of Environmental Protection (FDEP) must take to correct deficiencies in USEPA's December 2009 Determination and to carry out USEPA's and FDEP's mandatory duties under the Clean Water Act (CWA) to achieve water quality standards in the Everglades Protection Area. The 2010 Order directed USEPA to issue an Amended Determination no later than September 3, 2010.

This document (the Amended Determination) addresses the requirements, as outlined on pages 44-47 of the 2010 Order, lays out the steps that the State must complete, and where applicable, specifically describes USEPA's actions if the State fails to respond. USEPA's objective in issuing this Amended Determination is to satisfy the Court's directives in the 2010 Order, consistent with the CWA and implementing regulations. This Amended Determination will ensure that the water quality entering the Everglades Protection Area from the Everglades Agricultural Area (EAA) and C-139 Basin achieve the narrative and numeric criteria, by meeting a scientifically sound Water Quality Based Effluent Limit (WQBEL) in permits, in the shortest time possible. Attachment A is an overview map showing the primary features described in this Amended Determination.

In Sections I. and II. of this Amended Determination, USEPA, strikes the language of its 2009 Determination that the Court found invalid and directs the State to correct the deficiencies in the State's Amended Everglades Forever Act (Amended EFA) and the Phosphorus Rule that have been invalidated by the 2010 Order. In the event the State fails to timely correct the deficiencies in the Amended EFA and Phosphorus Rule, USEPA will provide timely notice and promulgate revised standards pursuant to 33 U.S.C. § 1313(c).

In Section III.A., USEPA is notifying FDEP that the narrative and numeric nutrient criteria in the State's water quality standards are not being met for the Everglades Protection Area. Using the most recent information available, data indicate that while levels of total phosphorus (TP) at inflows to the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge), Water Conservation Area (WCA) 2, and WCA 3 have decreased since the 1980s, all parts of the Everglades Protection Area do not yet meet the nutrient criteria and further reductions of TP in the inflows to the Everglades must be achieved if further degradation is to be prevented. USEPA summarizes pertinent analyses of historical data from several sources to document this conclusion, including water quality data, soil phosphorus analyses, and vegetation changes.

In addition, in Section III.B., this Amended Determination describes a two-part WQBEL as a critical component of an enforceable framework to ensure that the Stormwater Treatment Area (STA) discharges will not cause exceedances of the numeric criterion within the Everglades

Protection Area. The USEPA has derived a WQBEL to be implemented in permits for the STA discharges into the Everglades Protection Area. The WQBEL provides that:

TP concentrations in the discharge may not exceed either:

- 10 ppb as an annual geometric mean (GM) in more than two consecutive years; or
- 18 ppb as an annual flow-weighted mean (FWM).

Compliance with both parts of the WQBEL is necessary to assure that the STA discharges will not cause an exceedance of the long-term criterion of 10 ppb. USEPA calculated the WQBEL using a scientifically-based statistical approach in accordance with USEPA procedures. Expressing the WQBEL in this manner ensures the total phosphorus (TP) concentration and flow discharged from the STA to vary within acceptable limits while ensuring that the discharge will not cause an exceedance of the ambient water quality criterion of 10 ppb as a long-term GM in the Everglades marsh. Expressing one component of the WQBEL as a FWM concentration considers high flow loading events to the Everglades Protection Area and is more appropriate than relying only on a limit expressed as a GM concentration. Should FDEP propose an alternative approach to establishing a WQBEL, USEPA will evaluate its scientific rigor to ensure it appropriately implements the water quality criterion in accordance with the Clean Water Act (CWA) and its implementing regulations.

In Section III.C., USEPA is providing clear, explicit, and comprehensive instructions to the State of Florida on the manner and method to obtain the WQBEL, including specific milestones. In developing the defined actions and timetables for achieving the WQBEL for each STA, USEPA conducted extensive modeling and analysis, working with well-recognized experts in wetland treatment systems that have extensive experience working on Everglades restoration. Based on this analysis, the total expected treatment area expansion in the Everglades Agricultural Area needed to meet the WQBEL is approximately 42,000 acres.

The SFWMD recently announced the planned purchase of 8,900 acres of agricultural land in the Eastern Flow Path and 17,900 acres of citrus groves in the Western Flow Path[1] from U.S. Sugar Corporation. These purchases are to be finalized in October 2010. This pending land purchase, in addition to lands already in state ownership (the EAA-A1 and EAA-A2 compartments), provides substantial acreage for attaining the WQBEL indentified in this Amended Determination.

In developing the defined actions and timetables, USEPA assumed that no additional source controls will be undertaken. However, USEPA believes that, in addition to the remedies outlined in this Amended Determination, the State should pursue further source controls through improved on-farm best management practices (BMPs) and/or sub-basin treatment approaches as required by the Amended EFA. Reducing the concentration and load of TP entering the STAs

[1] USEPA refers to three distinct flow paths for runoff water from the EAA and the C-139 Basin. These are the Eastern Flow Path that drains the urban and eastern basins of the EAA through STA 1E and STA 1W to the Refuge; the Central Flow Path that drains the central basins of the EAA through STA 2/Compartment B and STA 3/4 to WCA 2A and 3A; and the Western Flow Path that drains the C-139 Basin and the western part of the EAA through the STA 5, STA 6, and Compartment C complex into WCA 3A.

through improved source control could further optimize the performance of the STAs and could reduce the land area needed to treat the increased flows anticipated in the future as Everglades restoration proceeds.

There may be possible alternative remedies to those proposed by USEPA based on various combinations of improved or expanded source or flow controls and different configurations of STAs and flow equalization basins (FEBs).[2] Given that further refined modeling may identify remedies that are capable of removing TP in order to achieve the WQBEL, USEPA believes it is appropriate to provide an opportunity to the South Florida Water Management District (SFWMD), as the permittee, to provide USEPA and FDEP technical input on remedies identified in the Amended Determination. Therefore, USEPA is offering SFWMD 60 days to submit to USEPA and FDEP any alternative remedies that will achieve the WQBEL as soon or sooner than the remedies identified by USEPA. Any such proposal must be submitted to USEPA and FDEP by November 2, 2010. The proposal must be accompanied by a schedule and specific milestones to ensure timely implementation. USEPA will evaluate any alternatives presented and consider incorporating a revised approach in subsequent permitting, compliance, and/or enforcement proceedings. If USEPA finds the alternative(s) to be acceptable and consistent with the expectations outlined in this Amended Determination, USEPA expects to respond to any alternative remedy proposal provided by SFWMD, with a supplement to the Amended Determination, within 45 days of receipt.

Attachment B summarizes for each flow path the number of additional acres of STA or FEBs that will provide the level of treatment needed to achieve the WQBEL. Attachment B also provides the date that the STAs are projected to be discharging at levels consistent with the WQBEL based on the specified remedy.

The Amended Determination describes specific activities and dates for meeting these milestones along with critical assumptions and factors unique to each flow path. There are several key milestones that are generally applicable including:

1. Completing land acquisition (if necessary);

2. Completing detailed designs for STAs or FEBs;

3. Acquiring all necessary federal and state permits;

4. Completing construction; and

5. Discharging consistent with the WQBEL.

Attachment H and Section III.C.3.(b) identify a potential option for treating water in the Eastern Flow Path that involves building and operating a storage reservoir in the C51 basin. The

[2] A flow-equalization basin (FEB) is a water storage area that can provide several benefits when used in combination with a downstream STA: provide some initial TP removal; capture peak flows during the wet season thereby reducing spikes in flow that can overload STAs and adversely affect performance; and allow water captured during the wet season to be metered out to the STA into the dry season to keep the STA from drying out.

State did not provide adequate assurance to USEPA of the success of this option prior to the release of this Amended Determination. The USEPA sees benefits with this potential option including: an increase in water flow to the Everglades Protection Area; better quality of water to the Refuge; fewer harmful fresh water diversions to the Lake Worth estuary; and meeting the WQBEL as early as 2017. The State is encouraged to submit adequate assurance of this option to the USEPA in its alternative remedies submittal on or before November 2, 2010.

In Section IV of this document, USEPA directs FDEP to take the following actions related to monitoring TP in the Everglades Protection Area:

1. Rectify deficiencies in the current monitoring network for measuring the achievement of the total phosphorus water quality criterion in the Everglades Protection Area; and

2. Enhance monitoring and reporting requirements, ensuring that water quality, soil TP concentrations, and changes in vegetation are tracked and evaluated to fully assess the individual and cumulative impacts of discharges into the Everglades Protection Area, and to monitor progress toward achieving the ambient water quality criterion for TP.

In Section V.A, USEPA directs FDEP to conform NPDES permits for all STAs consistent with specific instructions which USEPA provides regarding:

1. Removing all reference to the non-conforming elements of the Long Term Plan, the moderating provisions and the extended compliance schedules;

2. Incorporating the WQBEL, including added provisions for providing early warning of possible non-compliance with the WQBEL and reporting excess TP loads if the WQBEL is not met;

3. Updating various items that must be included in each Annual Report, as well as, the pollution prevention and operational plans for each STA; and

4. Requiring water quality, vegetation, and sediment transect monitoring at locations downstream of the discharge points and within the Everglades marsh to determine the extent of phosphorus intrusion resulting from the STA discharges and to determine if these discharges cause or contribute to violations of water quality standards.

The 2010 Order directed USEPA to immediately initiate and carry out its authority to withdraw approval of the State program pertaining to issuance of any new NPDES permits for discharges into, or within, the Everglades Protection Area, or for any future modifications to existing NPDES permits (including through State of Florida Administrative Orders). However, as described in Section V.B., on July 29, 2010, USEPA filed a Rule 60(b) Motion for Modification of Injunction requesting that the Court amend the provision in the 2010 Order that requires USEPA to initiate and carry out partial withdrawal of Florida's NPDES permitting authority and allow the substitution of a new injunctive provision that would apply after the existing permits have been conformed pursuant to the Court's Order. On August 2, 2010, the Court issued an order scheduling oral argument on USEPA's motion for October 7, 2010.

Because the Court has taken USEPA's motion under consideration and USEPA will not know the Court's disposition of its Rule 60(b) Motion prior to issuance of its Amended Determination, and because USEPA believes it lacks authority under the CWA to do a partial program withdrawal, it has not commenced initiation of withdrawal of FDEP's NPDES permitting program for the Everglades Protection Area. Instead, it awaits a ruling by the Court on the pending Rule 60(b) motion.

Section VI explains how all of the components of this Amended Determination provide an enforceable framework for ensuring compliance with the CWA and its applicable regulations. This includes:

1. Requiring the State to amend its water quality standards to bring them into compliance with the CWA;

2. Conforming all NPDES and EFA permits for discharges from the STAs into the Everglades Protection Area to include a WQBEL to meet water quality standards;

3. Providing clear, specific, and comprehensive instructions to the State on actions to ensure compliance with the WQBEL;

4. Exercising USEPA's full CWA enforcement authorities to ensure compliance with the WQBELs; and

5. Exercising USEPA's CWA permitting oversight authority to ensure all future permits comply with the CWA and implementing regulations.

Section VII of the document discusses the important relationship between this Amended Determination and actions being undertaken by the District Court in the case pending before the Honorable Federico A. Moreno, US v. SFMWD, Case No. 88-CV-1886-FAM (S.D. Fla.).

United States Environmental Protection Agency
Amended Determination

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Introduction

In its April 14, 2010 Order (2010 Order), the United States District Court, Southern District of Florida, directed USEPA and FDEP to carry out specific steps to meet their mandatory duties to achieve water quality standards in the Everglades Protection Area.[3] *Miccosukee Tribe of Indians of Florida; and Friends of the Everglades v. United States of America, et al.*, No. 04-21488-GOLD/MCALILEY (and consolidated cases). This document responds to the 2010 Order.

In the 2008 Order, the Court granted partial summary judgment for the plaintiffs and partial summary judgment for the defendants. This 2008 Order decided consolidated cases brought against the USEPA by the Miccosukee Tribe of Indians of Florida (Tribe) and the Friends of the Everglades (FOE). Both the Tribe and FOE sought review of USEPA's determination that the Everglades Forever Act Amendments (Amended EFA) were not new or revised water quality standards subject to review under section 303(c) of the Clean Water Act (CWA) and sought to have the Court order USEPA to disapprove those amendments. The Tribe and FOE also alleged that USEPA's actions approving parts of the Phosphorus Rule (the Phosphorus Rule or TP Rule) as new or revised water quality standards were arbitrary and capricious. Lastly, the Tribe and FOE sought review of USEPA's determination that other parts of the Phosphorus Rule were not new or revised water quality standards.

In its 2008 Order, the Court determined the Amended EFA were new or revised water quality standards and ordered USEPA "to comply with its duty under the CWA to approve or disapprove those changes consistent with the findings and conclusions" set forth in the Court's Order. Order at 99 (para. 1). The Court affirmed USEPA's determinations approving the 10 parts per billion (ppb) numeric criterion for phosphorus and the implementation methodology (the four-part test) as meeting the requirements of the CWA. Order at 99 (para. 6). The Court concluded that subsections (4)(d)(2)(c)[4], (5)(b)(3), 5(d), and 6 of the Phosphorus Rule do not meet the requirements of the CWA and declared those subsections invalid. The Court set aside USEPA's determinations approving these subsections. Order at 100 (para. 6). The Court also set aside USEPA's determinations that subsections (1), (2), and (5)(a)-(c) were not changes to water quality standards and ordered USEPA on remand "to comply with its duty under the CWA to approve or disapprove those changes in a manner consistent with the findings and conclusions" of the Court. Order at 100 (para. 8).

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[3]This matter has a long history and over the years USEPA has issued a number of determinations that provide additional background on the historical actions that have preceded this amended determination. Footnote 44 of the July 2008 Order summarizes four of USEPA's recent determinations (January 24, 2005, July 27, 2005, May 8, 2006, and May 31, 2006). USEPA determinations from November 5, 2003 and September 15, 1999 contain additional background information.

[4] Subsection (4)(d)(2)(c) is the fourth prong of the four-part test. USEPA raised this issue in the 2009 Determination, noting that the Court's focus appears to be the sentence in the paragraph that follows the four-part test provision: "If these limits are not met, no action shall be required, provided that the net improvement or hydropattern restoration provisions of subsection (6) below are met." See 2009 Determination, page 10, referencing fn 1.

Throughout both the 2008 Order and 2010 Order, the Court refers to this provision as the "no-action" or "escape clause." Order at 82, 85, and 97. Therefore, for purposes of this amended determination, reference to Subsection (4)(d)(2)(c) and Subsection (4)(d)(2) refer to the sentence quoted in this footnote and not the fourth prong of the four-part test.

In response to the Court's 2008 Order, USEPA issued its Determination on December 3, 2009. USEPA's 2009 Determination disapproved the following parts of the Amended EFA: subsection (3), including paragraphs (3)(b), (3)(c), (3)(d), and (3)(e), as well as subparagraphs (4)(e)(2), (4)(e)(3), and subsection (10), and other provisions relating to the Long Term Plan or modification to the compliance date. USEPA also disapproved the following parts of the Phosphorus Rule: subsections (1), (2), (5)(a-d), and (6). Although the Court in its 2010 Order found that USEPA's disapprovals of those provisions were consistent with the requirements of the 2008 Order, several parts of USEPA's 2009 Determination were stricken by the Court in its 2010 Order and those are discussed further in Section I.

Amended Determination

In the 2010 Order, the Court directed USEPA to issue an Amended Determination no later than September 3, 2010. The 2010 Order contained specific directives to USEPA on steps that need to be taken and included in the Amended Determination. The remainder of this document addresses the requirements of the 2010 Order and lays out the steps that the State of Florida must complete and, where applicable, specifically describes USEPA's actions if the State fails to respond accordingly. The Court's 2010 Order required the following:

1. "All provisions of the 2009 Determination which have been stricken by this Order shall be excluded from the Amended Determination." [2010 Order, page 47, paragraph 8]

2. "On remand, the [US]EPA shall issue an Amended Determination ('Amended Determination') **not later than Friday, September 3, 2010** that meets the requirements of this paragraph and the paragraphs that follow. The Amended Determination shall specifically direct the State of Florida to correct the deficiencies in the Amended EFA and the Phosphorus Rule that have been invalidated in a manner consistent with **Attachments B and C of this Order.** The USEPA shall require the State of Florida to commence and complete rule-making for the Phosphorus Rule within 120 days from the date of the Amended Determination and shall require amendments to the Amended EFA to be enacted by July 1, 2011. In the event the State of Florida fails to timely act, the [US]EPA shall provide timely notice, and the [US]EPA Administrator 'shall promulgate such standard[s]' pursuant to 33 U.S.C. § 1313(c) (Emphasis in original)." [2010 Order, page 44, paragraph 1]

3. "The [US]EPA Administrator, through the Amended Determination, shall notify the State of Florida that it is out-of-compliance with the narrative and nutrient standards for the Everglades Protection Area. The Amended Determination shall provide clear, specific and comprehensive instructions to the State of Florida on the manner and method to obtain enforceable [water quality-based effluent limits] WQBELs within a time certain, consistent with the Clean Water Act and its implementing regulations, the Summary Judgment Order and this Order. The Amended Determination shall specify without equivocation that compliance must occur in accordance with **specific milestones to be established in the Amended Determination** that provides an **enforceable framework for ensuring compliance** with the CWA and its applicable regulations. Furthermore, it shall require the State of Florida to measure on a yearly basis the cumulative impacts and effects of

phosphorus intrusion beyond the 10 ppb standard within the Everglades Protection Area until such time as full compliance with the 10 ppb standard is achieved. I underscore that the [US]EPA must establish **specific milestones** to ensure that the State of Florida does not continue to ignore, and improperly extend, the compliance deadline for meeting the phosphorus narrative and numeric criterion in the Everglades Protection Area (Emphasis in original)." [2010 Order, page 45, paragraph 2]

4. "The [US]EPA, in its Amended Determination, shall direct the State of Florida to conform all NPDES permits for STAs 1, 2, 3, 4, 5 and 6 – along with the accompanying Administrative Orders and Everglades Forever Act permits listed in **Attachment A** to this Order – to the Clean Water Act, the Summary Judgment Order and this Order so as to eliminate all references to the non-conforming elements of the Long-Term Plan, the moderating provisions and the extended compliance schedule through 2016, and to require compliance with the phosphorus narrative and numeric criterion in a manner consistent with the Clean Water Act and the forthcoming Amended Determination. All such permits shall be conformed not later than sixty (60) days of the date of the Amended Determination and shall be promptly filed with this Court (Emphasis in original)." [2010 Order, page 45, paragraph 3]

5. "On remand, the [US]EPA, in its Amended Determination, shall immediately initiate and carry out its authority under Section IX of the Memorandum of Understanding to withdraw approval of the State program pertaining to the issuance of any new NPDES permits for discharges into, or within, the Everglades Protection Area, or for any further modifications to existing NPDES permits (including through State of Florida Administrative Orders) – other than to carry out the requirements of Paragraph 3 [of the 2010 Order], above – until such time as the State of Florida is in full compliance with the Clean Water Act, its implementing regulations, the Summary Judgment Order, this Order, and the forthcoming Amended [US]EPA Determination." [2010 Order, page 46, paragraph 4]

6. "Other than to carry out the requirements of Paragraph 3 [of the 2010 Order], above, the FDEP is enjoined from issuing any new NPDES permits, or modifications to existing NPDES permits - through State of Florida Administrative Orders, Everglades Forever Act permits or otherwise - for STAs that discharge into, or within, the Everglades Protection Area **until such time** as the State of Florida is found by the [US]EPA and this Court to be in full compliance with the Clean Water Act, its implementing regulations, the Summary Judgment Order, and this Order. All new Administrative Orders and Everglades Forever Act permits issued under the laws of the State of Florida must conform to, and comply with, the Clean Water Act, its implementing regulations, the Summary Judgment Order, and this Order and the forthcoming Amended [US]EPA Determination (Emphasis in original.)" [2010 Order, page 46, paragraph 5]

The remainder of this Amended Determination responds to items 1 through 6 listed above. Item 1 is addressed in Section I. Item 2 is addressed in detail within Section II. Item 3 is covered in Sections III and IV. Items 4, 5, and 6 are addressed by Section V. Sections VI and VII describe in further detail USEPA's expectations with regard to the implementation of the

enforceable framework and the relationship to the case pending before the Honorable Federico A. Moreno, US v. SFMWD, Case No. 88-CV-1886-FAM (S.D. Fla.) (Consent Decree Case).[5]

This Amended Determination also describes an "enforceable framework" to which the Court referred in the 2008 and 2010 Orders. In addition to addressing the factors discussed in the 1999 Determination (which the Court references in both its 2008 and 2010 Orders), this Amended Determination describes additional measures necessary for an enforceable framework: the specific actions and timetables milestones that will need to be carried out to achieve the water quality based effluent limit (WQBEL), described in Section III.B., which is designed to meet the narrative and numeric water quality criteria for total phosphorus in the Everglades Protection Area.

The objective of this Amended Determination is to satisfy the Court's directives in the 2010 Order, consistent with the CWA and implementing regulations, and to ensure that the water quality entering the Everglades Protection Area from the Everglades Agricultural Area (EAA) and C-139 Basin will achieve the narrative and numeric criteria, by meeting a scientifically sound WQBEL, in the shortest time possible.

I. Revisions to USEPA's 2009 Determination

As part of this Amended Determination, USEPA is making specific revisions to its 2009 Determination consistent with the Court's 2010 Order. Pursuant to the Order, "[a]ll provisions of the 2009 Determination which have been stricken by this Order shall be excluded from the Amended Determination." The following language (shown as stricken text) from the 2009 Determination is removed and no longer valid. Pursuant to its authority under CWA 303(c)(3), USEPA has determined that various aspects of the revised standards in the Amended EFA and Phosphorus Rule are not consistent with the CWA and, therefore, such provisions are invalid. The 2009 Determination is revised accordingly. Attachment D is a copy of the 2009 Determination which shows the stricken text. The remainder of the 2009 Determination remains in effect.

Item 3 on page 2 of the December 3, 2009 Determination is revised as follows:

> 3. Florida Department of Environmental Protection (FDEP) is enjoined from issuing any permits for discharges in, or within, the Everglades Protection Area (EPA) under subsection (5)(b)(3), 5(d) and (6) of the Phosphorus Rule, and the "no action" provision of subsection (4)(d)(2)(c). ~~USEPA understands that FDEP is complying with this provision of the Order. FDEP has not issued any permits utilizing these provisions of the Phosphorus Rule and has indicated they do not plan to.~~

The Court's rationale for striking the last two sentences of item 3 can be found on pages 22-24 and 35 of the 2010 Order. The Court found that FDEP had issued permits utilizing invalidated provisions of the Phosphorus Rule. The Court found that FDEP included compliance schedules

[5] The 2010 Order discussed the relationship between the Consent Decree Case and the consolidated cases filed by the Tribe and FOE before Judge Gold. 2010 Order at 29. This is discussed in more detail below in Section VII.

that were blanket variances issued without following the procedure for use attainability analysis (UAA) required for variances under the CWA and its implementing regulations.

The second footnote on page 2 of the December 3, 2009 Determination is revised as follows:

> FDEP issued National Pollutant Discharge Elimination System (NPDES) permits for Stormwater Treatment Areas (STA) 2, 5, and 6 on September 4, 2007, while this case was pending. ~~Those permits included water quality based effluent limits ("WQBELs"), compliance schedules, and interim limits. The permits did not include moderating provisions or variances. This approach is consistent with the Court's statements concerning "authorizing compliance schedules in individual permits on a case by case basis." (Order at 45–46).~~ The permits were not challenged by any parties and became effective at the end of the notice period.

Several locations in the 2010 Order address the Court's rationale for striking most of the second footnote on page 2. Pages 18-19 refer to USEPA's failure to recognize the Administrative Orders (AOs) issued by the State in 2009 as inconsistent with the 2008 Order. Pages 22-23 hold that USEPA's conclusion that State permits did not include moderating provisions or variances is incorrect. Since the Court found that the AOs included moderating provisions or variances, under the CWA, a UAA is required. Furthermore, as indicated on page 24, since "no use attainability analyses have been conducted," the conclusion that the approach is consistent with the 2008 Order is no longer valid.

The last paragraph on page 10 of the December 3, 2009 Determination is revised as follows:

> Lastly, the provisions that USEPA is disapproving today had the effect of being less protective than the numeric criterion. The provisions that USEPA is disapproving today and the provisions that the Court declared invalid are no longer in effect for CWA purposes. The USEPA approved criterion and implementing methodology remain in effect for CWA purposes. ~~Because the criterion and implementing methodology are fully protective of the designated use, there is no need for the state of Florida or USEPA to take any further action pursuant to CWA section 303(c).~~

The Court's rationale for striking the last sentence of page 10 can be found on page 15 of the 2010 Order. Page 15 describes USEPA's failure to complete an analysis of the effect of Florida's non-compliance as well as a lack of further specific direction to the State regarding necessary actions to ensure an enforceable framework. The stricken language of the 2009 Determination is no longer valid and this Amended Determination is intended to address those specific requirements for the State and USEPA. The direction that USEPA is providing to the State in this section (section I) for amending its water quality standards is in accordance with the Court's order and pursuant to USEPA's authority under section 303(c) of the CWA. Under CWA section 303(c), revisions made by the State in response to this Amended Determination must be submitted to USEPA for review and approval.

II. Directions for Correcting Deficiencies in Florida's Phosphorus Rule and the Amended Everglades Forever Act

In its 2010 Order, the Court specified the changes to be made by FDEP to the Phosphorus Rule [see Attachment C, April 2010 Order]. USEPA filed a Rule 60(b) Motion asking the Court to modify its injunction involving specific changes the Court had ordered. Pending the outcome of the Rule 60(b) process, Attachment E reflects the changes USEPA asked the Court to make. If the Court denies this portion of the 60(b) motion, USEPA will take the appropriate actions to modify Attachment E. As required by the Court (Order at 44 – 45) and based on USEPA's authority under CWA section 303(c)(3), USEPA directs the FDEP to revise 62-302.540, Florida Administrative Code (F.A.C.) [Water Quality Standards for Phosphorus Within the Everglades Protection Area] to be consistent with Attachment E of this Amended Determination. FDEP is directed to complete its rulemaking by January 1, 2011. If FDEP has not finalized revisions to the Phosphorus Rule consistent with Attachment E by this date, USEPA will initiate rulemaking to promulgate the necessary revisions pursuant to CWA section 303(c) consistent with the Court's 2010 Order (at 44 - 45).

As required by the Court (Order at 44 – 45) and based on USEPA's authority under CWA section 303(c)(3), USEPA also directs the State of Florida to correct deficiencies in the Amended EFA consistent with Attachment F of this Amended Determination. As noted above, USEPA filed a Rule 60(b) motion asking the Court to modify its injunction concerning the language it struck in the Amended EFA. Pending the outcome of the Rule 60(b) process, Attachment F reflects the changes USEPA asked the Court to make. If the Court denies this portion of the 60(b) motion, USEPA will take the appropriate actions to modify Attachment F. The State of Florida is directed to enact amendments to the Amended EFA by July 1, 2011. If the State of Florida fails to act in a timely manner, USEPA will initiate rulemaking to promulgate revised standards pursuant to CWA section 303(c) to be consistent with the Court's 2010 Order (at 44 - 45). In its 2010 Order, the Court specified the changes to be made by the State of Florida to the Amended EFA [see Attachment B, April 2010 Order].[6]

The direction that USEPA is providing to the State in this section (section II) for amending its water quality standards is in accordance with the Court's order and pursuant to the USEPA's authority under section 303(c) of the CWA. Under CWA section 303(c), revisions made by the State in response to this Amended Determination must be submitted to USEPA for review and approval.

[6] In the recent Rule 60(b) motion, USEPA, among other things, asked the Court to modify its injunction involving certain language the Court struck from the Amended EFA in subsection 4(a) which could have the unintended effect of limiting the use of the ad valorem taxes for optimizing, operating and maintaining the Everglades Construction Project (ECP) which includes the existing STAs. An important aspect of the enforceable mechanism that USEPA considered in its 1999 Determination was the identification of funding sources to pay for the restoration projects. The inability to use these taxes for the ECP could limit the ability of the State to fund projects as described in this Amended Determination.

III. Manner and Method to Obtain Enforceable WQBEL Within Time Certain

A. Non–Attainment of Narrative and Numeric Nutrient Criteria Throughout Everglades Protection Area

Pursuant to the Court's Order (2010 Order, p 45), USEPA is notifying the FDEP that the narrative and numeric nutrient criteria[7] are not being met for the Everglades Protection Area.[8] Using the most recent report published by the South Florida Water Management District (SFWMD) and the FDEP, the *2010 South Florida Environmental Report* (the 2010 SFER), the data indicate that levels of total phosphorus (TP) at inflows to the Refuge, WCA 2, and WCA 3 have decreased since the 1980s. However, all parts of the Everglades Protection Area do not yet meet the nutrient criteria, and further reductions of TP in the inflows to the Everglades must be achieved if further degradation is to be prevented and the criteria are to be achieved. We have summarized below the pertinent analyses of historical data from several sources to document this conclusion.

1. Water Quality

The 2010 SFER summarizes the status of attainment with the numeric 10 ppb TP criterion (expressed as a geometric mean), as well as the observed data and trends, in the Everglades Protection Area. Figures 3A-10 through 3A-12 of the 2010 SFER provide the annual geometric mean TP concentrations during the entire period of record from Water Year (WY) 1978-2009 for the Everglades Protection Area inflow and interior sites. As demonstrated in those figures, the concentrations of TP at inflows to the Refuge and WCAs 2 and 3 have decreased; however, the inflow concentrations are still not at or below the applicable 10 ppb criterion (geometric mean). For WY2009, which includes the period May 1, 2008 through April 30, 2009, page 3A-42 of the 2010 SFER indicates that approximately 30% of interior marsh sites within the Everglades Protection Area exhibited annual geometric mean TP concentrations of 10 ppb or higher and approximately 16% of interior marsh sites exceeded the annual geometric mean TP concentration of 15 ppb, the annual maximum cap in the Phosphorus Rule's four-part test for measuring achievement with the TP numeric criterion.[9] Annual data for the phosphorus-impacted stations at the periphery of the Everglades Protection Area indicate concentrations above 15 ppb at all stations (2010 SFER Appendix 3A). Furthermore, WY2009 monitoring along transects downstream of Stormwater Treatment Areas (STA) 1E, 1W, and 2 confirm that at

[7] See Section III.B.1. for the definitions of the narrative and numeric criteria.

[8] The Court's Order directed USEPA to notify the State that it was out of compliance with the nutrient standards. The CWA does not consider a State to be "out of compliance" with the Act if water quality standards are not being attained. The CWA does require States to take actions to meet standards (e.g., include effluent limits in permits to meet standards) and to take actions when standards are not being attained (e.g., identify impaired waters and develop total maximum daily loads). To carry out the Court's Order, USEPA is notifying the State that it is not attaining their nutrient standards in the Everglades Protection Area.

[9] The TP criterion rule for the Everglades Protection Area, approved by USEPA, includes a four-part assessment methodology (four-part test). The purpose of this test is to serve as an assessment method to determine whether the long-term (decades) 10 ppb geometric mean criterion is being achieved on a short-term (annual) basis. The intent of the four-part test is to place an upper limit on TP concentration in the Everglades marsh and limit the variability in TP concentration allowed by the compliance test to the variability observed at marsh reference sites. Evaluations of this test have concluded that attaining these four concentration requirements together assures that the long-term TP concentration does not exceed the 10 ppb geometric mean criterion (USEPA 2005, Walker 2005).

marsh locations nearest to the STA discharges, at all transects in the Refuge and WCA2A, surface water TP exceeds 15 ppb (2010 SFER at 5-37).

From 2005 to 2009, the average annual TP concentrations being discharged from the urban basins, EAA, and the C-139 Basin into the Everglades Protection Area were 89.9 ppb for the Refuge, 31.0 ppb for WCA 2A, and 33.7 ppb for WCA 3A (2010 SFER executive summary p. 10). For 2009, the average annual TP concentrations discharged from the six STAs ranged from 13 ppb (STA 3/4) to 94 ppb (STA 6) (2010 SFER at 5-12).

2. Attainment of the TP Water Quality Criterion

Pages 3A-55 and 56 of the 2010 SFER address whether the TP criterion has been achieved in the Everglades Protection Area. The areas with soil phosphorus concentrations less than 500 mg/kg, in each WCA, including the Refuge, passed all four parts of the criterion test and were therefore considered by USEPA to be in attainment with the 10 ppb TP criterion.[10] However, the areas with soil phosphorus concentrations greater than 500 mg/kg failed one or more parts of the four-part test and therefore exceeded the criterion. Specifically, the WY2009 assessment of the four-part test confirms that surface water in the Refuge, WCA 3A and WCA 2A, at stations near water inflow structures and overlaying areas with high soil TP, still does not meet the TP criterion, with annual geometric mean TP concentrations as high as 61 ppb (site X1) in the Refuge, 35 ppb (F5) in WCA 2A and 23 ppb (CA36) in WCA 3A (2010 SFER App 3A-6).

3. Soil and Vegetation Changes

Between 2004 and 2009, four publications by scientists from several agencies and universities independently concluded that soil TP concentrations have worsened in parts of the Everglades Protection Area. In USEPA's 2007 Regional Environmental Monitoring and Assessment Program (R-EMAP) Status Report, USEPA summarized the soil conditions observed in 1995-96 and 2005. An excerpt from pages 62-63 of the 2007 report provides a succinct summary of the soil TP concentrations:

> Program data indicate that in 2005 the area of the Everglades with soil TP concentrations exceeding 500 mg/kg was 24.5 ± 6.4%, while 49.3 ± 7.1% of the 2063 square miles sampled exceeded 400 mg/kg (Figures 45 and 46). This contrasts with 16.3 ± 4.1% exceeding 500 mg/kg in 1995-96, and 33.7 ± 5.4% exceeding 400 mg/kg. Figure 47 shows the most recent (2003-2005) soil TP data at 1270 locations from all of the programs sampling in the Everglades (R-EMAP, University of Florida – SFWMD, and Florida or federal permit transect monitoring). Depicted as mg/kg, WCA 3A north of Alligator Alley, northern WCA 2A, and the edges of the Refuge most proximate to canals have the highest soil phosphorus in the portion of the Everglades underlain by peat soil (Figure 47). There are also several locations throughout southern WCA 3A and the Park with soil TP in excess of 500 mg/kg. However, these locations have no corroborative

[10] The Court's 2010 Order struck the definitions of unimpacted and impacted from the Phosphorus Rule. Because these definitions are used in the Rule for provisions that the Court did not strike, USEPA recommended in its July 29, 2010 Rule 60(b) motion to not strike those definitions. (Rule 60(b) motion, pages 19-20)

second indicator of enrichment such as water TP exceeding 10 ppb, presence of cattail, or altered periphyton communities.

Based on the information presented above, the percent of the Everglades with TP soil concentrations in excess of 500 mg/kg in 1995/1996 was approximately 16% (211,000 acres). By 2005, the high TP soil portion of the Everglades was approximately 24% (317,000 acres). In the 10 years between 1995 and 2005, TP-impacted areas increased by approximately 106,000 acres, or 50%.

As noted in the 2007 R-EMAP report, other scientific studies also documented increases in Everglades soil TP in recent years. Grunwald, et al. documented spatial expansion of elevated soil TP within WCA 2A from 1990 to 1998, concluding that, within WCA 2A, the mean soil TP concentration increased from 661 mg/kg to 860 mg/kg over this eight-year period.[11] Bruland, et al. analyzed soil TP data within WCA 3 collected from 1992 and 2003 and concluded that the area with soil TP > 500 mg/kg increased from about 21% (124,000 acres) to 30% (177,000 acres) over these 11 years.[12] Marchant, et al. documented an expansion of TP-enriched soils farther into the Refuge from 1991 to 2003.[13] The expansion of the high TP soils could be due to several causes: TP in discharges from the Everglades Construction Projects (the STAs) into the Everglades Protection Area in excess of the 10 ppb criterion; release of TP already present in upstream Everglades soils; and chemical processes in the soil, such as oxidation.[14]

The expanses of cattails in WCA 2A, WCA 3A, and the Refuge are associated with the areas of high TP in soils in the northern parts of WCA 2A and 3A and around the edges of the Refuge. The conversion of open-water sloughs to dense stands of cattail results in the loss of the vegetation mosaic that is a defining characteristic of the Everglades. This conversion results in a loss of wading bird foraging habitat, and is an indicator of a nutrient-induced imbalance in flora and fauna. In the 2007 R-EMAP Report, USEPA found that "the expanse of cattail in the northern WCA 3 is evident, as it is in peripheral portions of the Refuge and WCA 2" and that "cattail was documented as being present, but not necessarily dominant, at 19% of the R-EMAP sites sampled in 2005." In 2008, SFWMD scientists reported that the surface area of cattail in WCA 2A increased from 13,500 acres in 1991 to 23,000 acres in 1995, and then to 29,200 acres in 2003.[15] While the rate of change between these periods slowed from 2,374 acres/year to 770 acres/year, the vegetation in the Everglades continued to be altered over the 12-year period.

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[11] Grunwald, S., K. R. Reddy, S. Newman and W. F. Debusk. 2004. Spatial variability, distribution and uncertainty assessment of soil phosphorus in a south Florida wetland. *Environmetrics* 15:811-825.

[12] Bruland, Gregory L, Todd Z. Osborne, K. R. Reddy, Sabine Grunwald, Susan Newman and William F. DeBusk. 2007. Recent changes in soil TP in the Everglades: Water Conservation Area 3. *Environmental Monitoring and Assessment* 129:379-395.

[13] Marchant, B. P., S. Newman, R. Corstanje, K. R. Reddy, T. Z. Osborne, R. M. Lark. 2009. Spatial monitoring of a non-stationary soil property: phosphorus in a Florida water conservation area. *European Journal of Soil Science* 60(5):757-769.

[14] The effective treatment area of STAs has increased from about 18,000 acres in WY2003 to 43,000 acres in WY2009. (2004 SFER chapter 4 and 2010 SFER chapter 5).

[15] Rutchey, K, T. Schall and F. Sklar. 2008. Development of vegetation maps for assessing Everglades restoration progress. *Wetlands* 28(3):806-816.

The information presented above demonstrates that excess phosphorus continues to be discharged into the Everglades Protection Area, and that significant areas of the Everglades Protection Area continue to not attain the narrative and numeric water quality criteria.

B. WQBEL for the STAs That Implements the Numeric Water Quality Criterion of 10 ppb as a Long-term Geometric Mean

A critical component of an enforceable framework is a specific WQBEL to ensure that the STA discharges will not cause exceedances of the numeric criterion throughout the Everglades Protection Area. The WQBEL derived by USEPA to limit the STA discharges into the Everglades Protection Area has two components:

TP concentrations in the discharge may not exceed either:

- 10 ppb as an annual geometric mean (GM) in more than two consecutive years; or

- 18 ppb as an annual flow-weighted mean (FWM).

Compliance with both parts of the WQBEL will assure that the STA discharges will not cause an exceedance of the long-term criterion of 10 ppb. The background and statistical approach for derivation of each WQBEL component is summarized below. USEPA's WQBEL Technical Support Document (Attachment G) contains more detailed technical analysis and references. In a manner analogous to the two elements of the four-part test to assess attainment of the underlying water quality criterion cited in subsection 1 below, the WQBEL has: 1) a longer-term component (the 10 ppb GM not to be exceeded in more than two consecutive years) that assesses compliance with the water quality criterion well in advance of the criterion's longer timeframe; and 2) a short-term (higher) annual limit (the 18 ppb annual FWM) that caps the maximum TP level that can be discharged in a given year. Should FDEP propose an alternative approach to establishing a WQBEL, USEPA will evaluate its scientific rigor to ensure it appropriately implements the water quality criterion in accordance with the Clean Water Act (CWA) and its implementing regulations.

1. The TP Criterion for the Everglades Protection Area

Because the WQBEL is derived from and must comply with the underlying water quality standard, it is important to understand the underlying TP criterion for the Everglades Protection Area. TP has been measured monthly since the 1970s at reference[16] locations within the Everglades marsh in WCA 2A, 10 to 20 miles downstream of any water inflows. These data demonstrate that TP concentrations at these reference marsh locations naturally fluctuate both spatially and temporally above and below 10 ppb at any individual station. Although TP levels fluctuate, the long-term geometric mean remains at or below 10 ppb, with no indication of biological or ecological impact or imbalance. Technical staff developing the criterion used the geometric mean because it represents the central tendency of environmental data that are log-

[16] A reference station is a location that identifies the background level of water quality in the Everglades. These sites exhibit the unaltered ecosystem structure and function that are typical of a location with no evidence of phosphorus impacts or imbalance. Reference sites are routinely used to develop water quality criteria.

normally distributed (i.e., a distribution of data that has a preponderance of low values and relatively few high values), consistent with the measured phosphorus levels in the Everglades.

Relying on these data and analyses, in 2005 FDEP adopted and USEPA approved a water quality criterion expressed as a long-term TP geometric mean of 10 ppb for Class III waters in the Everglades Protection Area (see Florida Administrative Code (FAC) Rule 62-302.540). This 10 ppb geometric mean numeric criterion applies in addition to the existing narrative criterion, which states, "[i]n no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna." (see FAC Rule 62-302.530(48)(b)). The FDEP TP rule is also consistent with the State of Florida's Everglades Forever Act (EFA) which similarly specifies, "[i]n no case shall such phosphorus criterion allow waters in the Everglades Protection Area to be altered so as to cause an imbalance in the natural populations of aquatic flora or fauna." (see Florida Statutes 373.4592(4)(e)2).[17]

To determine whether the long-term criterion is being achieved in the Everglades marsh, the TP criterion rule approved by the USEPA includes a four-part assessment methodology (four-part test). The four-part test includes a longer-term 10 ppb GM value (over five years) that applies across all marsh stations and a short-term (annual) 15 ppb GM value that is the maximum that can occur at any individual marsh station. Use of both values places an upper cap on TP concentration in the Everglades marsh, while accounting for the variability observed at all marsh reference sites.

2. Description of Water Quality Based Effluent Limits (WQBEL)

Where technology-based permit effluent limits are not adequate to attain the water quality criterion of a waterbody, the CWA and implementing regulations for the CWA's National Pollutant Discharge Elimination System (NPDES) program require that discharge limits in NPDES permits be set at levels to meet water quality standards (see CWA section 301(b)(1)(C) and 40 CFR § 122.44(d)(1) and (5)). These limits are known as WQBELs.

The NPDES regulations further require that WQBELs "derive from and comply with" all applicable water quality standards (see 40 CFR § 122.44(d)(1)(vii)(A)). USEPA recommends the use of statistical procedures that translate underlying water quality criteria into defensible, enforceable and protective WQBELs (USEPA 1996). Based on this underlying regulation and as a result of the translation, WQBELs may differ from the underlying water quality criterion.

NPDES regulations require that a WQBEL be expressed as a daily maximum and a monthly average, unless impractical (see 40 CFR § 122.45(d)). However, as a technical matter, USEPA understands that expressing permit effluent limitations for nutrients like phosphorus over shorter terms (for example, as a daily maximum, weekly average, or monthly average) may

[17] The above summarizes the current situation but it is important to take note of the ongoing federal promulgation of numeric nutrient criteria for Class III waters in the State of Florida. Numeric nutrient criteria applicable to both inland and downstream estuarine and coastal waters of South Florida are expected to be proposed on November 14, 2011, and subsequently finalized on August 15, 2012. The process of developing those numeric nutrient criteria is ongoing at this time. Once finalized and implemented, those criteria may result in different ambient concentrations upstream of the STAs. In all cases upstream values must be protective of the downstream Everglades criterion. Florida Wildlife Federation v. Jackson, Doc. #90, N.D. Fla. Case No. 08-cv-324-RH-WCS.

be impractical and supports expression as annual permit limits since the effects of nutrients are expressed far afield and over longer time periods. Recent USEPA guidance for Chesapeake Bay permitting recognized this issue (USEPA 2004). USEPA is following the same approach for the WQBEL in this situation.[18]

3. Basis for Development and Use of a Flow-Weighted and Geometric Mean WQBEL

The naturally nutrient-poor marshes of the Everglades are affected by both the concentration and the load of phosphorus. Once it is discharged into the Everglades, this mass or load of TP cycles within the marsh where it can continue to impact flora and fauna. The higher load received from higher flows may accumulate in the marsh and affect its long-term observed concentrations.

In recognition of the importance of TP loading, all of the current phosphorus limits and water quality standards applied at water discharge structures in the Everglades, including the Park, express TP values as a FWM. In addition, the model used to size the STAs requires that TP data are expressed as a FWM. The FWM concentration is the average level of phosphorus in the water, weighted proportionally for the volume of flow during the time of sampling.

The current STA permits require that phosphorus data are collected weekly at discharge structures, and that the associated water flow rates are measured continuously. The calculation of FWM TP levels from such data gives greater weight to samples taken during high, rather than low, flows. Thus, high flow events resulting in higher TP loads discharged into the Everglades are directly measured and accounted for.

Establishing the annual cap as a FWM accounts for high flow TP loading events that can affect the cumulative delivery of phosphorus to the Everglades. Including a loading component provides additional protection and allows operational flexibility within the expected variability of the design parameters of the STA. In addition, an annual cap provides the means to evaluate performance and compliance on a more frequent basis than over a three-year period.

Because the underlying TP water quality criterion and each component of the four-part assessment methodology associated with that criterion are all expressed as a geometric mean, and to be consistent, USEPA chose to express the first part of the WQBEL as an annual GM. The annual GM cannot be exceeded in more than two consecutive years.

4. Method to Derive WQBEL

The WQBEL for STA discharges that USEPA developed is derived from and complies with the TP criterion for the Everglades Protection Area. To derive the WQBEL from the TP criterion, consistent with USEPA regulations, USEPA has applied a statistical approach that translates the 10 ppb long-term geometric mean water quality criterion averaged across the marsh stations to a single point at the discharge of the STAs. Based on the NPDES regulations

[18] In the 2004 Guidance, USEPA concluded "that permit limits expressed as an annual limit are appropriate and that it is reasonable in this case to conclude that it is 'impracticable' to express permit effluent limitations as daily maximum, weekly average, or monthly average effluent limitations."

cited above, a statistical approach that takes into account the variability of the pollutant concentration in the discharge is an appropriate method for deriving a WQBEL. USEPA relied on a statistical WQBEL approach for the Everglades STAs that used the long-term variability of TP and flows for these systems. (See Attachment G for a detailed analysis of the technical approach.)

As discussed above, the USEPA approach takes into consideration that the STA treatment systems are controlled marsh environments that will discharge variable concentrations of TP over time based on the influent concentrations and load of TP, the types of vegetation, variable flows and the operational practices for each STA. The construction and operation of the existing STAs has provided USEPA with substantial data on how they function. When all six STAs are considered together, there are about 50 years of historical data on TP concentration and flow values. Established statistical methods confirm that a strong relationship exists between the TP long-term GMs and FWMs at STA discharges.[19]

Inherent in the derivation of the WQBEL is an accounting for variability in the TP concentration at the discharge point. USEPA examined the year-to-year variability observed during STA operations over the past several years and compared this range of performance to an expected long-term performance that centers on the protective criterion. Because the STAs are not currently discharging at or below levels necessary to meet the underlying water quality criterion, USEPA statistically adjusted the historical STA TP data to simulate an STA discharging at the criterion - a long-term GM of 10 ppb. By adjusting the actual data to reflect levels that would meet the water quality criterion, USEPA can determine a range of acceptable TP concentrations at the STA discharge point that will meet the 10 ppb GM. Under this approach, a combination of the two values – 18 ppb FWM annual average and 10 ppb GM that cannot be exceeded in more than two consecutive years – are necessary to ensure that all relevant variability is accounted for and that the WQBEL will be stringent enough to meet the criteria as expressed in the 4-part test. Using this approach, the annual FWM TP concentration at the discharge point can be 18 ppb in any one year and still be protective of the marsh, as long as the annual GM of 10 ppb is also not exceeded in more than two consecutive years. This 18 ppb annual FWM discharge limit that must be met at each STA discharge every year represents a shorter term annual cap that helps to assure that the longer term average value would be met and is analogous to the four-part test 15 ppb GM value that must be met every year at each Everglades marsh station. As a result, USEPA is adopting the two-component WQBEL referenced above to be included in the NPDES and EFA permits for the STAs.

5. Conclusion

In this section (section III.B), USEPA is providing direction in this Amended Determination on the appropriate WQBEL for the STAs in accordance with the Court's order and in support of effective implementation by the State of its NPDES program authority under CWA section 402(b). USEPA has oversight authority over the state's program to help ensure its

[19] USEPA's analysis shows a very strong correlation (correlation coefficient = 0.92) between the geometric mean and flow-weighted mean of TP at STA discharges: flow-weighted mean = 1.23 times the geometric mean. Therefore, for example, 10 ppb geometric mean = 12 ppb flow-weighted mean, and 15 ppb geometric mean = 18 ppb flow-weighted mean.

effective implementation, including the authority to object to state permits and issue a federal permit where a state's proposed permit is outside the guidelines and requirements of the CWA.

The WQBEL calculated using the statistical approach described above will allow the TP concentration discharged from the STA to vary within acceptable limits while ensuring that the discharges will not cause exceedances of the ambient water quality criterion of 10 ppb as a long-term GM in the Everglades marsh. Expressing one component of the WQBEL as a FWM concentration prevents annual high flow loading to the Everglades and is, therefore, more appropriate than relying solely on a limit expressed as a GM concentration. Using established statistical approaches, the average annual FWM TP concentration at the discharge point can be 18 ppb in any one year and still be protective of the marsh, as long as the annual GM of 10 ppb is also not exceeded in more than two consecutive years.

C. Source Controls and Stormwater Treatment Area (STA) Expansions to Meet WQBEL

In the following discussion, USEPA refers to three distinct flow paths for runoff water from the EAA and the C-139 basins to reach the Everglades Protection Area. These are the Eastern Flow Path that drains the urban and eastern basins of the EAA through STA 1E and STA 1W to the Refuge; the Central Flow Path that drains the central basins of the EAA through STA 2/Compartment B and STA 3/4 to WCA 2A and 3A; and the Western Flow Path that drains the western portion of the EAA and the C-139 Basin through the STA 5, STA 6, and Compartment C complex into WCA 3A, flowing onto and through the Federal Reservation of the Seminole Tribe of Florida and the Federal Reservation of the Miccosukee Tribe of Indians of Florida.

As directed by the Court (2010 Order at 45), USEPA is providing clear, explicit, and comprehensive instructions to the State of Florida on the manner and method to obtain the WQBEL, including specific milestones. The total expansion required to meet the WQBEL is approximately 42,000 acres. The expansions identified by the USEPA in this Amended Determination assume that no additional source controls will be implemented that would reduce the inflow concentrations of TP to the current and anticipated expanded STAs. As we discuss below, USEPA expects the State to implement additional source controls consistent with its State law; however, as a conservative assumption, USEPA has designed the expansions based on existing inflow concentrations of TP.

The expansions discussed below include both STAs and flow equalization basins (FEBs). An FEB is a water storage feature located upstream of an STA that captures peak flows during the wet season, reducing flow spikes that can damage vegetation in the STA, and provides some TP treatment. Depending on the design, the FEB may also hold water until the dry season, and provide a needed source of water for the STA. For these reasons, USEPA has incorporated an FEB into the remedy design for the Western Flow Path. USEPA assumes that the FEB will be managed for the purpose of optimizing STA performance.

USEPA believes that further refined modeling may identify flow path-specific remedies that are equal to or better than the remedies presented in this Amended Determination in removing TP in a shorter or similar amount of time. USEPA believes it would be appropriate to provide an opportunity for the SFWMD as the permittee to provide USEPA technical input on

the remedies USEPA identifies in its Amended Determination. Therefore, USEPA is offering SFWMD the opportunity to submit within 60 days alternative remedies that could achieve WQBELs as soon or sooner than USEPA's recommended remedies. If SFWMD provides a sufficient demonstration, including modeling results that demonstrate an alternative approach will provide equal or better assurance of meeting WQBELs in the specified time frames than the remedy presented in this Amended Determination, USEPA and FDEP could take that information into account in evaluating whether there would be an alternative remedy in lieu of the remedy in this Amended Determination. USEPA would expect that any new remedy would need to be accompanied by a schedule and specific milestones to ensure timely implementation. USEPA and FDEP will evaluate the alternative presented and consider incorporating the revised approach in subsequent permitting, compliance, and enforcement proceedings. If USEPA finds the alternative(s) to be acceptable and consistent with the expectations outlined in this Amended Determination, USEPA will respond within 45 days of receiving the alternative remedy proposal with a supplement to the Amended Determination.

1. Source Control and Permitting Requirements

Starting with the 1991 Settlement Agreement in the Consent Decree Case, phosphorus control in the Everglades has been based on a combination of best management practices (BMPs) coupled with STAs. Although the specific requirements have changed over the years, the combination of source reduction and treatment continues to be the cornerstone of Everglades water quality restoration.

Subsection 4(f) of the 1994 EFA created a comprehensive permitting program for the farmers in the EAA and the C-139 Basin. The EFA requires farmers to obtain permits to develop BMPs to reduce the load of phosphorus leaving their farm basins by a specific amount, to implement a monitoring program to show the effectiveness of the BMP program and compliance with permits, and to continue to conduct research to identify water quality parameters that are not being significantly improved and identify further BMP strategies (see EFA Subsection 4(f)1 – 3, 5 and 6).[20] Under the permitting program, the farmers in the EAA basins have specific requirements to collectively reduce the phosphorus load in their discharges by a minimum of 25%; the C-139 Basin farmers are prohibited from collectively exceeding an annual average load of 28.7 metric tons for three consecutive years based on a specific period of record (1978 to 1988). Under this structure, as long as the farmers implemented BMPs, reduced the level of phosphorus leaving the basin as a whole by the specified amount, and met the taxing requirements of the EFA, no further actions were needed until December 31, 2006.[21] The SFWMD issues and enforces these permits.

[20] Under EFA Subsection 4(f)(3)(b), a compliance schedule is not available to new land uses and new stormwater management systems.

[21] After Judge Davis found subsection 4(f) of the EFA to be a de facto suspension of water quality standards as it applied to the farm discharges, USEPA issued its 1999 Determination approving subsection 4(f) as a compliance schedule implementing the phosphorus criterion for the farmers. Miccosukee Tribe of Indians vs. United States, Case No 95-533-CIV-DAVIS (S.D.FL.), 9/14/08 Omnibus Order. In the 1999 Determination, USEPA approved the compliance schedule (which contained this BMP/STA-based approach), however, stating that "As noted above, the reasonableness and acceptability of the 12 year schedule also assumes that the December 31, 2006 deadline will be met." 1999 Determination, FN 15. In sum, USEPA agreed to let the existing regulatory structure stand until December 31, 2006, but as of that date additional actions could be required and were mandated by the EFA.

In the 2008 Court Order, citing USEPA's 1999 Determination, the Court recognized the December 31, 2006 date as a deadline for complying with the TP criterion. If the water delivered to the Everglades was not achieving applicable water quality standards including the numeric criterion for TP by this date, the State was required to take additional steps to reduce the levels of TP. Under the EFA, this includes SFWMD reissuing the farm permits with specific limits in those permits.

Specifically, Section 4(f) of the EFA provides:

> 3. The Legislature finds that through the implementation of the Everglades BMPs Program and the implementation of the Everglades Construction Project, reasonable further progress will be made towards addressing water quality requirements of the EAA canals and the Everglades Protection Area. Permittees within the EAA and the C-139 Basin who are in full compliance with the conditions of permits under chapters 40E-61 and 40E-63, Florida Administrative Code, have made all payments required under the Everglades Program, and are in compliance with subparagraph (a)7., if applicable, shall not be required to implement additional water quality improvement measures, prior to December 31, 2006, other than those required by subparagraph 2., with the following exceptions:
>
> a. Nothing in this subparagraph shall limit the existing authority of the department or the district to limit or regulate discharges that pose a significant danger to the public health and safety; and
>
> b. New land uses and new stormwater management facilities other than alterations to existing agricultural stormwater management systems for water quality improvements shall not be accorded the compliance established by this section. Permits may be required to implement improvements or alterations to existing agricultural water management systems.
>
> 4. As of December 31, 2006, all permits, including those issued prior to that date, shall require implementation of additional water quality measures, taking into account the water quality treatment actually provided by the STAs and the effectiveness of the BMPs. As of that date, no permittee's discharge shall cause or contribute to any violation of water quality standards in the Everglades Protection Area.

The December 31, 2006 permitting requirements applied equally to the EAA farmers as well as to the C-139 basin farmers.[22] See EFA 4(f)(6).

Despite the regulatory programs in place, concentrations of TP in runoff from the S-5A and C-139 Basins are greater in the last five years than over the full period of record based on

[22] The C-139 Basin Rule has been amended and is scheduled to go before the SFWMD Board for adoption the week of September 6th, 2010. If adopted, it should become effective in November after public comment.

SFWMD data. The inflow concentration of TP has a significant effect on the outflow concentration of TP at the STA discharge point.[23] USEPA modeling indicates that reductions of TP in the inflow to the STAs can reduce the acreage of STAs required to the meet the WQBEL (see Attachment H). As discussed above in Section III.A., portions of the Everglades Protection Area are not achieving either the numeric TP criterion or the narrative nutrient criterion. Although the existing BMP program and the current STAs are providing reductions in the level of phosphorus discharged to the Everglades Protection Area,[24] additional steps are needed to ensure the water quality criteria are achieved. For the purposes of this Amended Determination, the additional steps include expansions of the STAs and/or use of FEBs. However, USEPA believes that the SFWMD could utilize their existing statutory mechanisms, knowledge of inflow concentrations to the STAs, and modeling results, to quantify how a given level of source control can improve the efficiency of the STAs, or possibly decrease the necessary acreage required in the remedies below.

2. Expanded Stormwater Treatment: Actions and Milestones

In responding to the Court's order, USEPA evaluated the need for additional STAs or FEBs in each of the three flow paths in order to attain the WQBEL in discharges to the Everglades Protection Area. Based on modeling conducted by USEPA, the existing footprint of the STAs including the ongoing expansions in Compartment B and Compartment C is projected to discharge TP at the following annual FWM concentrations: 34 ppb from STA 1E and STA 1W; 20 ppb from the STA 2 and Compartment B complex; 16 ppb from the STA3/4; and 18 ppb from the STA5, STA 6 and Compartment C complex (see Attachment H for assumptions and model results). Without additional STA acreage and/or source controls, none of these STAs can be expected to meet the WQBEL. USEPA's modeling predicts a significant STA expansion or FEB is needed in all three flow paths. In order to meet water quality standards in the Everglades, the State must build, as expeditiously as practicable, these additional STAs and FEB. For each flow path, the specific actions and milestones, are summarized below along with the underlying assumptions. However, as noted above, the SFWMD can evaluate these options and present alternatives within 60 days of this Amended Determination.

(a) Modeling Approach

USEPA used an STA phosphorus removal performance model to predict the STA or FEB acreage required in order to meet the WQBEL at the STA's point of discharge into the Everglades Protection Area. This model,[25] developed in 2001, has undergone several enhancements and has been routinely used by SFWMD to evaluate STA expansions. A description of the model, model input and the assumptions used about the inflow water volume and TP concentrations to be treated are provided in Attachment H.

In order to establish the size of the STAs or FEBs required to meet the WQBEL, the outflow TP concentration objective for the STAs must be determined along with an appropriate

[23] The outflow TP concentration is also influenced by the size of the STA and other factors.
[24] Since 1994, STAs and BMPs have prevented over 3,000 metric tons of TP from entering the Everglades Protection Area. (2010 SFER)
[25] Dynamic Model for Stormwater Treatment Areas (DMSTA). See Attachment H for more information.

margin of safety. USEPA conducted modeling scenarios using three different outflow concentration end points, beginning at the criterion, to assess the sensitivity of the predicted STA expansion acres to the desired end point, and the certainty that the WQBEL will be met. The lower the desired end point (in other words, the more stringent the discharge modeling end point), the larger the projected STA expansion acreage, and the greater the assurance (margin of safety) that the STA will meet the WQBEL. USEPA assessed three end points including a 10 ppb long-term geometric mean (the long-term criterion); a 9.3 ppb long-term geometric mean; and an 8.9 ppb long-term geometric mean.[26]

Traditional wastewater treatment systems are generally designed with a margin of safety to assure compliance with the conditions of environmental permits. In making this decision for the Everglades' wetlands treatment systems, USEPA has considered several factors in specifying the margin of safety. The larger an Everglades wetland treatment system, the more difficult it is to manage the system for optimal treatment, especially maintaining the system as fully flooded throughout drier years. In addition, there is a cost to the public, as a larger margin of safety requires the purchase of additional land to serve as treatment wetlands and operation of these larger systems is more technically challenging. Given these considerations, USEPA concluded that it is appropriate to incorporate a limited margin of safety into the design target for the STAs, and therefore, selected a TP concentration of 9.3 ppb long-term geometric mean as the basis for the additional STA acreage needed to meet the WQBEL.[27]

The inflow concentration of TP assumed in the model is also critical for determining the predicted size of the STA or FEB needed to meet the WQBEL. The higher the inflow concentration assumed, the larger the acreage needed to meet the WQBEL. USEPA assessed the TP concentrations discharged from the EAA and C-139 basins over the period of record as well as over the last five years. The concentrations in the S-5A basin and C-139 basin are higher during the last five years than over the period of record (despite the phosphorus removal attributed to the State's EAA and C-139 Basin regulatory programs). USEPA assumed in the modeling an inflow concentration equal to that observed over the last five years, and therefore, the remedies presented in this Amended Determination are not dependent upon further reductions in TP concentrations in the inflows to the STAs and/or FEBs.

(b) General Considerations in Developing the Schedule

In its 2010 Order, the Court instructed USEPA to "establish specific milestones to ensure the State of Florida does not continue to ignore, and improperly extend, the compliance deadline for meeting the phosphorus narrative and numeric criteria in the Everglades Protection Area." Order at 45. It is clear the Court intends these milestones to reflect a schedule for compliance as soon as practicable. USEPA has assessed historical information and considered other factors to determine specific milestones for each of the three flow paths. The schedule by which the

[26] These concentrations, which are expressed as a long-term geometric mean, as the Everglades Protection Area marsh criterion is expressed, are equivalent to 12 ppb, 11.5 ppb and 11.0 ppb at the STA discharge when expressed as a FWM. The DMSTA model used to size the STAs requires that TP data are expressed as a FWM.

[27] Lowering the design target from 9.3 ppb to 8.9 ppb results in additional 4000 acres of STA expansion. Given the potential for the STA to dry out, potentially inhibiting treatment performance, there is only an incremental gain in potential treatment performance at an additional cost of tens of millions of dollars. Therefore, USEPA has concluded that a margin of safety to this magnitude is unwarranted.

WQBEL can be met for each of the flow paths depends on many different and complicated factors such as: how fast the State can purchase the additional land needed for the expanded STA or FEB; how long it will take for certain land use changes to be adopted; how fast the State can design and build large STAs or FEBs; and how long will it take a new STA marsh to fully develop and process legacy phosphorus and begin to effectively treat the inflow water down to the levels required to meet the WQBEL.[28] USEPA considered all of these factors as it developed the milestones for each flow path. A general discussion of the factors and information considered by USEPA for each of the major categories of actions is discussed below.

Land Acquisition Schedule Analysis

Under the scenarios presented here, the SFWMD will need to purchase additional parcels of land to meet the WQBEL at the STA discharges. The SFWMD Board recently voted to purchase 26,800 acres from the U.S. Sugar Corporation for restoration and water quality improvements to the Everglades. Approximately 8,900 acres of the proposed purchase is located in Palm Beach County in the northern part of the S5A basin, and 17,900 acres are in Hendry County within the C-139 annex. This purchase is to be finalized in October 2010. The amount of time required for the State to complete land acquisition is highly variable and has ranged from two to eight years.

USEPA is allowing in this Amended Determination two months for land acquisition in the Western Flow Path where the pending U.S. Sugar Corporation purchase provides adequate land needed for treatment. In the Eastern Flow Path, the State will need to purchase land in addition to the pending U.S. Sugar Corporation purchase. USEPA is allowing three years for the State to complete the purchase of this additional land. For the purposes of this Amended Determination, completion of land acquisition is when the State has access to the property either by permission or by ownership.

STA Design Schedule Analysis

There are two general phases in the design of an STA: (1) the planning and conceptual design phase, and (2) the detailed design phase, including preparation of plans and specifications. Some, of the conceptual design for the STAs presented in this Amended Determination has been accomplished by the DMSTA modeling undertaken to produce this document. The detailed design, which is specific to the parcel of land on which the STA is built, requires access to the land for environmental assessments, testing, and data collection. The test results and other data provide the information needed for the production of detailed plans and specifications for land leveling, locations and sizing of levees, berms, canals and gates, and the hydraulics for how water will be moved into, through, and out of the STA (or FEB), including the size and locations of pumps. For access to the land, SFWMD must have acquired the land through purchase or, at least have been granted permission for access by the land owner before the detailed design phase can begin.

[28] Some soils in the STA expansion areas have previously been farmed and may contain high levels of phosphorus. When the expanded STAs are flooded, this legacy phosphorus will continue to be released to the water column until the system has stabilized.

Historical information provided by the SFWMD indicates STA design has ranged in the past from two to five years. USEPA is allowing in this Amended Determination two years for design, based on the assumption that the past experience of the SFWMD should greatly facilitate the design process. There is one exception in the Central Flow Path where a shorter design period is needed for an interim shallow storage feature on the EAA A1 site. Flow path by flow path details are provided below.

Permitting Schedule Analysis

While the design is ongoing, the SFWMD must obtain a number of different authorizations (permits) from local, state and federal agencies before it can initiate construction on a project. These include: an EFA permit from the State for construction of the project; a CWA Section 404 permit from the U.S. Army Corps of Engineers (USACE) for the discharge of dredged or fill material into waters of the US; a Section 10 permit under the Rivers and Harbors Act from the USACE if the project impacts a navigable water; a Clean Air Act permit from FDEP if the project includes a diesel pump station; a CWA Section 402 NPDES permit from FDEP to discharge to waters of the State; a consumptive water use permit from the State; and in some cases, permits from the local government for a land use change. If the project involves alterations to an USACE flood control levee, and a private party (not the USACE) is the applicant, then a 33 U.S.C. Section 408 analysis must be conducted.

The FDEP will not generally accept an EFA permit application until the project design is 30% complete, and will generally not issue the permit until the project design is 90% complete. The federal CWA Section 404 permit requires certification that state water quality standards will be met by the project and cannot be issued until the State EFA permit is issued (which provides the water quality certification).[29] The federal CWA Section 404 permit also must comply with the federal requirements under the National Environmental Policy Act (NEPA), including an Environmental Impact Statement (EIS) where the permit is considered a "major action significantly affecting the quality of the environment." In some cases, where the CWA Section 404 permit is not considered to be a "major Federal action significantly affecting the quality of the human environment," an environmental assessment may be conducted.[30] In addition, where the project may affect a threatened or endangered species or its habitat (as do most of the projects in the Everglades), the federal Section 404 permit requires the USACE to initiate a Section 7 consultation with U.S. Fish and Wildlife Service under the Endangered Species Act. The federal Section 404 permit would likely be the lengthiest of the permit processes, and would govern how soon construction on the project could begin. Based on past experience, USEPA assumes that all environmental permitting necessary for construction to begin can be accomplished in 2.2 years, in parallel with the design process. USEPA also assumes that it will take two additional months following the end of design to acquire final permits for those projects that are dependent on 90% design completion. Additional considerations affecting specific flow-paths are provided below.

[29] In some cases the USACE will issue a permit with a contingency clause that no work may begin until the CWA Section 401 certification and/or NEPA documentation is complete.

[30] USEPA's schedule is based on individual NEPA actions. It may be more efficient to combine all NEPA analyses into one EIS for all of the projects.

STA Construction Schedule Analysis

There are two main phases in the construction of an STA: 1) the civil works which include land leveling, and construction of levees, canals, gates, and other structures; and 2) construction and installation of pumps and pump stations.[31] The existing pumps and pump stations used in the Everglades construction projects are among the largest in the world, and were required to be specially designed and built for this purpose. The SFWMD now has prototypes for these pumps and experience in their procurement and installation.

Historical information provided by the SFWMD indicates STA construction has ranged in the past from three to seven years. USEPA is allowing in this Amended Determination three years for construction based on the conclusion that the SFWMD now has considerable experience in the construction of STAs and that a number of experienced construction contractors exist.[32] This timeline assumes that all expansions will need hydraulic improvements, most likely some system of pumps and an associated pump station. Therefore, from the end of the permitting phase, USEPA is allowing three years for the completion of construction. Flow-path by flow-path details are provided below.

Flooding Schedule Analysis

Approximately two years after construction is started, after the external berm and internal levees and gates are built, but before the pumps and the pump station are completed, an STA expansion is flooded with water.[33] This allows the marsh vegetation to begin to establish, and the existing legacy TP loads in the soil within an STA, if any, to be reduced. USEPA is assuming that within one year (by the time construction is complete), the STA will begin demonstrating net improvement in water quality at the downstream point within the STA on a consistent basis as compared to the inflow concentration. It is at this point that the SFWMD may begin discharging to the Everglades Protection Area.[34] It is assumed that flooding will begin two years after construction has started, with one exception in the Central Flow Path where some flooding has already occurred in the EAA A1 site. Flow-path by flow-path specific details are provided below.

STA Performance Consistent with WQBEL

Once discharge from the STA begins, the STA will continue to mature and lower discharge concentrations of TP will occur.[35] It is USEPA's judgment (based on the modeling

[31] For example, in STA 3/4 which is 16,500 acres (26 square miles), there are approximately 39 miles of levees and about 60 water control structures.
[32] The construction schedule does not make any assumptions concerning the length or intensity of the rainy season. Since this has the potential to delay construction some flexibility in the schedule may be needed to accommodate for rainfall conditions.
[33] Flooding depends on rainfall. Some flexibility in the schedule may be needed to accommodate rainfall conditions.
[34] The required net improvement in water quality includes not only TP, but also other parameters, in particular mercury. In the past, net improvement in mercury took longer than net improvement in TP for one STA, thereby controlling the timeframe before which some of the STA could discharge.
[35] STAs are constructed wetlands that are designed and managed to maximize phosphorus removal. Each STA has flowways containing treatment cells that operate in series and are delineated by levees. These treatment cells

conducted for this Amended Determination) that given the proper sizing of an STA, the TP in the discharge from the STA will meet the WQBEL once the STA is properly stabilized and functioning at its design efficiency.[36]

However, a period of time will be needed for the STA to perform at its full treatment capacity. This period of time will vary depending on the conditions of the STA. USEPA expects that intensive management of the STA will be required for fine-tuning it to achieve its desired performance. This may include adjustments in the type and proportion of vegetation which could take several growing periods to accomplish.[37] Hydrologic short circuiting within cells has also been an issue in past STA performance that could require time and effort to identify and correct.[38] While it is possible under the most optimistic scenario for the STA to reach the WQBEL in a shorter amount of time, USEPA believes that a more realistic expectation is for an STA expansion to begin performing in a manner consistent with the WQBEL 2.5 years after the STA is flooded.

There are several scenarios in this Amended Determination where existing STAs will continue to be hydraulically overloaded with runoff water until a portion of the flows can be diverted to new STA or FEB expansions. Once the flows are diverted to the expansion, the existing STA will need to adjust to the new hydraulic condition. There are no data from other STAs for estimating the time it takes an existing STA to adjust to new, albeit preferable, hydraulic conditions. Therefore, the estimate of time for this adjustment is uncertain. USEPA estimates, using best professional judgment, that it will take 9-12 months after excess flows are diverted away for the STA to begin performing in a manner consistent with the WQBEL.

Once an STA begins discharging consistent with the WQBEL, it is delivering water to the Everglades Protection Area that protects the designated use of the Everglades, and will not cause an imbalance in flora or fauna.[39] Compliance with the WQBEL will be determined in accordance with the provisions of the conformed NPDES and EFA permits described in Section V.

3. Flow Path by Flow Path: Actions and Milestones

As directed by the Court (2010 Order at 45), and consistent with its authority under CWA sections 104(a)(1), (2) and 104(b)(1) and (7), USEPA is providing clear, explicit, and comprehensive instructions to the State of Florida on the manner and method to obtain the

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contain various types of vegetation such as submerged aquatic vegetation or emergent vegetation. The modeling used to size the STAs in the remedies for this AD assumes some cells are dominated by submerged aquatic vegetation and some cells are dominated by emergent aquatic vegetation.

[36] USEPA recognizes that until such time the WQBEL has been achieved, elevated TP loads will continue to enter the Everglades. In order to assess the cumulative effects of these discharges, specific monitoring will be required to track the phosphorus discharged over time and its effects. See Section IV.

[37] Vegetation management may include repeated herbicide treatments and seeding by helicopter or by hand to establish an STA with the most efficient mix of submerged or emergent aquatic vegetation to maximize TP assimilation.

[38] SFWMD should take extra care to provide proper leveling of the site during construction.

[39] Some soils in the Everglades contain high levels of phosphorus from historical discharges. Release of this phosphorus from the soil to the water column could delay the attainment of the TP criterion in portions of the Everglades beyond the time when the upstream STAs are discharging at the WQBEL.

WQBEL, including specific milestones for building STA expansions or FEBs. A summary of the remedies needed to attain the WQBEL in all STA discharges to the Everglades Protection Area is provided in Attachment B. Based on USEPA modeling, approximately 42,000 additional acres are needed for STA or FEB in order to meet the WQBEL. The remedies are discussed in detail in the following flow-path by flow-path discussion.

(a) The Eastern Flow Path

The Eastern Flow Path drains runoff from the S5A basin and urban basins to the east, through STA 1E or STA 1W into the Refuge. STA 1E and STA 1W were initially designed to discharge at 50 ppb. Both are significantly undersized and not capable of treating the load of TP draining from these basins to levels needed to achieve the WQBEL. According to USEPA modeling conducted for this Amended Determination, assuming no reduction in the inflow concentrations, a 15,000-acre STA expansion is needed to attain the WQBEL. An additional estimated 1,500 acres will be needed for berms, levees, and canals for a total of 16,500 acres.[40]

The SFWMD Board recently voted to purchase 8,900 acres from U.S. Sugar in the northern part of the S5A basin; this purchase is to be finalized in October 2010. Purchase of this land affords the SFWMD with the opportunity to either use this land in place as an STA, or exchange this for land adjacent to the existing STAs. With the U.S. Sugar Corporation purchase, an additional 7,600 acres will need to be purchased for the full STA expansion required.[41]

The area to the east of STA 1E is highly urbanized and does not appear to offer much opportunity for expansion of the STA 1E footprint. As a result, USEPA is assuming that the expansion will occur adjacent to STA 1W. Since STA 1E will not be expanded, the inflow volume must be reduced to a volume that can be effectively treated to the WQBEL. Flow that cannot be treated by STA 1E will be diverted to the expanded STA 1W facility. Since both STA 1E and STA 1W depend upon the STA 1W expansion in order to meet the WQBEL, neither can meet the WQBEL until the additional land is purchased, and the expansion is designed, built and operating. Under this scenario, STA 1E and STA 1W (with the expansion) will treat all existing flows to the Refuge, and no flows will be diverted away from the Refuge for treatment elsewhere. (See the STA 1E and STA 1W summary tables below for milestones and final WQBEL date.)

USEPA has modeled another potentially viable alternative for the eastern flow path for meeting the WQBEL in possibly a shorter period of time. This alternative includes an 8,000-acre STA and a 1,700-acre storage reservoir (44 feet deep) in the C51 basin that is currently under consideration by the South Florida Water Management District (District) and a number of Lower East Coast utilities.[42] Under this alternative, the C51 reservoir would store water and release flows to STA 1E and an expanded STA 1W at a rate and quality that could be treated to the WQBEL.

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[40] See Attachment H, Table 3, ID 3.
[41] USEPA's remedy presented in this Amended Determination assumes that the STA expansion will occur in the area adjacent to STA 1W. If the U.S. Sugar Corporation purchase is used in place as an STA, additional acres may be needed to account for the loss of efficiency in utilizing an STA not contiguous with STA 1W.
[42] See Attachment H, Table 3, ID 6.

It was not possible in the time available for this Amended Determination for the USEPA to have assurance that a number of uncertainties with the C51 reservoir will be addressed. The success of this alternative depends upon a public-private partnership that will require many specific details and arrangements to assure the project moves forward on schedule and in a manner that will assure the right volume and quality of flows are delivered to the STAs. The SFWMD has indicated potential benefits this alternative might provide such as: an increase in flows of water to the Everglades Protection Area; better quality of water to the Refuge; fewer harmful fresh water diversions to the Lake Worth estuary; and meeting the WQBEL as early as 2017. The SFWMD may provide adequate assurance and sufficient information within the 60 day window to document the likelihood of success consistent with the timetable in the Amended Determination.

(i) STA 1E: Milestones and Schedule

STA 1E was originally designed by the USACE to treat water from the S5A and urban basins to meet a long-term TP outflow concentration of 50 ppb, which was the original design target under the 1992 Consent Decree in the Consent Decree Case. The STA is, therefore, significantly undersized and cannot attain the WQBEL at this time. For the existing STA 1E to meet the WQBEL, approximately 47% of the current flow will have to be diverted to an expanded STA 1W. As a result, STA 1E will not begin to fully meet the WQBEL until flows can be diverted to STA 1W after the STA 1W expansion is complete. This diversion will not occur until November 30, 2018 (see discussion of the schedule for STA 1W below).

STA 1E is also not currently performing to its full capacity due to operational issues involving failed or inadequate structures and elevation in some of the cells. Other culverts are likely to fail in the future, and need to be proactively repaired. Also, Cells 1 and 2 in STA 1E are temporarily operating at a decreased hydraulic capacity for an USACE pilot project (Periphyton Stormwater Treatment Area, or PSTA) which decreases the effective treatment area of the STA. Repairs, re-grading, decommissioning the pilot project, and establishment of the treatment system vegetation are all needed for STA 1E to ultimately meet the WQBEL. In the interim, before flow can be diverted to STA 1W, the repairs and modifications to STA 1E, when completed, will significantly improve the performance of the facility in reducing TP concentrations in the outflow water. For this reason, the repairs to STA 1E need to be made as soon as practicable so that the STA is delivering less TP to the Refuge, although full compliance with the WQBEL will not occur until the expanded STA 1W complex is operational and available to take flows away from STA 1E.

The USACE has either entered into contracts or is seeking approval to complete certain repairs to STA 1E. The anticipated schedule of repairs is built into the following milestones. <u>The State of Florida will need to work closely with the USACE and the District so that the following actions are completed in the timeframes specified below to bring STA 1E to full operational capacity by the dates in the STA 1E summary table below.</u> These activities will be completed in parallel with expansion activities in STA 1W. At the completion of the project, STA 1E will receive an annual average inflow volume of approximately 109,000 acre-ft per year.

STA 1E: Summary of Milestones and Schedule to Meet WQBEL	
Activity Milestone	**Date to Complete Activity**
Decommission USACE PSTA pilot project (after consultation with the Tribe)	September 30, 2011[43]
Complete repair/modification work: S-375 culvert repair Repair of 23 culvert joints and seals Re-grading of cells 5 and 7 Trash rakes and screens modifications	March 31, 2015
Improved performance of STA 1E (1 year after repairs and modifications are complete)	April 1, 2016
Flow modification to S-375 culvert (same date as STA 1W expansion is flooded)	November 30, 2017
Divert Flow to 1W (construction at STA 1W is complete.)	November 30, 2018
STA 1E performance consistent with WQBEL (1 year after diversion – allows the STA to adjust to the new hydraulic condition)	November 30, 2019

<u>The State will need to work with the USACE to decommission the periphyton pilot project in STA 1E by September 30, 2011.</u>

The USACE Jacksonville District initiated a pilot project in 2004 to test the efficacy of a periphyton-based treatment system (PSTA). The purpose of the PSTA was to utilize periphyton on a substrate to see if this would improve the phosphorus removal efficiency of the STA. To date, the Jacksonville District has collected approximately seven months of data over the six-year period of pilot project operation. The lack of sufficient water to establish periphyton and provide flow has been a primary reason for the limited amount of data collected. Also, the failure of the S-365A and B culverts contributed to limitations in data collection. The USACE is currently evaluating the data collected from the pilot project in 2010. Based on this analysis, the USACE anticipates decommissioning the pilot project in 2011 after consultation with the Tribe. Once started, decommissioning is expected to take approximately nine months.[44]

[43] The USACE has indicated that this is the earliest possible date for decommissioning the PSTA pilot project.
[44] SFWMD has been conducting a PSTA pilot study in STA 3/4 since 2007. Results indicate that under controlled conditions the pilot project has discharged TP at 8-12 ppb FWM (SFER 2010 at 5-150).

The State will need to work closely with the USACE so that the repairs and modifications to STA 1E listed below are completed by March 31, 2015.

Complete S-375 culvert repair: Culvert S-375 is a multi-bay gated culvert separating two distribution cells. Water intrusion through the culvert seals and joints causes erosion at the base of the culvert leading to the failure of the structure. The structure can no longer pass the design flows from one cell to another, and repairs are needed to allow the proper flow of water through the STA.

Complete repair of culvert joints and seals: STA 1E has 44 internal 8 ft-by-8 ft precast segmented concrete box culverts that allow the flow of water to be distributed across treatment cells and into the perimeter canal. The SFWMD performed a survey identifying 23 culverts that have degraded joints and seals which may cause failure of the culverts in the future (similar to the problem at S-375.) These conditions must be corrected to prevent culvert failure in the future.

Complete re-grading of cells 5 and 7: SFWMD commissioned a topographic survey of STA-1E in 2005. This survey indicated that Cells 5 and 7 (19% of the treatment area) are, on average, 0.73 feet and 1.19 feet too deep, respectively, in relation to the design elevation. The SFWMD has concluded that the increased depth prevents the establishment of emergent vegetation growth, and re-grading of Cells 5 and 7 is necessary to correct the elevation. The re-grading of the cells will require a significant volume of fill to bring the bottom elevation of the cells up to the appropriate grade. USEPA assumes that, to the extent practicable, the fill material used for re-grading will be relatively low in TP legacy concentrations. The USACE and the State (SFWMD) should take all steps possible to ensure the top of the fill material in Cells 5 and 7 has low legacy TP concentrations.[45]

Trash rakes and screens modifications: During severe tropical events, the amount of floating vegetation at the pump stations exceeds the trash rake system's capacity. While the equipment installed by the USACE matches the plans and specifications, the USACE agrees with the SFWMD that the current system will not perform at an acceptable level during a storm event, and the USACE is currently planning to undertake modifications to the trash and rake system.

The State will need to manage STA 1E so that improved performance of the STA will occur by April 1, 2016.

After the repairs and modifications to STA 1E are complete, it is assumed that within 1 year, the discharge from STA 1E will show reductions in the amount of TP released to the Everglades Protection Area. While the STA will not be able to meet the WQBEL until additional flows can be diverted to STA 1W, the improvements in TP loading will benefit the Everglades Protection Area.

[45] The USACE indicated to the USEPA that it is assessing the USACE's responsibility to fund and implement the re-grading of Cells 5 and 7. If the USACE determines it will not complete the re-grading, the State, working with the SFWMD, will need to take the measures necessary to meet the WQBEL at STA 1E by November 30, 2019.

The State (SFWMD) will need to modify S-375 to increase its flow capacity to the design flow of the pump station by November 30, 2017.

The design capacity of the S-375 culvert is not large enough to move adequate flows from STA 1E to STA 1W to allow STA 1E to achieve the WQBEL. SFWMD will either need to enlarge S-375 or build a parallel culvert to properly balance flows across STA 1E and 1W. This modification will also require a 33 U.S.C. Section 408 review since C-51 was originally designed as a federal flood control project and this levee is part of that system. However, given the other actions planned for this STA, this review will not add to the timeframe for achieving the WQBEL. The modification will need to be accomplished by the date at which flooding begins in expanded STA 1W.

The State will need to begin diverting approximately 47% of the flow currently going to STA 1E to the expanded STA 1W complex by November 30, 2018.

As discussed above, in order for STA 1E to meet the WQBEL, the flow to this STA must be reduced. The flows diverted from STA 1E will be treated in the expanded STA 1W; therefore, the expansion of STA 1W must be completed and ready to accept flows before flows can be diverted away from STA 1E. Based on USEPA's DMSTA modeling, flows in excess of an annual average inflow volume of 109,000 acre-ft per year must be diverted away from STA 1E for it to perform consistent with WQBEL.

The State will need to provide discharge water from STA 1E that is consistent with the WQBEL by November 30, 2019.

STA 1E will continue to be hydraulically over-loaded while the STA 1W expansion is under design and construction. Once flows are diverted away from STA 1E, it will take the STA some period of time to adjust to the new hydraulic conditions. There are no data from other STAs for estimating the time it takes an existing STA to adjust to new, albeit preferable, hydraulic conditions. Therefore, the estimate of time for this adjustment is uncertain. USEPA is estimating, using best professional judgment, that it will take up to 12 months after excess flows are diverted away for STA 1E to begin performing in a manner consistent with the WQBEL. At this point, the STA is to be delivering water to the Everglades Protection Area that protects the designated use of the Everglades, and does not lead to an imbalance in flora or fauna. Compliance with the WQBEL will be assessed in accordance with the terms of the conformed NPDES and EFA permit described in Section V.

(ii) Expanded STA 1W: Milestones and Schedule

STA 1W is significantly undersized to treat the current volume of inflow water to meet the WQBEL. In addition, approximately 47% of the current flow going to STA 1E must be diverted to an expanded STA 1W in order for STA 1E to meet the WQBEL. According to modeling conducted by USEPA for this Amended Determination, a 15,000-acre STA expansion of the STA 1W facility is needed for both STA 1E and STA 1W to meet the WQBEL. An additional 1,500 acres will be needed for levees, berms and canals for a total of 16,500 acres.[46]

[46] See Attachment H, Table 3, ID 3.

At the completion of the project, the expanded STA 1W complex will effectively treat to the WQBEL an annual average inflow volume of 321,000 acre-ft per year.

The State of Florida will need to complete the following actions in the timeframes specified below to bring STA 1W to full operation to attain the WQBEL. The requirements are summarized in the table below, and are then discussed in greater detail.

STA 1W Expansion - Summary of Schedule to meet WQBEL	
Activity Milestone	**Date to Complete Activity**
Complete land acquisition for 15,000 acre STA expansion (3 years)[47]	September 30, 2013
Complete expansion design (2 years)	September 30, 2015
Acquire all necessary environmental permits needed to begin construction of the STA 1W expansion (2 months after the end of design)	November 30, 2015
STA 1W expansion flooding starts (2 years after construction starts)	November 30, 2017
Complete construction (3 years after permitting); flows from STA 1E can now be diverted to STA 1W	November 30, 2018
STA performance consistent with WQBEL (2.5 years after flooding)	May 31, 2020

The State will need to complete its purchase (including any land exchange) needed to build a 16,500-acre STA expansion in the eastern flow path by September 30, 2013.

As discussed above, the State announced its intention to purchase 8,900 acres from U.S. Sugar in the northern part of the S5A basin; this purchase is to be finalized in October 2010. The 8,900 acre tract is about 15 miles north of STA 1W, by canal. The State will either use this land in place as an STA, or exchange this for land adjacent to, or in close proximity to, STA 1W.[48] The SFWMD is evaluating whether a possible exchange could provide land adjacent to the Refuge that is suitable for an STA.

Assuming current flows and loading, this purchase provides approximately 54% of the land needed for the expanded STA. An additional 7,600 acres would need to be purchased to

[47] Approximately 8,900 acres is currently under contract to be purchased by the SFWMD in the northern S5A Basin from the U.S. Sugar Corporation.

[48] USEPA's modeling is based on an assumption that the expanded STA will be built adjacent to the current STA 1W footprint. If a decision is made to use the 8,900 acre parcel purchased from U.S. Sugar Corporation in its current location, additional modeling will need to be conducted to determine a revised STA expansion acreage needed to meet the WQBEL. It is unclear whether use of the northern parcel in place will be as efficient as an expansion adjacent to STA 1W. Additional acreage, beyond 7,600 acres, may be needed under this scenario.

meet the STA expansion needs. If there are no ready and willing sellers in this area, then land acquisition may require the SFWMD to use its full authorities to acquire the land for the needed expansion. Past experience suggests that this will complicate the land acquisition process, and lengthen the amount of time to complete the purchase. Given this uncertainty, USEPA's schedule provides the State three years to complete the process.

The State will need to complete the detailed design including all plans and specifications for the 15,000-acre STA 1W expansion by September 30, 2015.

The detailed design, which is specific to the parcel of land on which the STA is built, requires access to the land for environmental assessments, testing, and data collection. The test results and other data provide the information needed for the production of detailed plans and specifications for land leveling, locations and sizing of levees, berms, canals and gates, and the hydraulics for how water will be moved into, through, and out of the STAs, including the size and locations of pumps.

The State will need to acquire all necessary environmental permits needed to begin the STA 1W expansion construction by November 30, 2015.

See Section III.C.2.(b) above for discussion of the environmental permitting process.

The State will need to have the STA 1W expansion site ready for flooding by November 30, 2017.

Approximately two years after construction is started, after the external berm and internal levees and gates are built, but before the pumps and the pump station are completed, the STA 1W expansion will be flooded internally with water. This allows the marsh vegetation to begin to establish, and the existing legacy TP loads in the soil within an STA, if any, to be reduced. USEPA is assuming that approximately one year after flooding, the STA will begin demonstrating net improvement in water quality at the downstream point within the STA on a consistent basis as compared to the inflow concentration. Once net improvement has occurred and the pumps and pump stations are completed, the State may begin discharging from the STA to the Everglades Protection Area.

The State will need to complete construction of the STA 1W expansion by November 30, 2018.

Construction includes two main phases: 1) the civil works which include land leveling, and construction of levees, canals, gates, and other structures; and 2) construction and installation of pumps and pump stations. Therefore, from the end of the permitting phase, USEPA is allowing three years for the completion of construction, including hydraulic improvements.

The State will need to discharge water from the expanded STA 1W facility (including the current STA 1W facility plus the 15,000-acre expansion) that is consistent with the WQBEL by May 31, 2020.

See Section III.C.2.(b) – STA Performance Consistent with WQBEL (above) for a discussion of factors affecting the date by which the STA can meet the WQBEL. The expanded STA 1W facility will be built in an area of existing agricultural production where significant legacy loads of TP may be present in the soil. The new treatment marsh will need to overcome the legacy loads of soil TP before TP removal from the inflow water will begin to occur. The USEPA estimates that it will take the expanded STA facility up to 2.5 years after flooding to begin to perform consistent with the WQBEL. At this point, the STA is to be delivering water to the Everglades Protection Area that protects the designated use of the Everglades, and does not lead to an imbalance in flora or fauna. Compliance with the WQBEL will be assessed in accordance with the terms of the conformed NPDES and EFA permit described in Section V.

(b) The Central Flow Path

The central flow path drains runoff from the S-2, S-6, and S-7 basins through STA 2 and STA 3/4 into WCA 2A and 3A. A project is currently well underway to expand the Central Flow Path by 6,800 acres in the Compartment B North Build-Out (Comp B NBO) and Compartment B South Build-Out (Comp B SBO). Modeling conducted by USEPA for this Amended Determination indicates that, even with the Compartment B expansions, the Central Flow Path will need an additional 15,600-acre STA expansion to meet the WQBEL. An additional 1,560 acres will be needed for berms, levees and canals for a total additional acreage of 17,160 acres.[49]

Within the Central Flow Path, there are two large parcels of land currently owned by the State that are designated under the Comprehensive Everglades Restoration Program (CERP) as water storage sites. These are the EAA A1 and the EAA A2 compartments. The SFWMD estimates the A1 site to have approximately 15,000 acres of potential STA effective treatment area, and the A2 site to have approximately 14,000 acres of potential STA effective treatment area. The A1 site is contiguous with STA 3/4 and the Comp B NBO and, as such, is strategically located for an expansion of the current STAs.

The A1 site alone is not large enough to fulfill the complete needs of the Central Flow Path for expanded STA acreage. A portion of the 14,000-acre A2 site, currently owned by the State, could provide the additional acreage needed without a lengthy land acquisition process. The A2 site is currently designated as a CERP water storage project for future construction. This land is currently under lease-back to farmers and notice will need to be served on those landowners regarding State plans to use this site for treatment or storage.

USEPA considered including an option in this Amended Determination for utilizing the A1 site as a deep reservoir in the event the Consent Decree Court rules to deny the State's motion for relief in building the A1 site as a reservoir. Such an option has been developed by

[49] See Attachment H, Table 3, ID 3.

USEPA and can be provided at such time that a decision to deny the State's motion is issued. However, on August 30, 2010, the Special Master issued his Report of the Special Master (SM Report), recommending the court relieve the SFWMD of its obligation to build the A1 reservoir. The Special Master based that recommendation on changing circumstances and the affect it could have on the ability to build other restoration projects. "If the District is required to build a reservoir on Compartment A-1, the ability of the State Parties to expand STA 3/4 by utilizing adjoining land (see Figure 1 above) will be eliminated and the cost to the District of having to build the A-1 Reservoir, make the Cross-Bolles Canal improvements, and build ECART, will significantly foreclose its financial ability to develop additional STAs to satisfy water quality standards ...." SM Report at 56-57. "The estimates provided to the Special Master are that something between $724 and $815 million would be required to build A-1 Reservoir and related canal improvement projects." SM Report at 58. Based on the Special Master's Report, USEPA is including in the Amended Determination one remedy based on an STA expansion in the A1 compartment. Should the Consent Decree Court rule to deny the State's motion, the alternative remedy for A1 as a deep storage reservoir can be provided in a timely fashion.

(i) STA 2, STA 3/4 and Compartment B: Milestones and Schedule

USEPA is assuming in this remedy that the A1 site will be utilized in full as a 15,000-acre STA. Any additional STA acreage needed can be obtained from the A2 site. Since the A1 site provides 15,000 acres of effective STA treatment area, an approximate 600-acre STA expansion will be needed at the A2 site. (Any remaining area within the A2 not needed as an STA could be developed for water storage.) USEPA believes the WQBEL can be attained in STA 3/4 and Comp B NBO by December 31, 2014 if the A1 site is first utilized as an interim shallow storage reservoir, and later converted to an STA. This will allow water to be stored in the A1 site and allocated to STA 3/4 and Comp B NBO at a flow and TP load that can meet the WQBEL.[50] The remaining central basin flows will be directed to STA 2 and the Comp B SBO. STA 2 and Comp B SBO will achieve the WQBEL when the A1 site and A2 site STA expansions are designed, built, and in operation. The SFWMD will need to make improvements in the canal conveyance from the S6 Basin to the expanded STAs in the Central Flow Path (such as the Cross-Bolles Canal system) to divert flows away from STA 2 and Comp B SBO in excess of the volume that can be effectively treated to the WQBEL. At the completion of these projects, the Central Flow Path STA complex will be discharging to WCA 2A and WCA 3A about 987,000 acre-ft of average annual flow (see Attachment H).

[50] See Attachment H, Table 3, ID 5.

The State of Florida will need to complete the following actions in the timeframes specified below to bring STA 2 and Compartment B SBO to full operation to attain the WQBEL. The requirements are summarized in the table below.

STA 2 and Comp B SBO: Summary of Schedule to Meet WQBEL (A1 and A2 utilized as STAs)	
Activity Milestone	**Date to Complete Activity**
Assumes Consent Decree Court Rules on use of the A1 site	September 30, 2011
Complete NEPA review for land use change of A1 and A2	May 31, 2013
Complete Design for STA in A1 and A2 (2 years after Consent Decree Court rules on use of A1)	September 30, 2013
Acquire all necessary environmental permits needed to begin construction of STAs in A1 and A2 (2 months after design is complete)	November 30, 2013
Expansion flooding in A2 starts (2 years after construction begins)	November 30, 2015
Complete construction of STAs in A1 and A2 (3 years after permitting)	November 30, 2016
Complete improvements in the canal conveyance from S6 to expanded STA 3/4 complex (A1 and A2 STAs)	December 31, 2016
STA 2 and the Comp B SBO STA performance consistent with the WQBEL (2.5 years after flooding)	May 31, 2018

The State will need to work with the federal agencies to complete the required NEPA review by May 31, 2013.[51]

Before any progress can be made on design and construction of an expanded STA on the A1 site, the Court in the Consent Decree Case must grant the State's motion for relief from building the site as a reservoir. If the decision in the Consent Decree Court is made one year from now and the ruling is in favor of the State, the State can file a new permit application with the USACE who can begin the NEPA process to change the use of the A1 site and a portion of the A2 site from water storage to an STA. The estimated timeframe for completion of the NEPA process is approximately 1.5 years. USEPA encourages the USACE and the SFWMD to use an efficient approach to conducting the required NEPA review.

[51] As noted above, there is a potential for one NEPA analysis to be completed for all of these projects.

The State will need to complete the detailed design including all plans and specifications for the A1 and A2 STA expansion by September 30, 2013.

USEPA is assuming that a detailed design for converting the use of the A1 and part of the A2 compartments from a reservoir to a STA can begin as soon as the Consent Decree Court rules on the A1 case. SFWMD should have access to the land immediately to begin testing and other data collection since the land is currently owned by the State. Given these assumptions, the State will need to complete the detailed design within two years after a decision is reached by the Court in the Consent Decree Case.

The State will need to acquire all necessary environmental permits needed to begin construction on the A1 and A2 expansion by November 30, 2013.

See Section III.C.2.(b) above for discussion of the permitting process.

The State will need to have the A2 expansion site ready for flooding by November 30, 2015.

Approximately two years after construction is started, after the external berm and internal levees and gates are built, but before the pumps and the pump station are completed, the STA expansion will be flooded internally with water. This allows marsh vegetation to begin to establish itself within the STA, and the existing legacy TP loads in the soil within an STA, if any, to be reduced. USEPA is assuming that approximately one year after flooding, the STA will begin demonstrating net improvement in water quality at the downstream point within the STA on a consistent basis as compared to the inflow concentration. Once net improvement has occurred and the pumps and pump stations are completed, the STA can begin discharging to the Everglades Protection Area.

The State will need to complete construction of the A1 and A2 expansions by November 30, 2016.

Construction includes two main phases: 1) the civil works which include land leveling, and construction of levees, canals, gates, and other structures; and 2) construction and installation of pumps and pump stations. USEPA is allowing three years for construction, including hydraulic improvements.

The State will need to complete improvements in the canal conveyance from S6 basin to the A1/A2/STA 3/4 complex by December 31, 2016.

STA 2 and Comp B SBO are not adequately sized to treat all flows from the S6 Basin. To avoid a lengthy land acquisition process to buy land adjacent to STA 2, USEPA's remedy will need the State to improve canal conveyance to move water away from STA 2 and Comp B SBO to STA 3/4 and the A1/A2 expansions.

The State will need to provide discharge water from the expanded A1 and A2 facilities (including the current STA 2 and Comp B SBO facilities) that is consistent with the WQBEL by May 31, 2018.

The expanded A1/A2 facility will be built in areas where some of the land has been lying fallow (the A1 compartment), and some of the land is in current agricultural production (the A2 compartment). A portion of the new treatment marsh may need to overcome legacy loads of soil TP before TP removal from the inflow water will begin to occur. USEPA estimates that it will take the expanded STA facility 2.5 years after flooding to begin to perform consistent with the WQBEL. At this point, the STA is to be delivering water to the Everglades Protection Area that protects the designated use of the Everglades and does not lead to an imbalance in flora or fauna. Compliance with the WQBEL will be assessed in accordance with the terms of the conformed NPDES and EFA permit described in Section V.

The State of Florida will need to complete the following actions in the timeframes specified below to bring STA 3/4 and the Comp B NBO into full attainment with the WQBEL. The requirements are summarized in the table below.

STA 3/4 and Comp B NBO - Summary of Schedule to meet the WQBEL A1 as FEB and later converted to STA + A2 STA	
Activity Milestone	**Date to Complete Activity**
Assumes Consent Decree Court rules on use of the A1 site	September 30, 2011
Complete NEPA review for land use change of A1 and A2	May 31, 2013
Complete design for A1 interim shallow storage reservoir	May 31, 2013
Acquire all necessary environmental permits needed to begin construction of A1 as interim shallow storage reservoir (2 months after design is complete)	July 31, 2013
Complete construction and begin diverting flows to the A1 interim shallow storage reservoir (8 months after permitting)	March 31, 2014
STA 3/4 and Comp B NBO performance consistent with WQBEL (9 months after flows diverted to A1 FEB)	December 31, 2014

The State will need to work with the federal agencies to complete the required NEPA review by May 31, 2013.

Before any progress can be made on design and construction of an expanded STA on the A1 site, the Court in the Consent Decree Case must grant the State's motion for relief from building the site as a reservoir. If the decision in the Consent Decree Court is made one year from now and the ruling is in favor of the State, the State can file a new permit application with the USACE who can begin the NEPA process to change the use of the A1 site and a portion of the A2 site from water storage to an STA. The estimated timeframe for completion of the NEPA process is one year and eight months. USEPA encourages the USACE and the SFWMD to use an efficient approach to conducting the required NEPA review.

The State will need to complete the detailed design including all plans and specifications for the A1 interim shallow storage reservoir by May 31, 2013.

Some construction has already occurred at the A1 site for a reservoir. Some perimeter berms are in place, grubbing and clearing have occurred, and some land leveling activities have taken place. USEPA is assuming that a detailed design for converting the use of the A1 parcel to an interim shallow storage reservoir can begin as soon as the Consent Decree Court rules on the A1 case. Given these assumptions, the State will need to complete the detailed design within approximately one year and eight months after a decision is reached by the Court in the Consent Decree Case. This design process will run in parallel with the NEPA process for changing the use of the A1 compartment from storage to treatment.

The State will need to acquire all necessary environmental permits needed to begin construction on the A1 interim shallow storage reservoir by July 31, 2013.

See Section III.C.2.(b) above for discussion of the permitting process. The schedule for A1 interim shallow storage reservoir allows the State one year and ten months after the Consent Decree Court rules on the A1 site to obtain the necessary permits for constructing the A1 site as an interim shallow storage reservoir.

The State will need to have construction of the A1 site interim shallow storage reservoir complete and flooded by March 31, 2014.

It is assumed by USEPA that the A1 site can be constructed as a shallow storage reservoir by March 31, 2014. The State has already made significant progress in building this site as a reservoir, and it is assumed that completing construction (which involves finishing the external berm) can be accomplished quickly.

The State will need to provide discharge water from STA 3/4 and the Comp B NBO facilities that is consistent with the WQBEL by December 31, 2014.

Once flows can be diverted to the A1 interim shallow reservoir, the STA 3/4 and Comp B NBO STAs can begin to adjust to the new favorable hydraulic conditions. STA 3/4 has been performing well even at the current over-loaded conditions. USEPA is assuming that STA 3/4

and Comp B NBO will take nine months to adjust and begin to perform consistent with the WQBEL. See Section III.C.2.(b) – STA Performance Consistent with WQBEL (above) for a discussion of factors affecting the date by which the STA can meet the WQBEL.

(c) The Western Flow Path

The Western Flow Path drains runoff from the C-139 basin and some runoff from the S-3 and S-8 basins through STA 5 and STA 6 into discharge canals that ultimately discharge to WCA 3A. A project is well underway to expand STA 5 and STA 6 by 4,100 acres in the Compartment C build out. Modeling conducted by USEPA for this Amended Determination indicates that, even with the Compartment C expansion, the Western Flow Path will need a 7,000-acre FEB to meet the WQBEL in STA 5, STA 6 and Compartment C.

Compartment C is currently under construction, and is planned for completion in February 2012. Construction was recently halted in response to the discovery of cultural resources. Consultation among the SFWMD, Seminole and Miccosukee Tribes, the State Historic Preservation Office and the USACE is being reinitiated under section 106 of the National Historic Preservation Act 16 U.S.C. 470 (1966). Upon completion of this consultation process, the SFWMD plans to report to the Special Master in the Consent Decree Case on the costs and timelines associated with remediation of the cultural resource sites. The deadline for completion of this process is not known at this time.[52]

USEPA is assuming these issues will be resolved and Compartment C will remain on schedule to be flooded in the 2012 wet season (approximately July 2012). Once Compartment C is operational, some inflows currently going to STA 5 and STA 6 can be diverted to Compartment C for treatment. This diversion to Compartment C will reduce the hydraulic over-loading in STA 5 and STA 6 and improve their overall performance, resulting in less TP loading to the Everglades. However, until the additional 7,000-acre FEB is operational, STA 5, STA 6 and Compartment C will be unable to meet the WQBEL.

USEPA explored the concept of requiring the State to meet the WQBEL in the existing STA 5 and STA 6 facilities shortly after flows could be diverted to Compartment C, and concluded the STAs will not be able to meet the WQBEL until the C-139 FEB facility is built and operational. STA 5 and STA 6 have performance problems related to hydraulic over-loading during the wet season and dry-out of portions of the STA during the dry season. Soils in STA 5 and STA 6 are sandy and far more permeable than the peat or muck soils in the central and eastern flow paths. As a result, water seeps through the soils into the ground water during the dry season causing dry-out of the STAs. When the dry part of the STA is re-flooded with water, TP from the soils is released into the water column, causing spikes in the outflow of the STA. This drying-out is associated with poor performance in STA 5 and 6, and may also result in poor performance in Compartment C. Given current performance issues in STA 5 and STA 6, these STAs will need to operate as a unit with the Compartment C and the C-139 FEB in order for effective treatment to occur. Therefore, STA 5, STA 6, and Compartment C will not meet the WQBEL until the STA expansion is fully operational.

[52] See South Florida Water Management District's Responses to Questions Posed by the Special Master During the Hearing on July 26-30, 2010.

The SFWMD recently announced a pending purchase of 17,900 acres of citrus groves from the U.S. Sugar Corporation in the C-139 basin annex. This purchase is to be finalized in October 2010. This large parcel of land is located west of, and adjacent to, Compartment C and STA 6, making it an optimal location for the expansion of the STA 5/STA 6/Compartment C complex. Therefore, even though land acquisition is needed in the Western Flow Path, this does not significantly lengthen the schedule for meeting the WQBEL since land acquisition is anticipated to be complete approximately two months after the Amended Determination is filed (or by November 2, 2010).[53]

When Compartment C and the 7,000-acre FEB are fully operational, the western STA complex including STA 5, STA 6, Compartment C, and the C-139 FEB will be capable of treating the existing run-off from the C-139 basin (an average annual inflow volume of 200,000 acre-ft per year) to the WQBEL.

(i) STA 5, STA 6, Compartment C, and C-139 expansion: Milestones and Schedules

The State of Florida will need to complete the following actions in the timeframes specified below to bring Compartment C to full operation. The requirements are summarized in the table below.

STA 5, STA 6 and Comp C - Summary of Schedule to meet the WQBEL	
Activity Milestone	**Date to Complete Activity**
Complete construction of Compartment C	February 29, 2012[54]
Compartment C is flooded (in 2012 wet season after cultural resource issue resolved)	July 1, 2012
Begin discharge from Compartment C (1.5 yrs after flooding)	January 1, 2014
Improved performance of STA 5 and STA 6 (1 yr after diverting flows to Comp C)	January 1, 2015
Complete construction of C-139 expansion and begin to divert flows away from STA 5, STA 6 and Compartment C	September 30, 2016

[53] USEPA is assuming the State's purchase of the U.S. Sugar Corporation property in the C-139 Basin will be finalized in November 2010. If this land acquisition is not finalized, this could affect the schedule for meeting the WQBEL in the Western Flow Path.
[54] This date is contingent upon completion of the cultural resource concerns in Compartment C.

STA 5, STA 6, Compartment C complex performing consistent with the WQBEL (1 year to adjust to new hydraulic condition)	September 30, 2017

The State will need to complete construction of Compartment C by February 29, 2012.

Compartment C is currently under construction. The levees and canals are scheduled to be completed by December 2010. The pumps and pump station will be fully operational by February 2012. USEPA is assuming issues with cultural resources, which have halted work in Compartment C, will be resolved so that the following schedule can be met. USEPA is also assuming that Compartment C will be completely flooded during the 2012 wet season (late spring to early summer). Once discharge from Compartment C begins, a portion of the inflows currently being treated by STA 5 and STA 6 can also be treated by Compartment C.

The State will need to have Compartment C ready and flooded by July 1, 2012.

In the case of the Western Flow Path, USEPA is assuming that flooding is likely to only be possible during the wet season. In this case, while the external berm and internal levees may be complete in the Fall of 2011, flooding will occur in the wet season of 2012.

The State will need to have Compartment C showing net improvement and begin discharging by January 1, 2014.

After flooding, marsh vegetation can begin to establish itself within the STA, and the existing legacy TP loads in the soil within the Compartment C STA, if any, can be reduced. Once the Compartment C STA begins demonstrating net improvement in water quality at the downstream point within the STA on a consistent basis as compared to the inflow concentration, the SFWMD may begin discharging to the Everglades Protection Area.

The State will need to manage STA 5 and STA 6 so that improved performance of the STAs will occur by January 1, 2015.

After excess flows are diverted away from STA 5 and STA 6 to Compartment C, it is assumed that within one year, the discharges from STA 5 and STA 6 will show reductions in the amount of TP released to the Everglades Protection Area. While the STAs will not be able to meet the WQBEL until flows can be diverted to the C-139 expansion, the improvements in TP loading will benefit the Everglades Protection Area.

The State will need to complete construction of the C-139 expansion by September 30, 2016.

Construction includes two main phases: 1) the civil works which include land leveling, and construction of levees, canals, gates, and other structures; and 2) construction and installation of pumps and pump stations. USEPA is allowing three years for construction, including hydraulic improvements.

The State will need to discharge water from the STA 5/STA 6/ Compartment C complex that is consistent with the WQBEL by September 30, 2017 and consistent with the water quality standards for the downstream Miccosukee and Seminole Tribal waters.

The C-139 FEB is in areas that are currently in citrus production. The past construction of STAs in areas of prior citrus production has not demonstrated large legacy loads of soil TP. Since this FEB will operate in series with STA 5, STA 6 and Compartment C and will discharge through STA 5, STA 6, or Compartment C, the FEB is not required to directly meet the WQBEL, but flow equalization in this upstream facility controls when STA 5, STA 6, and Compartment C will meet the WQBEL. It is assumed that it will take STA 5, STA 6, and Compartment C one year after the hydraulic loading is reduced to adjust to the new hydraulic condition. At this point, the STAs will be delivering water to the Everglades Protection Area that protects the designated use of the Everglades, and does not cause an imbalance in flora or fauna. Compliance with the WQBEL will be determined in accordance with the provisions of the conformed NPDES and EFA permit for this STA discussed in Section V.

C-139 Expansion - Summary of Dates	
Activity Milestone	**Date to Complete Activity**
Complete land acquisition for C-139 FEB	November 30, 2010
Complete NEPA Review	May 31, 2013
End of design for C-139 FEB (2 years after land acquisition)	June 30, 2013
Acquire all necessary environmental permits needed to begin construction of the C-139 expansion (one year and ten months after end of design)	August 31, 2013
C-139 expansion flooding starts (in wet season following 1 year and 10 months after construction starts)	July 1, 2015
Complete construction of C-139 expansion (3 years after permitting)	September 30, 2016
Flows now going through the C-139 FEB into STA 5/6 and Comp C	September 30, 2016

The State will need to complete its purchase of 8,800 acres needed to build a FEB in the C-139 annex by November 3, 2010.

The State announced a pending purchase of 17,900 acres in the C-139 annex. The purchase is to be finalized in October 2010.

The State will need to work with the federal agencies to complete the required NEPA review by May 31, 2013.

In order to obtain a CWA Section 404 permit to build an FEB in the C-139 basin, a NEPA review will need to be conducted. The USACE can begin the NEPA process as soon as the land purchase is finalized. The USACE is considering the development of a regional EIS. In this case, the NEPA process for the C-139 FEB will be on the same schedule as the EIS for the Central Flow Path. The estimated timeframe for completion of the NEPA process is approximately two years and seven months. USEPA encourages the USACE and the SFWMD to use an efficient approach to conducting the required NEPA review.

The State will need to complete the detailed design including all plans and specifications for the 7,000-acre FEB in the C-139 annex by June 30, 2013.

The detailed design, which is specific to the parcel of land on which the STA is built, requires access to the land for environmental assessments, testing, and data collection. The test results and other data provide the information needed for the production of detailed plans and specifications for excavation, berms, canals and gates, and the hydraulics for how water will be moved into, through, and out of the FEB, including the size and locations of pumps.

The State will need to acquire all necessary environmental permits needed to begin construction on the C-139 FEB by August 31, 2013.

See Section III.C.2.(b) above for discussion of the environmental permitting.

The State will need to start flooding the C-139 FEB in the 2015 wet season by July 1, 2015.

Approximately two years after construction is started, after the external berm and internal levees and gates are built, but before the pumps and the pump station are completed, the FEB may be flooded internally with water. However, in the case of the western STAs, USEPA is assuming that flooding is likely to only be possible during the wet season.

The State will need to complete construction of the C-139 expansion by September 30, 2016.

Construction includes two main phases: 1) the civil works which include land leveling, and construction of levees, canals, gates, and other structures; and 2) construction and installation of pumps and pump stations. USEPA is allowing three years for construction, including hydraulic improvements.

The State will need to begin diverting flows through the C-139 expansion and into STA 5, STA 6 and Compartment C by September 30, 2016.

As soon as construction is complete on the C-139 FEB, flows can be diverted away from STA 5, STA 6, and Compartment C into the C-139 FEB. From the C-139 FEB, flows will be

allocated to STA 5, STA 6, and Compartment C at a rate that the TP loading can be treated by the STAs to the WQBEL.

IV. Measure and Submit Annual Reports on Cumulative Impacts until Water Quality Standards Attained

Pursuant to the 2010 Order at 45, the State is directed to "measure on a yearly basis the cumulative impacts and effects of phosphorus intrusion beyond the 10 ppb standard within the Everglades Protection Area until such time as full compliance with the 10 ppb standard is achieved." Monitoring and reporting was a critical element of the enforceable framework in USEPA's 1999 Determination. At that time there was an extensive monitoring and reporting program in place that met those requirements. This program continues today.[55] The FDEP and SFWMD currently have a monitoring program for assessing TP throughout the Everglades Protection Area with results reported in the annual South Florida Environmental Report (SFER).

However, there are enhancements to this monitoring program that would be needed to fully address the Court's 2010 Order to monitor and report on cumulative effects. Therefore, USEPA is directing FDEP to conduct or perform other actions related to monitoring of TP and its cumulative impacts in the Everglades Protection Area. In addition, the SFER needs to report on an annual basis the total volume of water discharged into the Everglades Protection Area from the EAA and C139 Basins, the annual FWM TP concentration, and the TP load. The SFER also needs to report the loads of TP that would have been discharged had the annual FWM TP concentration been at 18 ppb and the annual GM TP concentration been at 10 ppb (WQBEL).

<u>A. Rectify two limitations with the current application of the total phosphorus water quality criterion in the Everglades Protection Area. The State is to review the application of the four-part test and submit to USEPA a methodology for how it intends to address the two deficiencies specified below by January 31, 2011.</u>

The TP criterion rule for the Everglades Protection Area includes a four-part assessment methodology (four-part test) that was affirmed by the Court in 2008. (F.A.C. 62-302.540(4)). The purpose of this test is to assess whether or not the long-term (decades) 10 ppb geometric mean criterion is being achieved on a short-term (annual) basis. The four-part test places upper limits on TP concentration in the Everglades marsh using temporal and spatial scales to limit the variability or range of TP concentrations throughout the Everglades to the variability observed at the unimpacted marsh reference sites. The objective is to determine whether the TP criterion is met throughout all of the Everglades Protection Area. Results are reported annually by FDEP in the SFER. As of 2009, FDEP applies the four-part test via a network of 58 water quality sampling stations within the Refuge, WCA2 and WCA3 (2010 SFER 3A-11 to 3A-14, Appendix 3A-6). However, there are two limitations with the State's current application of the four-part test to the Everglades Protection Area.

[55] Subsection (4)(d) [Everglades research and monitoring program] specifically identifies the research and monitoring required as well as the submission of an annual report (providing the results of the research and monitoring) to the Legislature.

(1) Failure to consistently assess achievement of the criterion in drier parts of the Everglades Protection Area: The first limitation involves the lack of application of the TP criterion to drier portions of the Refuge and northwestern WCA3A. At the time that the TP Rule was approved in 2005, the four-part test station network was being established. Paragraph 7 of the Rule incorporates a data quality screening protocol that limits the applicability of the Rule to only those stations that have a minimum of six months of data within a given water year. Now that five years of data are available (2010 SFER Appendix 3A-6), it has become apparent that a consequence of this six-minimum sample requirement is that from 2005 to 2009, the TP criterion typically was not consistently applied to two drier portions of the Everglades Protection Area: three stations in the Refuge (A108, LOX 3 and LOX 5) and one station in WCA3A (CA35) immediately north of the Federal Reservation of the Miccosukee Tribe of Indians of Florida. This latter station is of particular interest because it is FDEP's only four-part test station upstream of these tribal waters that can assure that the downstream waters are protected as required by the CWA.

To correct this limitation, FDEP needs to assess the application of the four-part test every five years and assure that the criterion is applied in a manner that is protective of these drier portions of the Everglades Protection Area. FDEP should report the first review with any suggested corrective measures to USEPA by January 31, 2011.

(2) Gaps in the spatial coverage of the monitoring network in the Refuge (WCA1): The application of the four-part test needs minor adjustment to the station locations within the Refuge in order to fill in gaps in the spatial coverage. Two stations need to be added to the four-part test network in the Refuge; a station midway between X4 and LOX 11, and a station midway between LOX 7 and LOX A137. See page 3A-11 of the 2010 SFER.

B. Prepare an annual report due on March 1 of each year starting on March 1, 2011 summarizing TP water quality, vegetation, and soils data from each transect monitoring site. The report must provide a summary of whether the TP conditions at each site are improving, worsening, or remaining unchanged.

Sampling along transects downstream of the STAs is necessary to determine the extent of phosphorus intrusion into the Everglades marsh due to STA discharges above the 10 ppb WQBEL, and to determine whether these discharges cause or contribute to violations of water quality standards. This type of sampling is useful for understanding the spatial extent of impacts, as well as changes in condition, including improvement, at a location over time. STA 1E and 1W discharge directly into the Refuge. The discharge from STA 2 presently travels two miles in a canal before it flows into the Everglades Protection Area. The EFA permits for these STAs currently require downstream monitoring along transects. The conformed[56] NPDES permits for these three STAs will also require monitoring along transects downstream of the STA discharge for the purpose of documenting TP intrusion into the Everglades Protection Area, and determining whether STA discharges are causing or contributing to water quality standards violations and are causing other ecological impacts.

[56] As described in more detail in section V.A., USEPA is providing a strikethrough "conformed" version of all current STA NPDES and EFA permits in Attachment I.

In addition to requiring annual reporting of monthly monitoring for surface water TP concentration, the soil TP concentration must also be determined at the transect stations in the 0-10 cm soil profile once every two years. Also, beginning in the dry season of 2011, the extent of macrophyte indicators of phosphorus enrichment such as, but not limited to, cattail, will be quantified each year during the dry and wet seasons using established methods.[57] Any modification to the monitoring plan or methods must be pre-approved by USEPA. If future modifications to water delivery patterns result in water from STA3/4 being discharged directly southward into WCA3A, then the same transect monitoring program will be required in the STA3/4 NPDES permit beginning two years before discharge.[58] The conformed permits reflect these requirements.

C. Assure that stratified random sampling is conducted every five to seven years throughout the Everglades Protection Area in order to document soil TP conditions and temporal trends. The next sampling is to be completed by December 2012[59] (unless an adjustment to this date is needed to integrate with monitoring conducted through the CERP) and a final report provided to the USEPA by December 2013.

An additional monitoring design is required in order to quantitatively determine the magnitude, extent, and expansion of phosphorus pollution and cumulative impacts throughout all of the Everglades Protection Area. Phosphorus levels in soil are a key indicator of enrichment. Various sampling designs have been previously used by scientists in the Everglades to make quantitative statements about soil phosphorus.[60]

By January 31, 2011 the most appropriate sampling design will be determined subject to review by USEPA. This will include the specific location and number of sampling stations. The design will be subjected to scientific review and submitted to USEPA for approval by February 28, 2011. This monitoring effort should be integrated as appropriate with monitoring conducted through the CERP or other restoration or natural resource management activities. This comprehensive monitoring and reporting program will ensure that the progress being made in restoration of the Everglades can and will be documented. This will also ensure that as the additional STAs or FEBs are being constructed, the status of the Everglades will be monitored to document further degradation or improvement. Ultimately, this program will provide some of the information needed to determine whether restoration is complete.

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[57] SFWMD 2010 *Project WCA-2A Monitoring Plan for STA 2 and Compartment B Build-out Downstream Monitoring Plan*. SFWMD-FIELD-MP-071-01. (January 20, 2010)

[58] Part of the long term goal of Everglades restoration is to restore sheetflow to the Everglades that will require modification to how the water is delivered to the Everglades Protection Area.

[59] The most recent sampling for soil TP throughout the Everglades was completed in 2008 for WCA 2 and in 2005 for the rest of the Everglades Protection Area.

[60] Previous soil TP sampling efforts have sampled about 200 to 1000 individual sites per event, with the specific location and number of sample stations determined by different scientific and statistical methods, each of which has strengths and weaknesses. The District has used a grid approach and a stratified random design (2006 SFER at 6-49 to 6-50). USEPA R-EMAP has used a stratified version of a random probability-based design. This approach allows quantitative determinations across space about the status of an ecological condition, such as in 2005 soil TP exceeded 500 mg/kg in 24.5 +/- 6.4% of the Everglades Protection Area. (see Scheidt, D. J. and P. I. Kalla. 2007. Everglades ecosystem assessment: water management, water quality, eutrophication, mercury contamination, soils and habitat. Monitoring for adaptive management: a R-EMAP status report. USEPA 904-R-07-001. United States Environmental Protection Agency, Atlanta, Georgia.)

D. Assure that maps that accurately depict the spatial extent of cattail and a summary report are completed on a recurring basis for the Refuge, WCA 2, WCA 3, and the Park. The first report and maps are to be completed by dates detailed below (unless an adjustment to this date is needed to coordinate with monitoring conducted through the CERP) and a final report provided to the USEPA by dates detailed below.

Vegetation maps have been used to document the spatial extent and spread of cattail throughout the Everglades Protection Area.[61] Maps that accurately depict the extent of cattail, a biological indicator of phosphorus enrichment and imbalance, are to be completed for each region of the Everglades Protection Area (the Refuge, WCA2, WCA3 and the Park). These efforts should be integrated as appropriate with monitoring conducted through the CERP. The summary report must quantify the extent of cattail and the rate of expansion, if any, throughout the Everglades region. Deadlines for acquiring the imagery and completing the cattail maps and report are as follows:

Region	Date of most recent cattail map imagery	Image Acquisition	Cattail Map and Report Completed
WCA2A	2003	March 2011	March 2012
WCA3A and WCA3B	2004	March 2012	December 2014
Refuge	2004	March 2013	March 2014
Park (freshwater)	2009	March 2014	December 2015

V. NPDES and EFA Permits

In this Amended Determination, USEPA's development and description of the WQBEL in section III.B, in accordance with the Court's 2010 Order, supports the effective implementation by the State of its NPDES program authority under section 402(b) of the CWA. USEPA has oversight authority over the State's program to help ensure its effective implementation, including the authority to object to state permits and issue a federal permit where a state's proposed permit is outside the guidelines and requirements of the CWA. The 2010 Order established that the permits must be conformed based on the court's finding that FDEP violated the injunction in the Court's 2008 Order on Summary Judgment by taking action in "administrative orders" that are incorporated into NPDES permits and that provide for an extended compliance period for attainment of the water quality standards for phosphorus under the NPDES permits. 2010 Order at 18-21. After FDEP conforms the NPDES permits to include the WQBELs, judicial review of the conformed permits would be available in Florida tribunals.

[61] Rutchey, Ken, Ted Schall and Fred Sklar. 2008. Development of vegetation maps for assessing Everglades restoration progress. *Wetlands* 28(3):806-816; Sklar, F. T. Dreschel and K. Warren. 2009. Chapter 6: Ecology of the Everglades Protection Area. In 2009 South Florida Environmental Report – Volume I. South Florida Water Management District and Florida Department of Environmental Protection. West Palm Beach, Florida.

A. Conforming STA NPDES Permits and EFA Permits.

Pursuant to the Court's Order, FDEP is directed to take the following actions related to the existing NPDES and EFA permits for discharges from the STAs:

1. Conform all existing STA NPDES and EFA permits to the CWA, the Court's 2008 Order, and the Court's 2010 Order, by eliminating all references to the non-conforming elements of the Long-Term Plan, the moderating provisions, and any extended compliance schedules through 2016.

2. Incorporate into conformed permits a WQBEL as identified in this Amended Determination.

3. Conform all permits within 60 days of this Amended Determination.

Attachment I to this Amended Determination includes a redline/strikethrough version of each current STA NPDES and EFA permit that USEPA has prepared for use by FDEP that addresses the Court's Order that all non-conforming elements of the existing permits be eliminated. USEPA has also provided specific instructions in the Attachment I permits that: 1) incorporate the WQBEL, including added provisions for providing early warning of possible non-compliance with the WQBEL and reporting excess TP loads if the WQBEL is not met; 2) update various items that must be included in each Annual Report; 3) update the pollution prevention and operations plans; and 4) require various water quality, vegetation, and sediment monitoring in downstream Everglades marsh transects to enable future evaluation of the extent of phosphorus intrusion due to STA discharges and evaluation of the extent to which STA discharges cause exceedances of water quality standards (as required in Section IV.B. above). A detailed explanation of USEPA's changes to the Attachment I permits is provided in Attachment J.

B. Elimination of Compliance Schedules in NPDES and EFA Permits for Discharges into the Everglades Protection Area

Florida's implementing regulations have a general provision authorizing compliance schedules for new or revised water quality standards.[62] That State statutory provision, at section 403.0885, mirrors the federal NPDES regulation regarding compliance schedules in permits at 40 C.F.R. § 122.47. This is the provision under which FDEP included the administrative orders/compliance schedules in the current STA permits. USEPA's previous approval in USEPA's 1999 Determination authorized a compliance schedule based on section 403.0885 for

[62] EPA's interpretation of the CWA section 301(b)(1)(C), articulated in In the Matter of Star-Kist Caribe, Inc., 3 E.A.D. 172, 175, 177 (1990), is that the section's July 1, 1977 deadline for meeting WQBELs prohibits compliance schedules only for water quality standards adopted and approved before July 1, 1977. EPA interprets section 301(b)(1)(C) to allow for compliance schedules in permits for WQBELs based on post-1977 water quality standards, provided that state law clearly indicates, either in water quality standards or implementing regulations, that compliance schedules are authorized.

EFA subsection (4)(f)(4), that lapsed on December 31, 2006. In the 2010 Order, in addition to finding that the 2006 date cannot be extended as it relates to subsection (4)(f)(4), the Court also found that FDEP may no longer rely on the section 403.0885 provision to authorize compliance schedules in STA permits. Thus, while Florida has a general provision authorizing compliance schedules for WQBELs, for CWA purposes, the State's specific deadline for the Everglades Protection Area (December 31, 2006) is controlling for discharges of phosphorus into the Everglades Protection Area. Attachment I reflects the necessary revisions to remove compliance schedules (or Administrative Orders under Florida regulation) from the permits. Therefore, compliance schedules for WQBELs in the NPDES and EFA permits for discharges into the Everglades Protection Area are no longer authorized.

Further extensions of time for compliance with the required WQBELs in an NPDES or EFA permit for STA discharges might be authorized if FDEP develops and USEPA approves a variance from the water quality standard that recognizes the existing impairment to the designated use and downgrades the use after USEPA approval of a use attainability analysis. Absent a regulatory revision, schedules for coming into compliance with WQBELs could be included in an appropriate enforcement mechanism (see discussion in Section VI below).

While both USEPA regulations (at 40 CFR Part 131) and the 2010 Order (at 11) recognize the ability and processes that states may use to downgrade the designated uses of a water body, either through short-term recognition of an impaired use with a variance or for a more extended downgrade after the completion of a use attainability analysis, USEPA does not advocate either approach because USEPA believes the designated uses are attainable. Moreover, with regard to the timely implementation of additional control measures, any such revisions to the water quality standards would require additional time and personnel to proceed through the state's rulemaking process, thus diverting those resources from achieving the shared water quality goals for the Everglades Protection Area.

FDEP will need to submit the conformed NPDES permits to USEPA for review. USEPA will review the permits to confirm that FDEP has conformed the permits consistent with the CWA and its implementing regulations, the Court's Orders, and this Amended Determination.[63] Pursuant to the Court's 2010 Order, FDEP must conform its permits within 60 days (November 2, 2010).

C. Initiation of Withdrawal of State Authority to Issue New NPDES Permits or Future Modifications of NPDES Permits for Discharges Into, or Within, the Everglades Protection Area

The Court's Order directed USEPA to "immediately initiate and carry out its authority under Section IX of the Memorandum of Understanding to withdraw approval of the State program pertaining to issuance of any new NPDES permits for discharges into, or within, the Everglades Protection Area, or for any future modifications to existing NPDES permits (including through State of Florida Administrative Orders." (2010 Order at 46). This provision only applies to newly issued permits, so the withdrawal would not affect the State's authority to comply with the Court's order that FDEP conform the existing permits within 60 days of this

[63] In USEPA's 60(b) motion, USEPA proposed a procedure for EPA review of new, re-issued, or modified NPDES permits subsequently issued (in lieu of partial program withdrawal).

Amended Determination. The Court's Order further provides that Florida's program authority be withdrawn until such time as the State is in full compliance with the CWA, its implementing regulations, the Court's 2008 and 2010 Orders and this Amended Determination. (Id.)

On July 29, 2010, USEPA filed a Rule 60(b) Motion for Modification of Injunction requesting the Court to replace the provision in the 2010 Order that requires USEPA to initiate and carry out partial withdrawal of Florida's NPDES permitting authority with a new injunctive provision that would apply after the existing permits have been conformed pursuant to the Court's Order. On August 2, 2010, the Court issued an order scheduling a hearing on USEPA's motion for October 7, 2010.

In its Rule 60(b) motion, USEPA proposed that the Court modify its Order to impose a process by which, after the existing permits are conformed, USEPA reviews and corrects (if needed) any subsequent State permitting action before the action is proposed. That process would then rely on USEPA's existing permit-by-permit oversight authority under CWA section 402(d) to review proposed permitting actions developed by FDEP. Under this approach, USEPA would provide up-front substantive direction to FDEP regarding any permitting action that the State contemplates proposing (much as the Court's 2010 Order currently requires for conformance of the existing permits). USEPA has clear authority under the CWA to review draft NPDES permits for legal and substantive adequacy, to object to permits when appropriate, and to take over the permit at issue if FDEP were to fail to adequately respond to a USEPA objection.

Because the Court is considering USEPA's Rule 60(b) motion and has scheduled a hearing for a date after USEPA must issue the Amended Determination, USEPA is not initiating program withdrawal proceedings in this Amended Determination.

D. FDEP Enjoined from Issuance of NPDES and EFA Permits

The Court's 2010 Order also included the following self-implementing injunction against the State of Florida:

> "Other than to carry out the requirements of Paragraph 3 [of the 2010 Order], above, the FDEP is enjoined from issuing any new NPDES permits, or modifications to existing NPDES permits - through State of Florida Administrative Orders, Everglades Forever Act permits or otherwise - for STAs that discharge into, or within, the Everglades Protection Area until such time as the State of Florida is found by the [US]EPA and this Court to be in full compliance with the Clean Water Act, its implementing regulations, the Summary Judgment Order, and this Order. All new Administrative Orders and Everglades Forever Act permits issued under the laws of the State of Florida must conform to, and comply with, the Clean Water Act, its implementing regulations, the Summary Judgment Order, and this Order and the forthcoming Amended [US]EPA Determination. (Order at 46-47)."

No further action is required by USEPA to implement the Court's injunction.

VI. Enforceable Framework for Ensuring Compliance with the CWA and Applicable Regulations

In setting aside USEPA's determinations in the 2008 Order, the Court made several references to the 1999 Determination and the detailed analysis that USEPA conducted of the "enforceable framework" that supported USEPA's 1999 approval of the compliance schedule implementing Everglades Forever Act (EFA) subsection 4(f) as a new or revised water quality standard. (2008 Order at 31). In the Background section of the 2008 Order, the Court noted: "Most importantly, [US]EPA considered whether there was 'an *enforceable framework* that ensured the numeric water quality criterion for phosphorus would be met by the December 31, 2006, deadline in the EFA or sooner if possible.' (emphasis added by Court). It [USEPA] essentially concluded that the Everglades would be protected because '[t]he EFA incorporated a permitting scheme, and adopted provisions to ensure that by December 31, 2006, *discharges into the Everglades Protection Area will no longer cause or contribute to any violations of state water quality standards'*. (emphasis added by Court)." (2008 Order at 31).

In its 1999 Determination, USEPA reviewed the EFA and other available information to determine if the compliance schedule set out in the EFA was needed, was as short as practicable, and did not preclude earlier compliance. USEPA explained that it "considered whether there was an enforceable framework that ensured the numeric water quality criterion for phosphorus would be met by December 31, 2006 deadline in the EFA or sooner if possible." (1999 Determination at 9). In making its determination, USEPA evaluated eight factors and concluded that the 2006 compliance schedule in the EFA "is necessary, is being enforced, and serves the purposes of the CWA to enhance water quality." *(Id at 18).*

In the 2010 Order, the Court required USEPA to specify an enforceable framework for ensuring compliance with the CWA and its applicable regulations. (Order at 45). USEPA believes that all of the components of its Amended Determination together represent an enforceable framework for ensuring compliance with the CWA and its implementing regulations.

First, Florida's water quality standards for the Everglades will be amended to bring them into compliance with the CWA and its implementing regulations either through action by the State of Florida or USEPA. A significant amendment will be that the water quality standards will no longer include any reference to the extended compliance deadline of 2016.

Second, to ensure that all NPDES and EFA permits for discharges from the STAs into the Everglades Protection Area include effluent limitations are as stringent as necessary to meet the water quality standards for the Everglades Protection Area, USEPA has provided clear instructions to the State of Florida on how the current permits must be conformed to comply with the CWA and its implementing regulations. USEPA's instructions include specifying what the appropriate WQBEL is for each of the STAs. Importantly, USEPA has instructed the State that the permits may not include any compliance schedules. The new WQBELs must be effective

upon the date the permits are effective. Consistent with the Court's Order, FDEP is to conform the permits within 60 days of the Amended Determination.

Third, USEPA has also provided clear, specific and comprehensive instructions to the State of Florida on what actions must be taken to ensure compliance with these new WQBELs. USEPA has specified the actions that must be taken to ensure expansion and proper operation of each of the STAs in order to meet the new WQBELs.

Fourth, USEPA is prepared to exercise its full CWA enforcement authorities to ensure the actions it has identified as necessary for compliance with the new WQBELs and achieve attainment of the water quality standards are implemented according the milestones set forth in the Amended Determination.

Fifth, if the Court grants USEPA's Rule 60(b) Motion, USEPA will exercise its CWA permit oversight authority to ensure that all new NPDES permits or future modifications of permits that FDEP will issue for discharges into the Everglades Protection Area fully comply with the CWA and implementing regulations. USEPA has authority under CWA section 402(d) to object to any State NPDES permit that does not comply with the requirements of the CWA. When USEPA objects, unless the State revises the permits to address USEPA's objection, exclusive authority to issue such permits transfers to USEPA.

USEPA believes that the above actions all serve to create an enforceable framework for ensuring compliance with the CWA and its implementing regulations.

VII. Relationship to U.S. v. SFWMD, Case No, 88-CV-1886-FAM (S.D. Fla.)

In the 2010 Order, the Court discussed the distinctions and similarities between the Consent Decree Case and the case in front this Court.

> To be sure both cases directly concern the problems facing the Everglades. The crucial distinction is that the Consent Decree Case turns on a consent decree created pursuant to *State law* – not the Clean Water Act. Thus while the Federal Clean Water Act implications here subsume certain matters pertinent to the Consent Decree Case, this federal statutory action – which concerns the entire Everglades Protection Area, - casts a wider net. Both cases address, however a crucial similarity: the fact that the December 31, 2006 deadline promised in the Consent Decree and mandated in the [US]EPA 1999 Determination has not been met. . . . While the parallel proceeding share certain features, they are not identical, nor are the available remedies the same, though careful consideration should be given [to] accomplishing related goals in a manner consistent with the Congressional mandate set forth in the CWA. 2010 Order at 29 – 30.

The Court went on to require USEPA to reconcile the obligations and commitments under the Consent Decree with the Amended Determination that mandates CWA compliance. USEPA is defined as part of the United States in the Consent Decree Case and participates in all aspects of that case. As a result, USEPA is in the position to reconcile the obligations and commitments in either forum.

Currently there are several outstanding motions in the Consent Decree Case that are parallel to the actions in this case. The existing 1992 CD as amended includes construction deadlines and acreages for all the STAs. Consent Decree, Paragraph 10, and Appendix C. It also requires the implementation of on-farm best management practices program. Consent Decree, Paragraph12, and Appendix E. As discussed in the 1999 Determination, implementation of those remedies was an important factor in approving the December 31, 2006 compliance schedule.

In this Amended Determination, USEPA has developed a comprehensive set of water quality remedies that require expanding the footprint of all the STAs in each of the flow-ways in the EAA, including those remedies needed to address water quality in the Refuge. As noted in the August 11, 2010 post hearing brief filed by the United States in the Consent Decree Case, the United States intends to provide the Amended Determination to the Consent Decree Court in response to the Special Master's August 30, 2010 report, so that the Court may consider the comprehensive remedies developed by USEPA. See United States' Post Hearing Memorandum In Support of State Motion for Relief Under FRCP 59(e) and 60(b) From Order to Construct EAA A1 Reservoir, August 11, 2010, at 1-2.

The current status of the Consent Decree Case centers around the March 31, 2010 Order (2010 Consent Decree Order) granting two motions filed by the Tribe. In that Order, the Court mandated that the EAA A1 Reservoir be constructed and the court also found that the State and SFWMD were in violation of certain other aspects of the Consent Decree. These issues were referred to the Special Master for hearings. Subsequently, the SFMWD filed a Rule 59(e) and 60(b) motion seeking to be relieved of the commitment to construct the EAA A1 Reservoir. The basis for that motion is that underlying facts have changed and the EAA A1 property is physically situated such that the lands would be better used as an STA or a FEB, but not as a deep water storage reservoir. The Special Master held hearings on the motion the week of July 26, 2010 and has issued a recommendation to the Court on August 30, 2010. That recommendation states that the State should be granted relief from building the reservoir on the EAA A1 site. The United States filed its own enforcement motion in the Consent Decree case on July 15, 2010. See Motion of Plaintiff United States of America for Resolution of Liability Issues (D.E. 2179).

USEPA has considered the EAA A1 Reservoir land as an important option for expanding STA 3/4, thereby compressing the timeframe for compliance with the WQBEL. USEPA is awaiting the Consent Decree Court's ultimate disposition of this matter. The Special Master is also scheduling hearings on both the liability issues identified in the Tribe's motions and the ultimate remedies needed to meet the water quality requirements of the 1992 Consent Decree for the Refuge.

In sum, USEPA will continue to participate in the Consent Decree Case, to reconcile the obligations and commitments in both forums. This section (section VII) is intended to be purely descriptive, and is not intended to have any binding effect in the Consent Decree Case.

Restoration Strategies
Regional Water Quality Plan

Prepared by

South Florida Water Management District

April 27, 2012

Final Version

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Acronyms and Abbreviations

ac-ft	acre-feet
cfs	cubic feet per second
DMSTA	Dynamic Model for Stormwater Treatment Areas
EAA	Everglades Agricultural Area
EAV	Emergent Aquatic Vegetation
EBWCD	East Beach Water Control District
EPA	Everglades Protection Area
ESWCD	East Shore Water Control District
FDEP	Florida Department of Environmental Protection
FEB	Flow Equalization Basin
MIA	Miami Canal
MDR	Model Design Report
NNRC	North New River Canal
ppb	parts per billion
SAV	Submerged Aquatic Vegetation
SFCD	South Florida Conservancy District
SFWMD	South Florida Water Management District
SFWMM	South Florida Water Management Model
SSDD	South Shore Drainage District
STA	Stormwater Treatment Area
TP	Total Phosphorus
USEPA	United States Environmental Protection Agency
WCA	Water Conservation Area
WQBEL	Water Quality Based Effluent Limit
WPB	West Palm Beach
WY	Water Year

1.0 Introduction

To address water quality concerns associated with existing flows to the Everglades Protection Area (EPA), the South Florida Water Management District (SFWMD or District), Florida Department of Environmental Protection (FDEP), and United States Environmental Protection Agency (USEPA) engaged in technical discussions starting in 2010. The primary objectives were to establish a Water Quality Based Effluent Limit (WQBEL) that would achieve compliance with the State of Florida's numeric phosphorus criterion in the EPA and to identify a suite of additional water quality projects to work in conjunction with the existing Everglades Stormwater Treatment Areas (STAs) to meet the WQBEL.

Based on the collaborative effort described above, a suite of projects have been identified that would achieve the WQBEL. This report describes those resulting projects and the evaluation tools and assumptions that were utilized in the technical evaluation.

The projects have been divided into three flow paths (Eastern, Central and Western), which are delineated by the source basins that are tributary to the existing Everglades STAs. The identified projects primarily consist of Flow Equalization Basins (FEBs), STA expansions, and associated infrastructure and conveyance improvements. The primary purpose of FEBs is to attenuate peak stormwater flows prior to delivery to STAs and provide dry season benefits, while the primary purpose of STAs is to utilize biological processes to reduce phosphorus concentrations in order to achieve the WQBEL. Each component listed in this document is a planning estimate of the project feature required in each flow path to meet the water quality standards for the EPA. The Eastern Flow Path contains STA-1E and STA-1W. The additional water quality projects for this flow path include an FEB in the S-5A Basin with approximately 45,000 acre-feet (ac-ft) of storage and an STA expansion of approximately 6,500 acres (5,900 acres of effective treatment area) that will operate in conjunction with STA-1W. The Central Flow Path contains STA-2, Compartment B and STA-3/4. The additional project is an FEB with approximately 54,000 ac-ft of storage that will attenuate peak flows to STA-3/4, and STA-2 and Compartment B. The Western Flow Path contains STA-5, Compartment C and STA-6. An FEB with approximately 11,000 ac-ft of storage and approximately 800 acres of effective treatment area (via internal earthwork) within STA-5 are being added to the Western Flow Path.

2.0 Evaluation Tools and Assumptions

2.1 Modeling Tools and Datasets

The Restoration Strategies Preliminary Plan used hydrologic and water quality models to evaluate regional alternatives. The focus of the modeling was to identify project features necessary to achieve the WQBEL.

2.1.1 South Florida Water Management Model

The South Florida Water Management Model (SFWMM or 2x2) is a regional, hydrologic model specifically developed and applied to simulate the unique hydrology of the south Florida system and its regional management. Use of the SFWMM in the Restoration Strategies planning effort involved application of the model to estimate the current volume and timing of surface water flows discharged from source basins contributing inflows to existing and additional project features described in this plan, with eventual discharge into the EPA. These modeled hydrologic estimates were processed for inclusion in the water quality modeling effort described in subsequent sections.

2.1.1.1 Description of Model

The SFWMM is a coupled surface water-groundwater model which incorporates overland flow, canal routing, unsaturated zone accounting and two-dimensional single layer aquifer flow. The model simulates the major components of the hydrologic cycle in south Florida including rainfall, evapotranspiration, infiltration, overland and groundwater flow, canal flow, canal groundwater seepage, levee seepage and groundwater pumping. The model has been exclusively developed for the south Florida region and has been calibrated and verified using water level and discharge measurements at hundreds of locations distributed throughout the region within the model boundaries. In addition to simulating the natural hydrology in south Florida, the model also simulates the management processes that satisfy policy-based rules (both existing and proposed) to meet flood control, water supply and environmental needs. It can incorporate current or proposed water management control structures and current or proposed operational rules. The SFWMM simulates hydrology on a daily basis using climatic data for the 1965-2005 period which includes many droughts and wet periods.

2.1.1.2 Description of Hydrologic Modeling Scenario

The SFWMM simulation of hydrology for this planning effort was the Restoration Strategies Baseline 2 scenario or RS_BASE2. A detailed description of the south Florida system-wide assumptions and projects that were incorporated into the RS_BASE2 scenario is found in the Model Documentation Report (MDR) attached in **Appendix A**.

The intent of the RS_BASE2 model scenario is to represent a projection of the south Florida system hydrology as it would be in the future condition (circa 2015-2020). This projection is dependent on several assumptions, including anticipated completion of current and planned projects, system operating protocols and projections of future consumptive use and environmental demands. Although the entire south Florida regional system is modeled by the SFWMM, the primary area of interest for the Restoration Strategies initiative is the basin hydrology in and in the vicinity of the Everglades Agricultural Area (EAA), specifically related to basins that contribute flow to Everglades STAs that discharge into the EPA.

2.1.1.3 Summary of Source Basin Hydrology

For the purposes of Restoration Strategies project planning, application of the SFWMM provides hydrologic estimates of the areas identified in **Figure 1**. For each basin, daily flow time series are provided from the RS_BASE2 model output. This dataset provides the basis for the generation of inputs to the DMSTA model by utilizing a method that is consistent with previous DMSTA modeling efforts (Gary Goforth, Inc., 2009a). During this process, some aspects of the SFWMM-estimated hydrology are recalculated or rescaled to more closely approximate observed historical data. The aggregated source basin volumes are provided in **Table 1**.

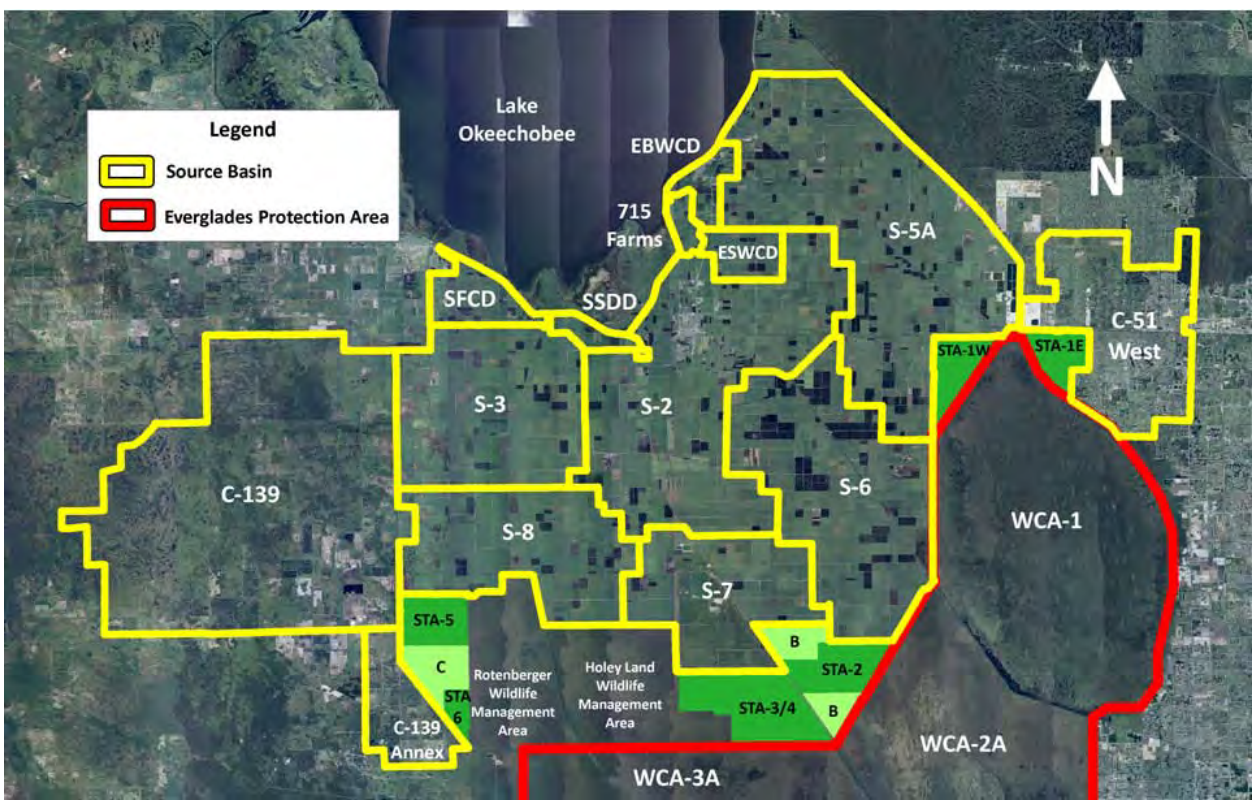

Figure 1. Potential Restoration Strategies Source Basins

Table 1. Restoration Strategies Source Basin Average Annual Volumes

Source Basin Name	Average Annual Flow (ac-ft)
C-51 West / L-8	169,700
West Palm Beach (S-5A)	293,500
Hillsboro (S-2/S-6)	181,400
North New River (S-2/S-7)	263,900
Miami Canal (S-3/S-8)	218,400
EBWCD	17,000
ESWCD & 715 Farms	22,700
SSDD	11,700
SFCD	19,100
C-139	202,400
C-139 Annex	0
Lake Okeechobee (Regulatory)	58,300
Lake Okeechobee (Urban Water Supply)	29,200
Total	1,487,300

Note: See Section 3.1.3.1 for an explanation of L-8 Basin flows

2.1.2 Dynamic Model for Stormwater Treatment Areas (DMSTA)

2.1.2.1 Description of Model

The Dynamic Model for Stormwater Treatment Areas (DMSTA) was developed for the U.S. Department of the Interior and the U.S. Army Corps of Engineers (Walker and Kadlec, 2005; http://wwwalker.net/dmsta/). DMSTA was developed and calibrated to information specific to south Florida and to predict phosphorus removal performance of Everglades STAs and storage reservoirs, and has been commonly used by both state and federal agencies for STA design and evaluation since 2001. The 2005 version of DMSTA was calibrated to data from 35 fully functional treatment cells with viable vegetation communities of various types. The model provides detailed output on the water and phosphorus balances of individual treatment cells and entire STAs, regional networks of STAs and storage reservoirs. Warning messages are generated in cases where simulated conditions exceed the calibration boundaries for phosphorus concentration, depth, dryout frequency, and/or flow velocities.

Model input requirements include daily values for flow, phosphorus concentration, rainfall, evapotranspiration (ET), depth (optional input or simulated value) and releases

(optional input or simulated), treatment area configuration, cell size, flow path width, vegetation type, estimates of hydraulic mixing, outflow hydraulics, and seepage estimates. Phosphorus removal rates (settling rate; *K*) and other phosphorus cycling parameters can be either user-defined or calculated within DMSTA based on calibration data sets. DMSTA assumes that the specified vegetation types (emergent, submerged, periphyton) will be maintained in the long-term, but does not take into account areas subject to periodic disturbance such as hurricanes, droughts and other extreme conditions that are not reflected in the calibration datasets where vegetation management may be difficult.

DMSTA is the best available tool for simulating phosphorus removal performance of existing or planned storage reservoirs and STAs. DMSTA is configured to allow integration with the SFWMD's regional hydrologic models (SFWMD, 2005) and can be configured to simulate complex regional networks of STAs and reservoirs. DMSTA's spreadsheet interface and relatively limited input data requirements allows the development and evaluation of various STA designs (Walker and Kadlec, 2011).

2.1.2.2 Model Implementation

For this planning project, the District utilized DMSTA, Model Version 2c (Version Date: 7/29/2011) provided by Dr. William Walker, Jr. to predict long-term flow-weighted mean phosphorus concentrations. As part of the technical collaboration with SFWMD since 2010 related to this planning project, Dr. William Walker, Jr. developed an intuitive Everglades STA-specific regional design worksheet that works seamlessly with DMSTA. The regional design worksheet can quickly be modified by the user to develop scenarios and evaluate DMSTA simulation results. An example of this regional design worksheet is provided in **Appendix B**.

2.1.2.2.1 Model Assumptions

The DMSTA model and regional design worksheet require several parameters that specify both physical and operational characteristics of an STA or reservoir. Many of the DMSTA parameters used for this planning project are provided in **Appendix B**. In addition to specific input parameters required by the model, there are several overall planning-level assumptions that must be determined (prior to DMSTA modeling) in order to appropriately pre-process the data that is required by DMSTA. The following section describes the critical overall assumptions implemented during this planning project.

Effective Treatment Areas for Existing STAs

One of the model parameters required by DMSTA is the surface area of the treatment wetland, or effective treatment area. While various DMSTA modeling methodologies are appropriate for planning level projects, the District simulated each STA cell individually within DMSTA. For example, all eight (8) treatment cells at STA-1E were individually parameterized within DMSTA. In addition, the Compartment C treatment cells at STA-5/6 (Cells 5-4A and 5-5A) were both further disaggregated into three (3) individual treatment cells within DMSTA to represent the intermediate berms with multiple low level weirs, upstream collection canals, and downstream spreader canals that exist within both of these cells. **Table 2** provides an overview of effective treatment areas for existing Everglades STAs that was assumed for this planning project. The total project area (which includes inflow, outflow, seepage canals, and upland areas) for existing Everglades STAs is approximately 68,000 acres.

Table 2. Summary of Existing Everglades STA Effective Treatment Areas

Stormwater Treatment Area	Effective Treatment Area (acres)		
	Target Vegetation		Total
	EAV	SAV	
STA-1E	2,053	2,941	4,994
STA-1W	2,016	4,528	6,544
STA-2 (with Comp. B)	5,269	10,226	15,495
STA-3/4	7,941	8,386	16,327
STA-5/6 (with Comp. C)	7,776	5,909	13,685
All STAs	25,055	31,990	57,045

Source Basin Total Phosphorus Concentration Period of Record

For this planning project, it was assumed that the total phosphorus (TP) concentrations for the basins tributary to the Everglades STAs would be based on historical data obtained during the 10-year period of record, Water Years 2000-2009 (May 1, 2000 through April 30, 2009). This 10-year period of record is considered a reasonable representation of future anticipated conditions and is suited for use in long-term regional water quality planning efforts. It incorporates a range of hydrologic and meteorological conditions (i.e. it includes periods with both hurricanes and droughts). Historical daily flows and TP concentrations and loads, that were calculated using data collected via the District's hydrological monitoring network and water quality monitoring programs, were used to develop twelve (12) mean monthly TP concentration values for each source basin. Where data were available, mean monthly TP concentrations were also

developed for water management or drainage districts established by Chapter 298, Florida Statutes (commonly referred to as 298 Districts). The method used to develop the mean monthly TP concentrations for this planning project is consistent with the methodology documented in the report entitled "Updated STA Phosphorus Projections For the 2015 Planning Period" (Gary Goforth, Inc., 2009a). **Table 3** provides the mean monthly TP concentrations for each of the source basins used for this planning project.

Table 3. Source Basin Mean Monthly Total Phosphorus Concentrations

Month	EAA WPB	S5A DIV	EBWCD	C51W	S361	L-8	EAA Hillsboro	EAA NNRC	EAA MIA	ESWCD & 715 Farms
January	116	208	233	94	57	140	70	130	69	64
February	197	296	292	116	53	93	128	132	163	107
March	205	170	366	117	81	141	106	105	70	99
April	160	178	384	195	60	127	130	132	119	121
May	175	116	183	152	72	125	118	139	115	80
June	175	377	329	151	68	91	85	85	85	106
July	126	103	358	139	75	81	91	75	78	123
August	172	303	427	153	94	116	136	81	68	122
September	177	217	445	181	92	119	144	116	85	156
October	166	188	479	273	68	117	130	105	66	224
November	167	79	352	151	52	77	67	46	98	167
December	128	119	221	123	90	121	63	104	54	65

Month	SSDD MIA	SSDD NNRC	SFCD	G136	C139S	Lake NNRC	Lake MIA	Lake WPB	Lake Hillsboro
January	114	71	90	49	80	147	165	258	147
February	130	108	94	472	81	122	176	174	122
March	145	117	94	51	112	158	118	229	158
April	163	97	107	86	165	158	157	240	158
May	136	97	116	43	128	131	120	157	131
June	131	74	115	315	328	144	138	167	144
July	123	60	101	284	269	93	89	174	93
August	141	98	111	233	255	93	151	204	93
September	123	89	114	227	285	115	148	139	115
October	137	97	112	191	233	125	164	145	125
November	135	121	125	128	197	170	148	213	170
December	113	71	80	91	139	164	127	245	164

Note: See Section 3.3.3 for information regarding specific assumptions that affect G136 and C139S TP concentrations.
See Section 3.1.3.1 for information regarding L-8 Basin flows

Lake Okeechobee Total Phosphorus Concentrations

In addition to stormwater runoff, the Everglades STAs also receive water from Lake Okeechobee. Both regulatory releases and urban water supply deliveries from Lake Okeechobee may be conveyed to the Everglades STAs. Due to the distance between Lake Okeechobee outlet structures and Everglades STA inlet structures, and the phosphorus dynamics that exist within the regional water management system, the TP

concentrations of Lake Okeechobee water measured at lake outlet structures are 50-70 ppb higher than TP concentrations measured at STA inlet structures (using data from Water Years 2000-2009). For the purposes of this planning project, the TP concentrations as measured at Lake Okeechobee outlet structures were used for all Lake Okeechobee water simulated to be conveyed to the Everglades STAs.

STA Duty Cycle Factor

The STA duty cycle factor is intended to represent the portion of time that an STA is projected to be offline for major maintenance or rehabilitation activities. For example, a duty cycle factor of 0.95 corresponds to an STA being offline 5% of the time (i.e. 1 year offline within a 20 year period). DMSTA applies the duty cycle factor as a multiplier to the net phosphorus settling rate, which effectively reduces the simulated phosphorus removal performance for the entire period of simulation. For this planning project, a duty cycle factor of 0.95, which is consistent with the offline time documented for the existing Everglades STAs, was assumed for all existing and additional STAs.

Extreme Event Diversions

It was assumed that the SFWMM-simulated STA diversion flows (i.e. flows that were simulated not to be conveyed to the STAs by the SFWMM due to structural constraints or damaging (i.e. high) STA water depths) would be included in the inflow datasets used during the water quality focusedDMSTA modeling. However, since most STA inflow structures (and the STA wetlands themselves) are not designed to convey all flows that occur as a result of extreme storm events, such as those that may occur during hurricanes or other tropical events, it is recognized that STAs may not receive all source basin flows and that STA diversion flows will occur occasionally. The intent of STA diversion operations is to prevent or minimize damaging depth and flow conditions within the STAs, ensure the continued health of treatment vegetation and thus maintain phosphorus removal performance, and to ensure flood damage is minimized in the EPA tributary basins. Therefore, it is anticipated that extreme event diversions will be addressed through the STA permit and/or regulatory process.

Urban Water Supply Deliveries

For this planning project, urban water supply deliveries from Lake Okeechobee were simulated as being treated within the STAs. During the dry season when regional water availability is typically limited, and treatment of water supply deliveries would result in additional losses due to STA seepage, evapotranspiration, etc., flexibility will be required to operate the regional water management system to maximize efficiencies

and help ensure water supply responsibilities are met. Therefore, it is anticipated that urban water supply deliveries will be addressed through the STA permit and/or regulatory process.

3.0 Projects

This section describes a suite of projects that have been discussed that would work in concert with existing Everglades STAs to attain the WQBEL. Numerous modeling simulations and conceptual engineering evaluations were conducted to analyze each flow path and identify the appropriate combination of features that are best suited to optimize performance, recognizing flow path specific TP concentrations, flows patterns, and existing STA performance. For convenience, descriptions of the various features are grouped into three flow paths, Eastern, Central and Western (**Figure 2**). **Appendix B** contains the DMSTA modeling sheets for the projects.

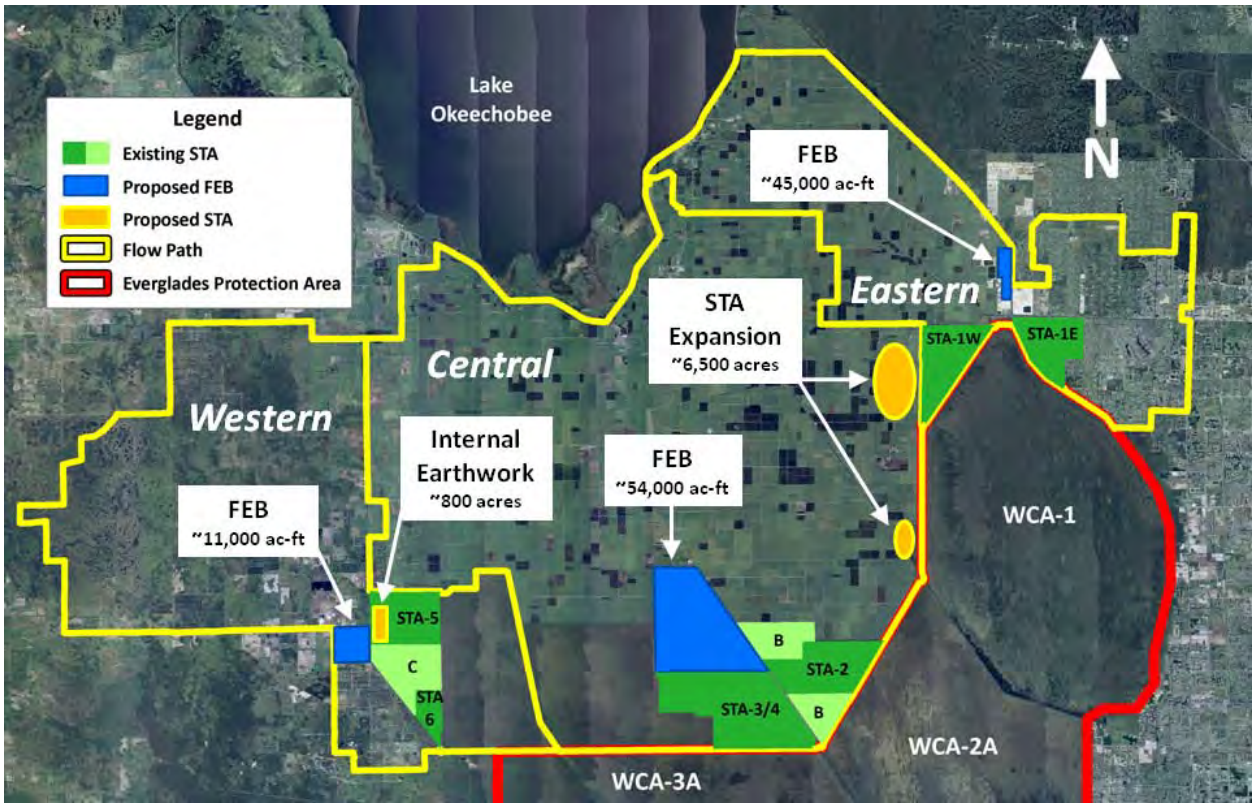

Figure 2. Restoration Strategies Flow Paths and Projects

Stormwater Treatment Areas – Description and Purpose

Stormwater Treatment Areas, or STAs, are large-scale freshwater wetlands constructed to remove phosphorus from urban and agricultural stormwater runoff prior to discharge to the Everglades. Phosphorus is removed from the water column through physical, chemical, and biological processes such as sedimentation, precipitation, plant growth, microbial activity and the accumulation of dead plant material that is converted to a layer of soil. A typical STA has multiple cells that are divided into several parallel treatment paths or flow ways. Water flows through these systems via water control structures, such as pump stations, gates, or culverts. The dominant plant communities in STAs are broadly classified as emergent aquatic vegetation (EAV) and submerged aquatic vegetation (SAV). Interspersed among this vegetation, where conditions are favorable, are floating aquatic vegetation and periphyton communities.

In contrast to conventional chemical treatment technologies which are designed to allow real time active control of treatment processes to provide technically reliable performance, STAs are cutting edge, biological systems which are more complex and reliant on multiple factors that are less controllable and subject to natural perturbations. STAs are considered the most cost-effective and environmentally preferred means of removing phosphorus from water prior to discharge to the Everglades (62-302.540, F.A.C.). Since 1994 the District spent approximately $70 million on Advanced Treatment Technology (ATT) and STA Optimization research. The District continues to apply science and engineering to optimize and enhance performance of the STAs to ensure that the best available science is being utilized to further reduce phosphorus concentrations in discharges to the Everglades. The Everglades STAs, varying in size and configuration, have been in operation in south Florida since 1993. The total area of Everglades STAs, including infrastructure components, is approximately 68,000 acres with approximately 57,000 acres of effective treatment area. To date, Everglades STAs have been successfully operated to prevent significant quantities of phosphorus from entering the Everglades.

Flow Equalization Basins – Description and Purpose

Wetlands, including Everglades STAs, are affected by a variety of factors including water depth, vegetation type, geometry, inflow water quality, hydraulic loading, and the intensity, duration and timing of flow events. Everglades STAs are typically subject to large and sustained flow pulses due to the hydrological and land use characteristics of south Florida. In general, if the volume of water that is displaced during flow pulses is large, detention time and phosphorus removal performance will likely be less than

optimal. To assist the Committee on Independent Scientific Review of Everglades Restoration Progress, Kadlec (2011) prepared a draft document summarizing the effect of pulsing on wetlands and evaluating the potential improvements to wetland performance as flow pulses are reduced. Kadlec's analyses indicate that storage reservoirs operated to reduce pulse flows have the potential to significantly improve the performance of Everglades STAs (Kadlec, 2011). Recent DMSTA modeling evaluating the effect of FEBs operated to attenuate pulse flows to STAs demonstrated that an FEB can reduce the required STA expansion area by thousands of acres. Therefore, based on more than twenty years of STA operational experience, best professional judgment of District engineers and scientists, and the information summarized above, reducing flow pulses to Everglades STAs was considered a key objective of the water quality projects. Consequently, storage reservoirs or FEBs are included for all three project flow paths.

3.1 Eastern Flow Path

3.1.1 Project Description

The Eastern Flow Path consists primarily of the C-51 West and S-5A Basins. The flows from these drainage basins are currently routed to STA-1W and STA-1E for treatment prior to discharging into Water Conservation Area (WCA) 1 (**Figure 3**). The S-5A and S-319 Pump Stations will continue to provide the existing level of flood protection to the S-5A Basin and the C-51 West Basin.

The Eastern Flow Path projects are intended to manage basin runoff in a more advantageous manner, by reducing the impacts of storm event driven inflows on the STAs, as well as expanding the effective stormwater treatment area. This is accomplished by: redirecting a portion of the STA inflows to an approximately 45,000 ac-ft FEB located adjacent to the L-8 Canal, for flow attenuation, prior to conveyance to STAs for treatment; increasing the spatial extent of STA-1W by approximately 6,500 acres (5,900 acres of effective treatment area) for additional phosphorus treatment capacity; and modifying the system to allow utilization of the G-341 structure consistent with its design intent (**Figure 3**).

In the Eastern Flow Path, the primary projects include:

- Construction of an approximately 45,000 ac-ft FEB adjacent to the L-8 Canal to attenuate peak flows and optimize STA inflow rates.

- Construction of an approximate 6,500 acre STA expansion (targeting 5,900 acres of effective treatment area) in the vicinity of the STA-1W complex to provide additional treatment capacity for S-5A and C-51 West basin runoff.
    - Exact location and sizing will be dependent on detailed design but will be sufficient to ensure the project performs consistent with the WQBEL.

- Conveyance improvements necessary to enable the G-341 structure to operate consistent with its design intent.

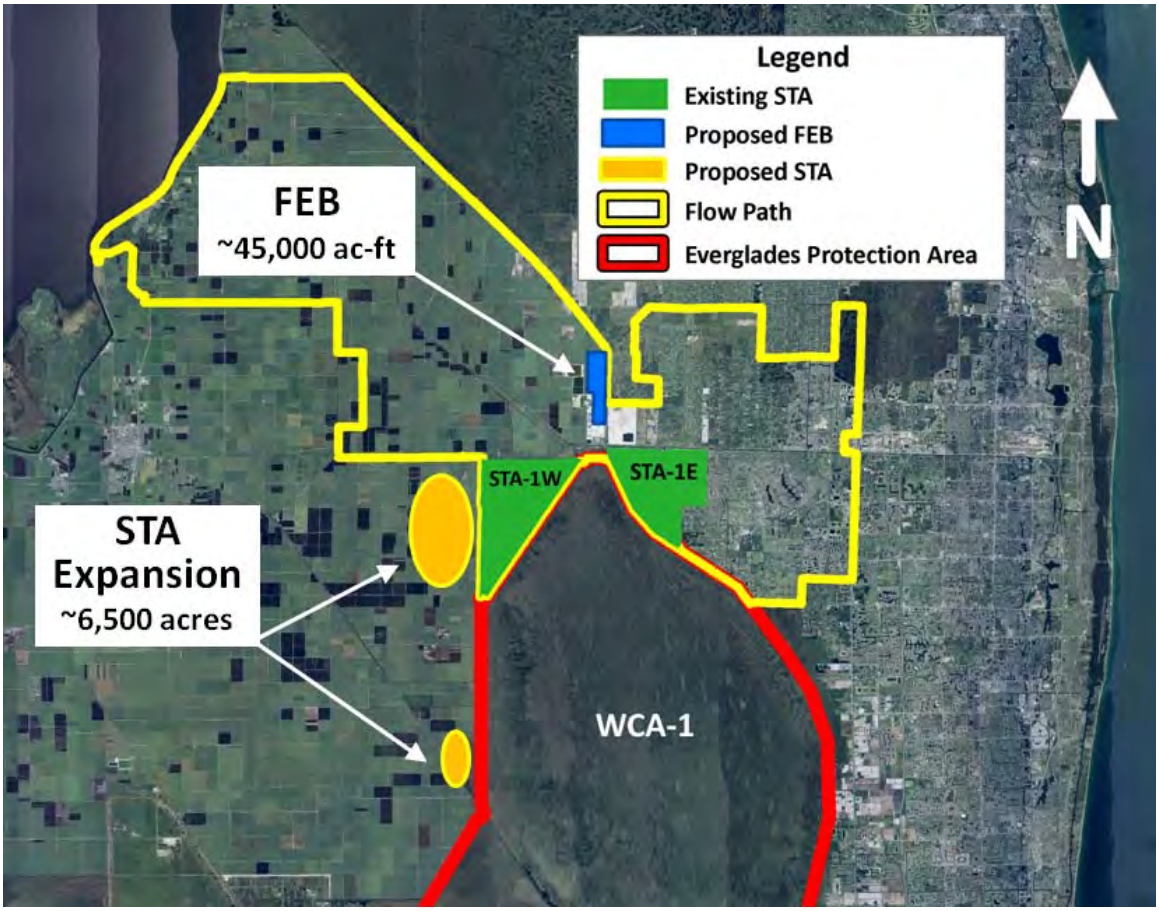

Figure 3. Eastern Flow Path Projects

3.1.2 Conceptual Engineering and Operations

- **S-319 Pump Station (Existing)**

The primary purpose of the S-319 Pump Station is to provide flood protection for the C-51 West Basin (**Figure 4**). The S-319 Pump Station, which has a design capacity

of 3,980 cubic feet per second (cfs), conveys surface water runoff and other flows from the C-51 West Canal into the STA-1E East Distribution Cell.

In this plan, there is no change to the current use of the S-319 Pump Station and it will continue to be utilized for flood protection in the C-51 West Basin to move water from the C-51 West Canal to the STA-1E East Distribution Cell.

- **STA-1E Distribution Cell (Existing)**

  The STA-1E Distribution Cell is divided into the East Distribution Cell and the West Distribution Cell by a north-south levee and structure S-375 (**Figure 4**). The primary purpose of these two cells is to distribute flows to the downstream treatment cells of STA-1E by conveyance of water east or west from the S-319 Pump Station. The S-375 structure serves to convey water from the East Distribution Cell into the West Distribution Cell where it can be conveyed either into the treatment cells for STA-1E or through G-311 to the STA-1 Inflow Basin.

  The STA-1E Distribution Cell will continue to be utilized to provide an optimized amount of flow to STA-1E. Excess flows above the optimum flow will be redirected through the S-375 and G-311 structures to the STA-1 Inflow Basin.

- **STA 1 Inflow Basin (Existing)**

  The STA-1 Inflow Basin provides the capability to convey flows from Pump Stations S-5A and S-319 to STA-1W, STA-1E and the future L-8 FEB (**Figure 4**). The STA-1 Inflow Basin is also able to receive flows from the L-8 Canal to STA-1E through G-311 or to STA-1W through G-302.

- **S-375 Structure (Existing)**

  The S-375 structure has an approximate capacity of 1,580 cfs (**Figure 4**). During high flow events from the C-51 West Basin and at times when there is capacity for storage in the FEB or STA-1E is receiving optimal flows; water will be diverted through S-375 to the G-311 Structure. Due to current capacity constraints with the S-375 structure, an S-375 structure expansion or overflow weir will be required.

- **S-375 Structure Expansion (New)**

  As part of the project, an additional structure will be constructed adjacent to the existing S-375 (**Figure 4**). The new structure will have an approximate design capacity of approximately 2,400 cfs to allow conveyance of full design flows from the S-319 Pump Station through use of both the S-375 structure and the new structure.

- **G-311 Structure (Existing)**

  The G-311 structure serves to deliver water between the STA-1 Inflow Basin and STA-1E West Distribution Cell (**Figure 4**). The G-311 structure has the capability to redirect flows from the S-319 Pump Station into the STA-1 Inflow Basin or direct flow from the STA-1 Inflow Basin to the STA-1E West Distribution Cell.

- **S-5A Pump Station (Existing)**

  S-5A Pump Station provides flood protection to upstream basins (**Figure 4**). The removal of stormwater runoff from the upstream basins has been, and will continue to be, the primary function of the S-5A Pump Station. The S-5A Pump Station has a design capacity of 4,800 cfs.

  In this plan there is no change to the current use of the S-5A Pump Station and it will continue to be utilized for flood protection to the S-5A Basin to move water from the L-12 Canal to the STA-1 Inflow Basin.

- **S-5AS Structure Automation (New)**

  The existing S-5AS structure is located at the southern termination of the existing L-8 Canal where it enters the STA-1 Inflow Basin (**Figure 4**). The two cable-operated vertical lift gates are locally controlled in accordance with operational criteria. S-5A Basin and C-51 West Basin runoff will be directed north through S-5AS to the L-8 FEB under this plan. With the implementation of this project, the use of the S-5AS structure will increase and therefore will require the structure to be automated.

- **L-8 Canal Divide Structure (New)**

  The current structures in the L-8 Canal are located at the junction of the M Canal at West Palm Beach's Control Pump Station #2 and S-76 located near Lake Okeechobee . In order to avoid impacts to surrounding lands, a new divide structure will be required within the L-8 Canal. The structure will be designed to allow current operational criteria for flows within the L-8 Canal with minimal head loss, while allowing stages within the southern L-8 Canal to be raised in order to hydraulically move water north from the STA-1 Inflow Basin to the new L-8 FEB. The structure will also be used to allow flows to be directed south from the L-8 FEB to the STA-1 Inflow Basin.

- **L-8 FEB (New)**

  The L-8 FEB is a 950-acre former rock mine in central Palm Beach County with unique geology (**Figure 4**). The project is capable of storing approximately 45,000 ac-ft of water to attenuate peak flows and optimize STA-1E and STA-1W inflow volumes. In order to fully utilize the L-8 FEB, additional project features are required. These projects include an inlet structure, discharge pump station, embankment protection measures and strategic dredging to fully interconnect the cells.

  In order to utilize the full storage capacity of the L-8 FEB for flow attenuation of water redirected from the STA-1 Inflow basin, the new inlet structure will have a capacity of 3,000 cfs and will be able to fill the reservoir to its intended maximum operational pool stage of +16.5 NAVD (+18.0 NGVD).

  The discharge pump station will have a capacity of approximately 450 cfs for delivery of flows from the L-8 FEB to the STA-1 Inflow Basin. The discharge pump station will be able to draw the FEB down to an elevation of -37.0 NAVD (-35.5 NGVD), which is approximately 5 feet above the bottom of the reservoir.

  The District is currently in the process of solicitation for a Design/Build contractor to complete design and construction on the project. This consists of hiring a firm to construct the inlet structure and outflow pump station, revetment protection features for the surrounding levees, and final configuration of the flow path within the reservoir itself.

  Over the years as the site has been mined, the mining developer was required to keep the process water on site. This consists of recycling the water within the pits used for dredging the lower portion of the reservoir. This process water was deposited in the southern cell for settling of fine particles (rock flour), prior to reusing the water in the dredging of the other cells. In addition, as material was removed for further processing and eventual disposal to contracting firms for building infrastructure, the material required washing. The same water utilized for dredging was also utilized for washing the rock obtained from the reservoir. This wash water was also then placed in the southern cell for settling out fine particles.

  Over the many years it took to excavate and clean the rock material from the reservoir, an elevated chloride level was created in the process water. Since the District received ownership of the reservoir, the reservoir has been used to a very limited degree to supplement environmental deliveries to the Loxahatchee River and water supply in drought years. Each time the reservoir use has been monitored, and although the overall volume of water exchanged within the reservoir has been

limited, there has been a substantial decrease in the chlorides in the cells that are fully interconnected. However, the two most southerly cells still have a limited hydrologic connection to the remaining cells and therefore still have higher chloride concentrations.

The above Design/Build contract will create additional connections between the cells (including the two most southerly cells) and will create a configuration that maximizes the exchange of water between cells. In addition, the Design/Build contract will include a requirement for the contractor to empty the reservoir to the expected low operational level and to refill the reservoir with surface water runoff, before the District accepts the completed project. This will allow the District to begin operations of the FEB's enhanced delivery system to the existing STAs at completion with water discharged from the reservoir meeting Class III water quality requirements.

- **G-302 Structure (Existing)**

  Inflow structure G-302 is located at the head of the Inflow Canal for STA-1W (**Figure 4**). Structure G-302 provides flows from STA-1 Inflow Basin to STA-1W. During the design of the expansion of STA-1W, an analysis will be performed to determine if there is a need to expand this structure or install additional structures. This determination is dependent on the final design of the expansion and potential changes to STA-1W.

Figure 4. L-8 FEB and STA-1 Conceptual Design

- **STA-1 West Expanded (New)**

  STA-1W Expanded (STA-1WEX) is a combination of the existing STA-1W footprint and the additional treatment area required (**Figure 5**). For the purpose of this section, the STA-1WEX project will consist of all features necessary to make the Eastern Flow Path projects perform consistent with the WQBEL. An approximately 6,500 acre STA expansion (5,900 acres of effective treatment area) is included as a new project for the Eastern Flow Path. At the current time, the final footprint of the expansion has not been established. However, a conceptual alternative for potentially available land is generally described below. Upon actual identification of the lands available for the project, multiple conceptual designs will be required to determine the most cost effective treatment layout to meet the requirements of the WQBEL.

The conceptual design described below is one of many options that could be considered depending on hydraulics and available land. This may consist of modifications to the physical configuration or operational protocols of the existing STA-1W as well as the design of the new treatment areas. In any case, the final design will incorporate the best available information to ensure appropriate vegetation partitioning and water depths.

- **STA-1W (Existing)**

  The current design of STA-1W was constrained by the available land and the need to maximize treatment areas while maintaining the necessary hydraulics to move the water through the system for both treatment and flood control purposes (**Figure 5**). In the new project design, the existing footprint will be evaluated to determine if the area can be utilized more effectively. The evaluation will consider the vegetation distribution across cells and whether reorientation of flow paths would be beneficial if adjacent land is available for the STA expansion.

- **4700 Acre STA Expansion (New)**

  For the purpose of this conceptual design, it is assumed that 4,700 acres of land contiguous with the existing STA-1W footprint is available (**Figure 5**). Further, it is assumed that the 4,700 acres does not contain any major infrastructure that would need to be avoided or incorporated into the design of the STA expansion. In this conceptual design, it is assumed that the new cells would be operated in coordination with STA-1W and therefore would be designed in series with the existing cells. As stated above, upon final identification of the lands, further investigations will be required.

  This project will consist of a new pump station (approximately 2,280 cfs) that would be located in the vicinity of the existing STA-1W Discharge Canal. The new pump station would have approximately 75% capacity of G-310 to pump the outflow of the existing STA-1W footprint to a new distribution canal at the front end of the 4,700 acre STA. The 4,700 acres would be subdivided with appropriate inflow structures, distribution and collection canals into 3 cells. Outflow from these SAV cells would be collected and delivered to WCA-1 through the existing G-310 pump station.

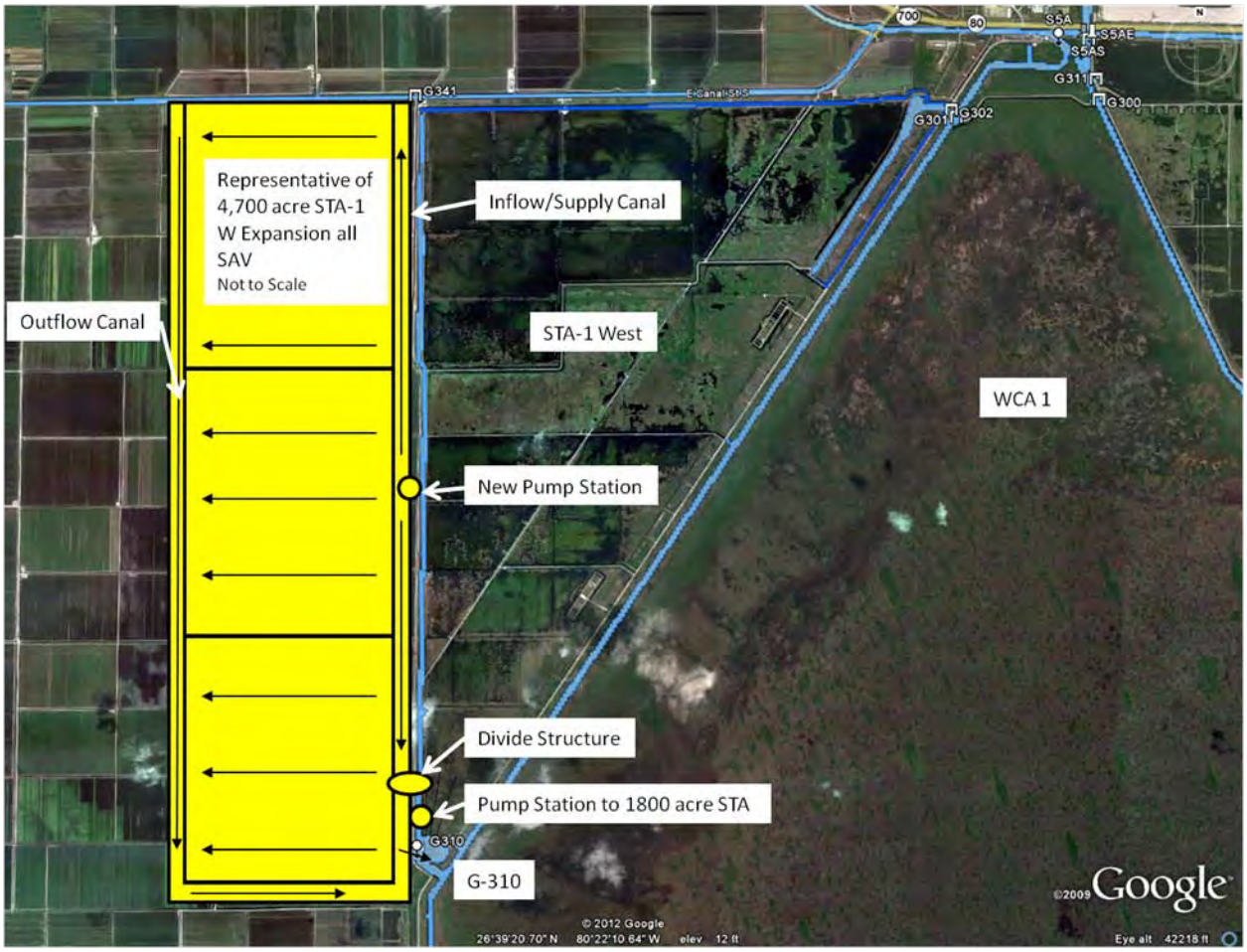

Figure 5. 4,700 STA-1 West Expansion Conceptual Design

- **1,800 Acre STA Expansion (New)**

  This conceptual project assumes 1,800 acres of land located southwest of the existing STA-1W, in the vicinity of the property called the Snail Farm, is available (**Figure 6**). Further, it is assumed there are no major infrastructure limitations within the new acreage. In determining the use of 1,800 acres that are not contiguous with the existing STA-1W, it will be assumed that the new STA cells are developed in series with the existing cells. As stated above, upon final identification of the lands, further investigations will be required.

  This project will consist of a new pump station (approximately 760 cfs) that would be located near G-310 and the existing STA-1W discharge canal. The new pump station would have approximately 25% capacity of G-310 to pump

the outflow of the existing STA-1W footprint to a new conveyance and distribution canal at the front end of the 1,800 acre STA. The one cell SAV treatment area would contain the appropriate inflow/outflow structures, distribution and collection canals. Outflow would be collected by a new pump station and discharge at a new location into the WCA-1 canal near the S-6 pump station.

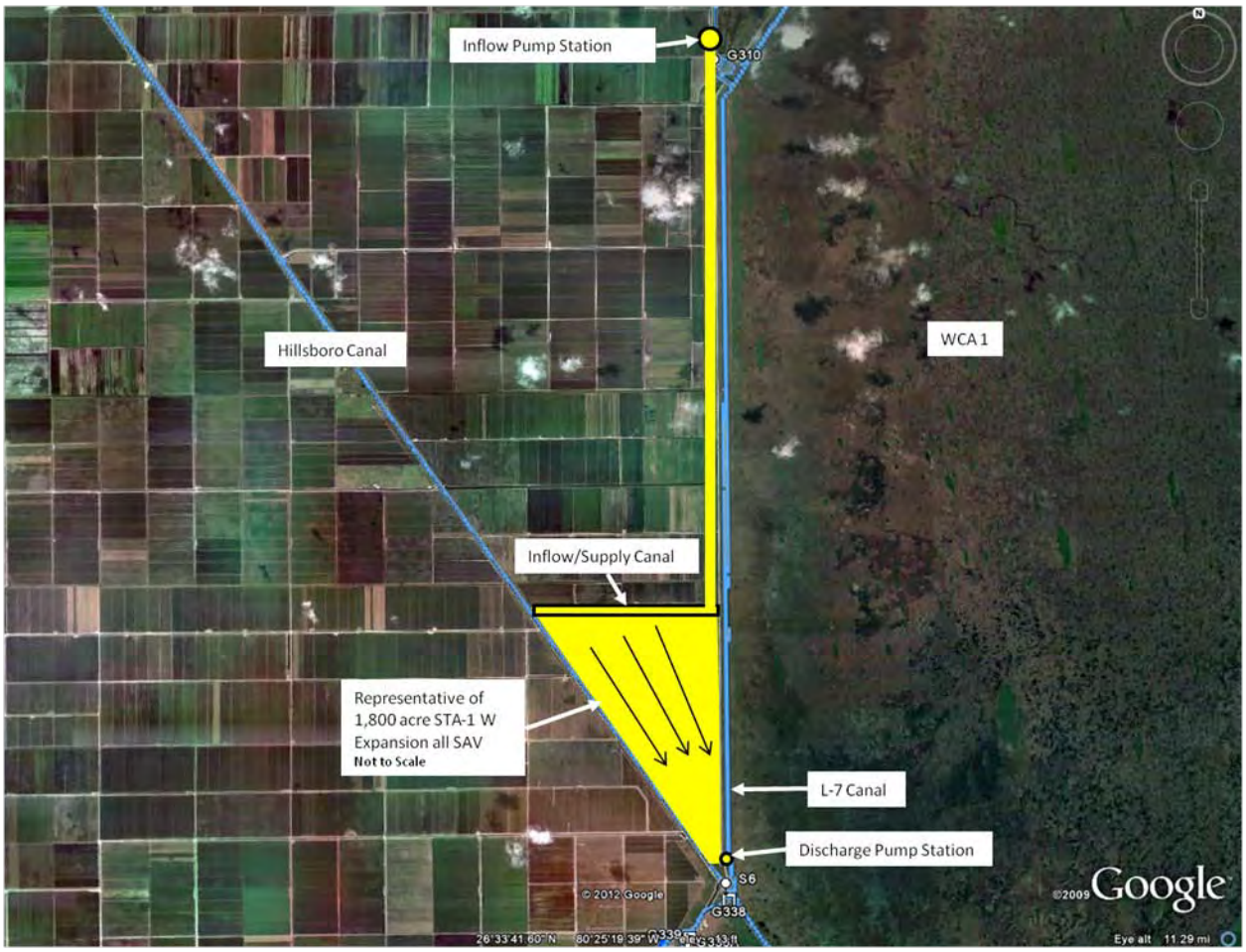

Figure 6. 1,800 STA-1 West Expansion Conceptual Design

- **G-341 Related Improvements**

This structure is located in the Ocean Canal between the S-5A Basin and the S-2/S-6 Basins (**Figure 7**). The original design intent was to divert up to a maximum of 600 cfs from the intermediate reach between S5AX and G-341 to the west. Due to various constraints, the full intent of the structure's design has not been able to be implemented. There are multiple methods that will need to be analyzed to identify the most cost effective measures available to fully implement the designed

operations for the G-341 structure. During the project design phase, multiple conceptual designs will be developed and analyzed. These alternatives could include operational changes to the Central and Southern Florida Flood Control Project or an alternative delivery path. One such path looked at in previous studies is enlargement of the Cross Canal and delivery of waters down the North New River Canal for delivery to STA 2, STA 3/4 or the EAA FEB. One conceptual option is described below**.**

Confluence of Ocean and Hillsboro Canal

The current interface of flows from the Ocean canal into the Hillsboro Canal is in the shape of a "T" and was originally designed to move the water both north and south in the Hillsboro Canal. Due to this "T" configuration, there is significant hydraulic loss when moving water south (**Figure 7**). As a result in the reduction in back pumping to Lake Okeechobee, this Project will require the flows from the Ocean canal to be routed south to STA 2. The canal will be reconstructed with a revised connection to allow reduction in head losses. As part of the project, the canal will be reshaped and a new bridge will be required.

- **Dredging of Hillsboro Canal**

  In order to operate G-341 per the design intent, there is a need to move more water to the Central Flow Path than the original design anticipated (**Figure 7**). In order to move this additional water south, a hydraulic analysis will be required on the Hillsboro canal to determine if additional dredging will be required.

- **Additional Capacity at S-6 Pump Station**

  In order to operate G-341 per the design intent, there is a need to move more water to the Central Flow Path than the original design anticipated. In order to move this additional water to the Central Flow Path by the Hillsboro canal, the S-6 Pump Station will require 600-1,000 cfs of additional capacity. This increased capacity can be achieved through modification of the existing pump station or adding an additional station adjacent to the existing one.

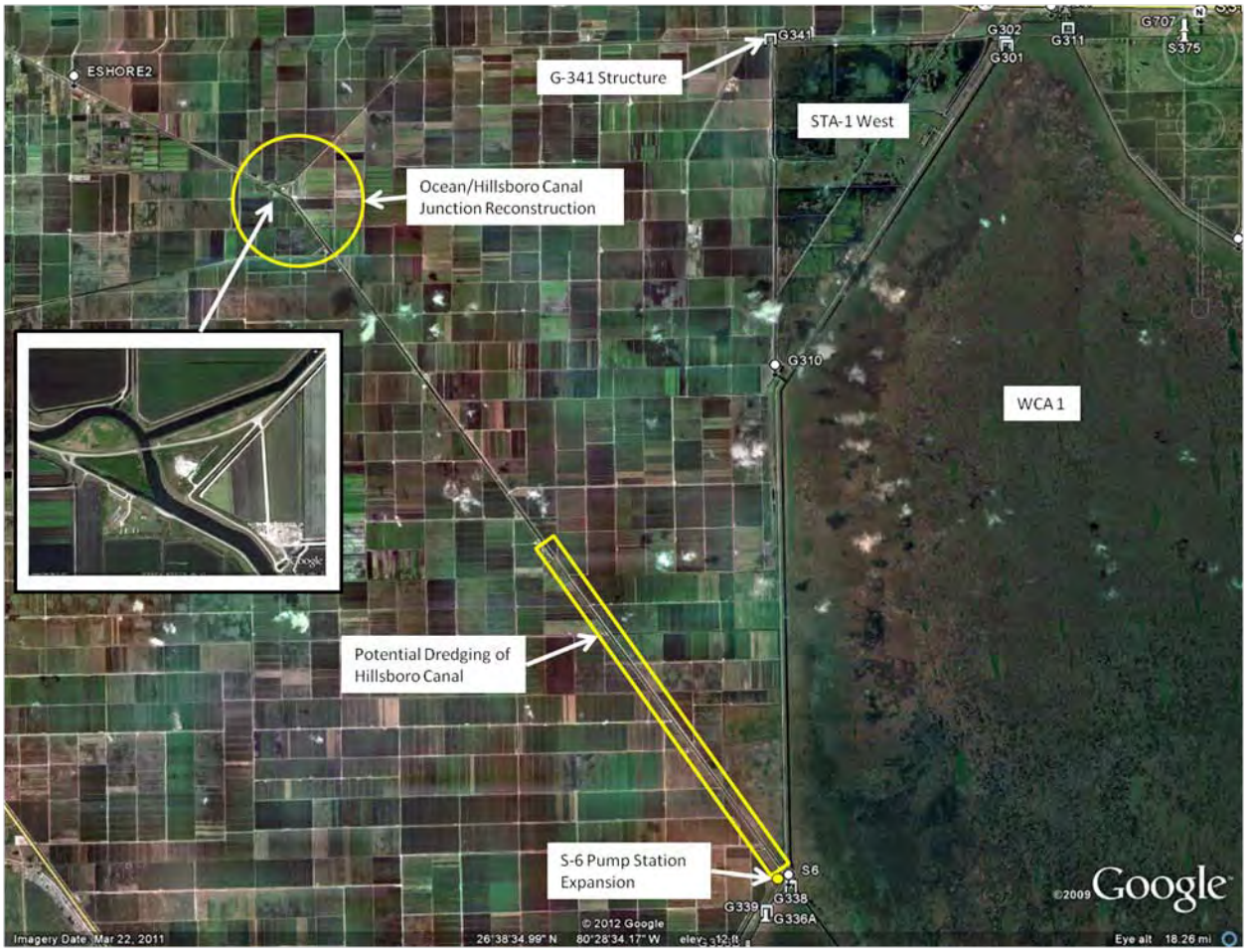

Figure 7. G-341 Related Improvements Conceptual Design

3.1.3 Model Assumptions and Results Specific to the Eastern Flow Path

3.1.3.1 L-8 Basin Runoff

Runoff from the L-8 Basin is currently conveyed to multiple locations, including STA-1E, STA-1W, the Arthur R. Marshall Loxahatchee National Wildlife Refuge, the C-51 West Canal and the Lake Worth Lagoon. As part of the Comprehensive Everglades Restoration Plan (CERP), the U.S. Army Corps of Engineers and the District are underway with the planning, design and construction of projects that will divert a substantial portion of L-8 Basin runoff from its current locations to the Loxahatchee River. However, it is anticipated that a portion of L-8 Basin runoff will continue to be conveyed as it is today. For this planning project, it was assumed that an average annual volume of approximately 41,000 ac-ft of L-8 Basin runoff would be included in the potential volume of runoff that could be conveyed to STA-1E, STA-1W and the

Eastern Flow Path water quality projects. In addition, it was assumed that an equivalent volume of runoff (a mixture of L-8 and C-51 West Basin runoff) would be conveyed east by the C-51 Canal via S-155A, as described in the STA-1E Operation Plan (Gary Goforth, Inc., 2009b).

3.1.3.2 Flow Equalization Basin Operations and Performance

In the DMSTA modeling, no phosphorus removal was assumed for the Eastern Flow Path FEB. However, to maximize the treatment efficiency of the Eastern Flow Path STAs, enhanced FEB operations and release protocols were implemented. The enhanced FEB operations attenuate the impact of peak flows and loads on STAs during wet seasons, attempt to provide optimal inflows to the STAs, and reduce the frequency and severity of dryout conditions in the STA during dry seasons. Simulation results indicate that FEBs with enhanced operations improve STA phosphorus removal efficiency and provide a more robust system capable of accommodating highly variable hydrologic and phosphorus loading conditions.

3.1.3.3 STA Expansion Area

The STA expansion area for the Eastern Flow Path was assumed to have approximately 5,900 acres of effective treatment area (6,500 total acres) and to operate in concert with STA-1W. Together, STA-1W and the Eastern Flow Path STA expansion are assumed to be composed of approximately 25 percent emergent aquatic vegetation and 75 percent submerged aquatic vegetation.

3.1.3.4 Summary of Eastern Flow Path Flows and Total Phosphorus Loads and Concentrations

To simulate Eastern Flow Path scenarios with DMSTA, the SFWMM-simulated source basin daily flows are combined with the corresponding mean monthly TP concentrations. The overall model assumptions described above are then incorporated, which result in a daily flows and TP concentrations for the Eastern Flow Path that are compatible with DMSTA. **Table 4** provides a summary of the average annual flows and TP loads and concentrations for each source basin that result from this process.

Table 4. Average Annual Flows and Total Phosphorus Loads and Concentrations for the Eastern Flow Path

Source Basin	Flow (ac-ft per year)	Total Phosphorus Load (metric tons per year)	Total Phosphorus Concentration (ppb)
S-5A	233,700	47.5	165
EBWCD	17,000	7.8	370
C-51 West	141,500	28.2	163
C-51 West (via S361)	9,700	0.9	73
L-8	18,500	2.5	110
Lake Okeechobee (Urban Water Supply via S352)	1,900	0.4	176
Total	422,300	87.3	168

DMSTA Modeling Results

Based on the DMSTA modeling results (Appendix B), the long-term flow-weighted mean outflow TP concentration for this flow path is 11.1 ppb. Due to the uncertainty associated with DMSTA simulated low level annual concentrations, annual values less than 12 ppb were replaced with a value of 12 ppb. When implementing a minimum annual TP concentration of 12.0 ppb, the long-term flow-weighted mean outflow TP concentration is 12.8 ppb.

3.1.4 Safety Factors

For the purpose of this plan, safety factors are modeling assumptions or activities that provide greater assurances that the TP WQBEL can be achieved. The safety factors in the eastern flow path are:

<u>Sub-Regional Source Control</u>

The modeling inflow datasets in the Eastern Flow Path did not assume additional TP concentration reductions above the TP load reduction already being achieved in accordance with the current BMP regulatory program in the S-5A basin. As part of the Restoration Strategies Water Quality Planning effort, the District proposes to build upon the success of the existing BMP Regulatory Program by focusing on areas and projects with the greatest potential to further improve water quality. The District's goal is to design projects to increase retention/detention of TP above what is currently required at the basin-ID level in strategic onsite locations or through sub-regional source control projects in series with the onsite BMPs to further reduce TP loads to the STAs.

The S-5A Sub-basin within the EAA Basin was selected as a priority sub-basin based on the inflow concentrations from Lake Okeechobee into the S-5A, the water quality of the farms discharging within the S-5A, the potential to affect the inflow to the STAs, and potential positive impact to the Refuge. Conceptual projects within the S-5A Sub-basin were considered based on a combination of factors, including water quality of farm discharges, proximity and potential impact to the STA, and having willing participants.

Three conceptual projects and area locations have been identified for sub-regional source controls projects, the Southeast cluster (collective of five separate basin ID's), East Beach Water Control District (298 District) and a District lease property. Collectively, the three project locations contribute an annual average of 24.78 metric tons (WY2006 – 2011) of phosphorus which is 37.4% of the basin load into STA-1E/1W. It is anticipated that these projects have the potential to reduce this load which would be an additional reduction in phosphorus from entering the STA-1E/1W complex that was not taken into account in the model inflow datasets.

Extreme Event Diversions

It was assumed that all SFWMM-simulated STA diversion flows would be treated by the STAs in the water quality-focused DMSTA modeling. However, it is recognized that there are structural and other constraints that will require STA diversions to occur. Therefore, since the water quality modeling assumes all flows will be treated, the predicted model performance could be considered conservative.

FEB Phosphorus Treatment Performance

The DMSTA modeling for the FEB assumed no phosphorus reduction. However based on the hydraulic residence time in the FEB, some level of phosphorus reduction is expected.

Internal Improvements to STAs

Internal improvements within the STAs, to address short circuiting, vegetation, topographic, and other issues, will continue to be implemented and are expected to further improve treatment performance. This improvement in performance is not accounted for in the DMSTA modeling, therefore current modeled treatment performance is conservative.

3.2 Central Flow Path

3.2.1 Project Description

The Central Flow Path consists of the S-2, S-3, S-6, S-7 and S-8 Drainage Basins. The Hillsboro, North New River and Miami Canals route flows from these basins to STA-2, Compartment B and STA-3/4. STA-2, Compartment B and STA-3/4 treat the water for phosphorus prior to discharging into WCA-2A and WCA-3A. The projects listed below will continue to provide the existing flood protection to the various basins through the G-370, G-372, S-6, G-434 and G-435 pump stations.

The Central Flow Path projects are intended to manage basin runoff in a more advantageous manner, by reducing the impacts of storm event driven inflows on the STAs. This is accomplished by redirecting a portion of the STA inflows to an approximately 54,000 ac-ft FEB located north of STA-3/4, for flow attenuation, prior to discharge to STAs for treatment (**Figure 8**). No additional infrastructure within STA-2 and Compartment B is anticipated to be required to accommodate inflows from the FEB. A further evaluation will be done during detailed design.

In the Central Flow Path, the primary project includes:

- Completion of construction of an approximately 54,000 ac-ft FEB adjacent to the North New River Canal and north of STA-3/4 to attenuate peak flows and optimize STA inflows to STA-3/4 and Compartment B.

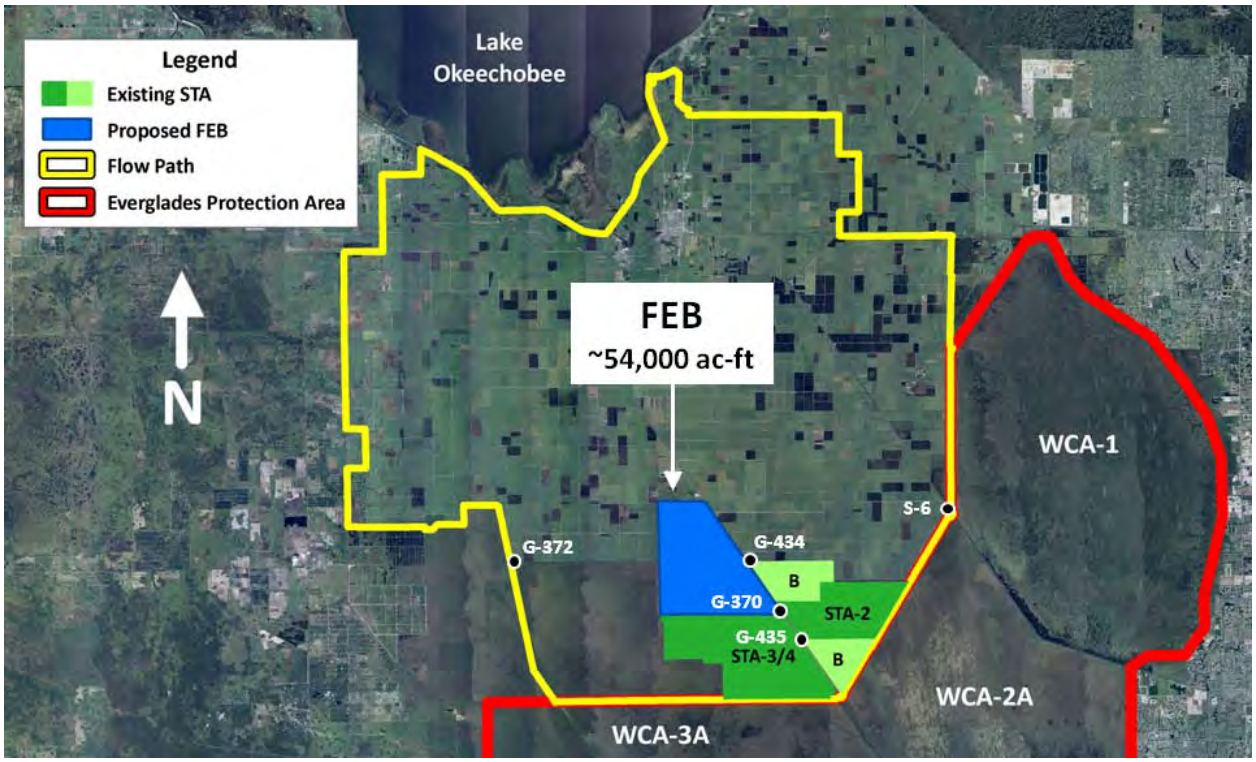

Figure 8. Central Flow Path Projects

3.2.2 Conceptual Engineering and Operations

- **S-6 Pump Station (Existing)**

  The primary purpose of the S-6 Pump Station is for flood protection of the upstream S-6/S-2 Basins. The S-6 Pump Station, which has a design capacity of 2,925 cfs, conveys surface waters into STA-2 and Compartment B North.

  In this plan, there is no change to the current use of the S-6 Pump Station other than modifications listed in the Eastern Flow Path. It will continue to be utilized for flood protection in the S-6 Basin to move water from the Hillsboro Canal to STA-2 and Compartment B North.

- **G-434 Pump Station (Existing)**

  The purpose of the G-434 Pump Station is to convey stormwater to Compartment B North for the treatment of phosphorus prior to discharge to WCA-2A. The G-434 Pump Station has a design capacity of 1,120 cfs.

  In this plan, G-434 will continue to be utilized to convey stormwater runoff from the North New River Canal at an optimized rate when there is capacity in Compartment

B North. In combination, with the development of the EAA A-1 FEB (EAA FEB), G-434 will also convey flows from the EAA FEB to Compartment B North when required.

- **G-435 Pump Station (Existing)**

  The purpose of the G-435 Pump Station is to convey stormwater to Compartment B South for the treatment of phosphorus prior to discharge to WCA-2A. The G-435 Pump Station has a design capacity of 480 cfs.

  In this plan, G-435 will continue to be utilized to convey stormwater runoff from the North New River Canal at an optimized rate when there is capacity in Compartment B South. In addition, with the development of the EAA FEB, G-435 will also convey discharges from the EAA FEB to Compartment B South when required.

- **G-370 Pump Station (Existing)**

  The purpose of the G-370 Pump Station is flood protection, primarily for the upstream S-7/S-2 Basins (**Figure 9**). The G-370 Pump Station original design capacity was 2,170 cfs, however, the actual constructed capacity is 2,775 cfs. G-370 conveys surface waters from the North New River Canal into STA 3/4.

  In this plan, the flood control aspects of G-370 will be maintained. However, the pump station will be utilized for deliveries both to STA-3/4 and to the EAA FEB. It is also anticipated that the seepage control pumps installed in G-370 will be utilized by the EAA FEB to protect surrounding infrastructure from the higher stages developed in the EAA FEB.

- **G-370 Inflow Basin to EAA FEB (New)**

  Currently, G-370 discharges into the STA 3/4 inflow/supply canal. To redirect the flows to the EAA FEB, an inflow basin will be constructed for the EAA FEB (**Figure 9**). The G-370 inflow basin will be similar to the STA-1 Inflow Basin.

  Downstream from the G-370 Pump Station, a gated structure will be constructed in the STA-3/4 inflow/supply canal. The purpose of this structure will be to allow discharge from G-370 to flow into STA-3/4 at its optimized rate. The capacity of the gated structure will be sized to allow full flood control operation requirements when the EAA FEB is at maximum stage.

  The inflow basin will also have a gate on the South side and a weir on the North side to allow approximately 2,775 cfs flow from G-370 to the EAA FEB inflow channel.

The southern structure is utilized to control flows when there is a desire to split flows between the EAA FEB and STA-3/4 or when the EAA FEB is not available. The north weir is utilized to prevent flows from the EAA FEB inflow channel flowing back into the inflow basin when it is in use for discharging from the EAA FEB to the North New River.

Two additional structures, approximately 2,000 cfs each are located on the east and west side of the inflow basin to allow discharges from the EAA FEB into the North New River Canal.

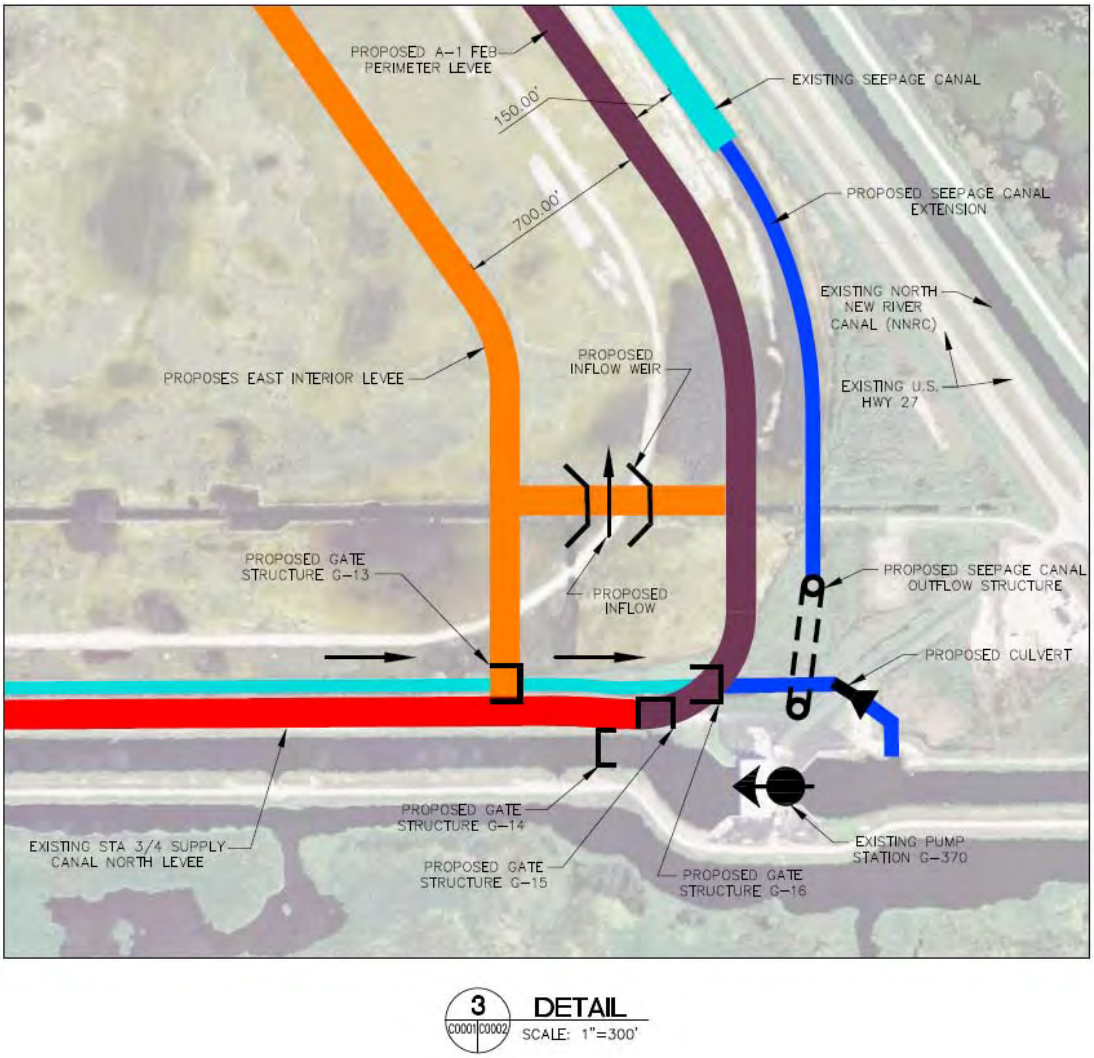

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Figure 9. EAA A-1 FEB G-370 Inflow/Discharge Structure

- **G-372 Pump Station (Existing)**

  The primary purpose of the G-372 Pump Station is for flood protection to the upstream S-8 Basin (**Figure 10**). The G-372 Pump Station, which has a design capacity of 3,700 cfs, conveys surface waters from the Miami Canal into STA-3/4.

  In this plan, the flood control aspects of G-372 will be maintained. However, the pump station will be utilized for deliveries both to STA-3/4 and to the EAA FEB.

- **G 372 Inflow to EAA FEB (New)**

  Currently, G-372 discharges into the STA-3/4 inflow/supply canal (**Figure 10**). To redirect the flows to the EAA FEB, two structures are needed.

  Downstream from the G-372 Pump Station, a gated structure will be constructed in the STA-3/4 inflow/supply canal. The purpose of this structure is to allow discharge from G-372 to flow into STA-3/4 at its optimized rate. When the FEB is full and a flood event is occurring, the in stream gate to STA 3/4 must pass all flows to STA 3/4. Usually this gate is closed or partially closed to direct flow to the FEB. The capacity of the gated structure will be sized to allow full flood control operation requirements when the EAA FEB is at maximum stage.

  An additional structure of approximately 3,700 cfs will be constructed on the eastern edge of the STA-3/4 inflow/supply canal to allow discharge of flows from G-372 to the inflow channel of the EAA FEB.

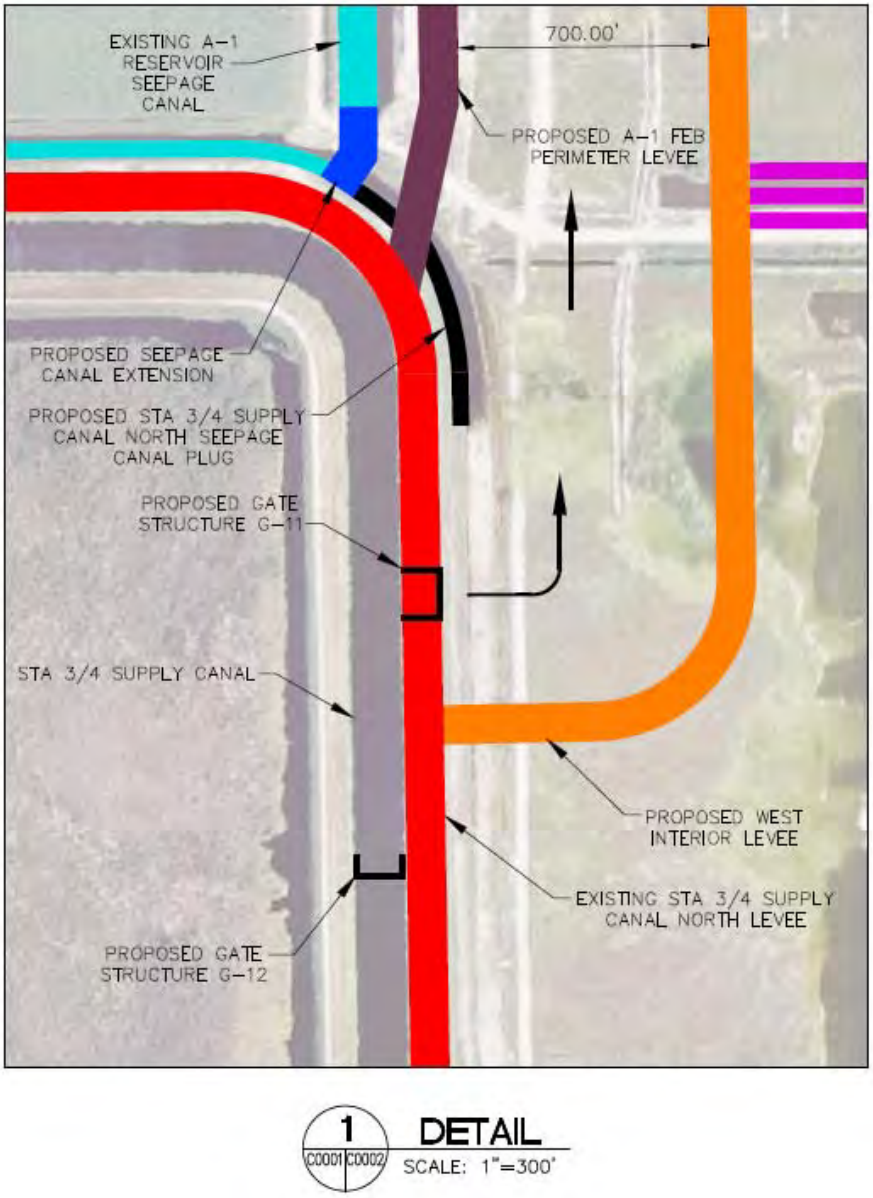

Figure 10. EAA A-1 FEB G-372 Inflow Structure

- **EAA A-1 Flow Equalization Basin (New)**

  In the Central Flow Path, an approximate 54,000 ac-ft FEB upstream of STA-3/4, STA-2, and Compartment B is included to attenuate peak flows and optimize STA inflow volumes (**Figure 11**). The EAA FEB primarily delivers water to STA-3/4 with a designated percentage of flows going to STA-2 and Compartment B. Inflows to the EAA FEB will be from the North New River Canal and Miami Canal through the G-

370 and G-372 pump stations, respectively. Discharges from the EAA FEB will be via gravity through two gated outflow structures into the G-370 inflow canal. A majority of the flows (80%) will be pumped back through the G-370 and into STA-3/4 inflow/supply canal for treatment. The remaining flows (20%) will be conveyed to STA-2 and Compartment B North via the G-434 pump station and to Compartment B South via the G-435 pump station.

The EAA FEB is to be constructed utilizing the materials and features developed during the start of construction of the EAA A-1 Reservoir. As part of the reservoir project there were 1,200 foot wide areas scraped down to the cap rock along the perimeter of the site in preparation for constructing the embankment. With the maximum storage height being limited in the EAA FEB, the embankment foot print becomes much smaller. By utilizing the available scraped down area as a flow path, it has been determined, based on preliminary hydraulic analyses, that the existing pump stations G-370 and G-372 currently have the capability to deliver flows to the north end of the FEB.

After flows are delivered to the north end of the EAA FEB, the water will be spread utilizing the northern scraped area to enable sheet flow from north to south within the facility. Also, as additional hydraulic modeling is being developed, investigation is ongoing to determine if the existing infrastructure can be utilized to create a serpentine flow path through the site to minimize short circuiting and maximize hydraulic residence time. These conditions are expected to support vegetation that will aid in the uptake of phosphorus within the FEB.

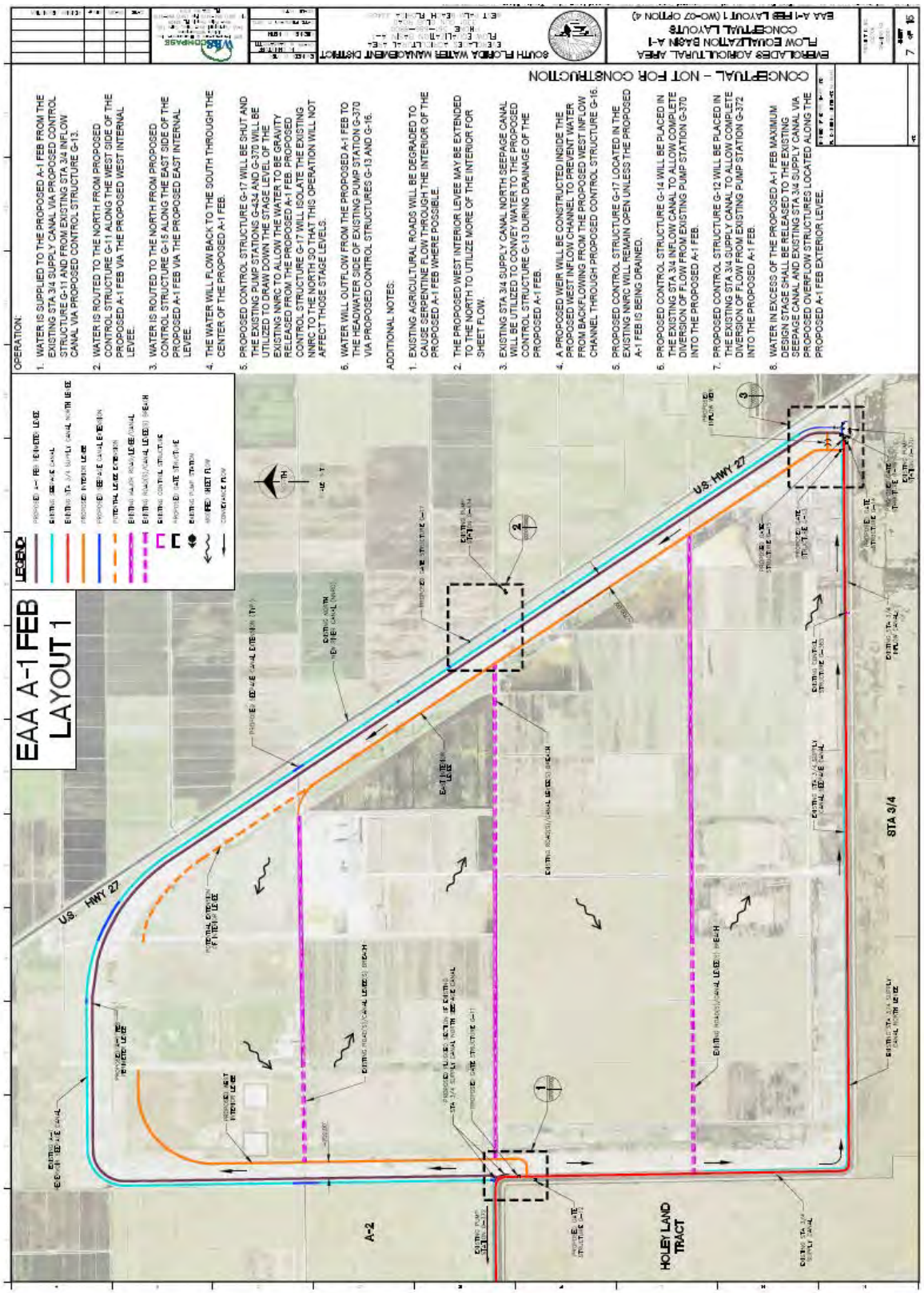

Figure 11. EAA A1 FEB Conceptual Design

- **North New River Canal Divide Structure (New)**

  The current structures in the North New River Canal are G-371, located south of G-370 near S-7, and S-351, located at Lake Okeechobee. In order to avoid impacts to surrounding lands, a new divide structure will be required within the North New River Canal. The structure will be designed to allow current operational criteria for flows within the North New River Canal with minimal head loss.

  The purpose of the new structure is to allow stages within the North New River Canal to be lowered without impacting upstream users in order to hydraulically move the water from the EAA FEB to the existing G-370, G-434 and G-435 pump stations.

3.2.3 Model Assumptions and Results Specific to the Central Flow Path

3.2.3.1 Flow Equalization Basin Operations and Performance

In the DMSTA modeling, the phosphorus removal performance of the Central Flow Path FEB was assumed to be consistent with emergent aquatic vegetation. FEB discharges were simulated using DMSTA's default outlet hydraulic algorithms to simulate conditions typically encountered in wetland cells or shallow reservoirs.

3.2.3.2 Summary of Central Flow Path Flows and Total Phosphorus Loads and Concentrations

To simulate Central Flow Path scenarios with DMSTA, the SFWMM-simulated source basin daily flows are combined with the corresponding mean monthly TP concentrations. The overall model assumptions described above are then incorporated, which results in a daily flows and TP concentrations for the Central Flow Path that are compatible with DMSTA. **Table 5** provides a summary of the average annual flows and TP loads and concentrations for each source basin that result from this process.

Table 5. Average Annual Flows and Total Phosphorus Loads and Concentrations for the Central Flow Path

Source Basin	Flow (ac-ft per year)	Total Phosphorus Load (metric tons per year)	Total Phosphorus Concentration (ppb)
S-5A	59,800	15.7	213
S-6	181,400	24.8	111
S-7	263,900	31.9	98
S-8	218,400	22.5	83
ESWCD & 715 Farms	22,700	3.7	132
SFCD	19,100	2.5	108
SSDD	11,700	1.7	116
C-139 (via G136)	14,700	2.8	154
Lake Okeechobee (Regulatory Releases)	58,300	10.4	145
Lake Okeechobee (Urban Water Supply via S351 and S354)	27,300	4.6	138
Total	877,300	120.6	111

Note: The C-139 values above include reductions of TP concentrations due to C-139 Basin Rule

DMSTA Modeling Results

Based on the DMSTA modeling results, the long-term flow-weighted mean outflow TP concentration for this flow path is 12.4 ppb. Due to the uncertainty associated with DMSTA simulated low level annual concentrations, annual values less than 12 ppb were replaced with a value of 12 ppb. When implementing a minimum annual TP concentration of 12.0 ppb, the long-term flow-weighted mean outflow TP concentration is 13.0 ppb.

3.2.4 Safety factors

For the purpose of this plan, safety factors are modeling assumptions or activities that provide greater assurances that the TP WQBEL can be achieved. The safety factors in the central flow path are:

<u>Lake Okeechobee Total Phosphorus Concentrations</u>

For this planning effort, the mean monthly total TP concentrations assumed for STA inflows from Lake Okeechobee were calculated based on TP concentrations measured at Lake outlet structures. In comparison, TP concentrations measured at STA inflow structures are 50 – 70 ppb lower for the period of record WY2000 – WY2009.

Extreme Event Diversions

It was assumed that all SFWMM-simulated STA diversion flows would be treated by the STAs in the water quality-focused DMSTA modeling. However, it is recognized that there are structural and other constraints that will require STA diversions to occur. Therefore, since the water quality modeling assumes all flows will be treated, the predicted model performance could be considered conservative.

Internal Improvements to STAs

Internal improvements within the STAs, to address short circuiting, vegetation, topographic, and other issues, will continue to be implemented and are expected to further improve treatment performance. This improvement in performance is not accounted for in the DMSTA modeling, therefore current modeled treatment performance is conservative.

Footprint of the EAA FEB

The DMSTA modeling assumed the EAA FEB was approximately 13,500 acres. In re-utilizing the site previously designed and partially constructed as a deep storage reservoir (EAA Reservoir), there is approximately 15,000 acres of useable FEB area inside the proposed embankments. As it is more cost effective to construct on the entire 15,000 acre site, the FEB will be approximately 15,000 acres which is up to 1,500 acres larger than what was assumed in the modeling.

3.3 Western Flow Path

3.3.1 Project Description

The Western Flow Path consists of the C-139 Basin. STA-5, Compartment C and STA-6 treat the water for phosphorus prior to discharging into the L-4 canal and ultimately into WCA-3A. The projects listed below will continue to provide existing flood protection to the C-139 Basin through the existing STAs, G-407 gravity structure and G-508 Pump Station.

The Western Flow Path projects are intended to manage basin runoff in a more advantageous manner, by reducing the impacts of storm event driven inflows on the STAs, as well as expanding the effective stormwater treatment area. This is

accomplished by: redirecting a portion of the STA inflows to an approximately 11,000 ac-ft FEB located South of Deer Fence canal and west of STA-5 Flowway 3, for flow attenuation, prior to discharge to STAs for treatment, and by increasing the effective treatment area within the Western Flow Path (**Figure 12**).

Projects in the Western Flow Path primarily consist of:

- Construction of an approximately 11,000 ac-ft FEB adjacent to the Deer Fence Canal and West of STA-5 Flowway 3 to attenuate peak flows and optimize STA inflow volumes.

- Construction of internal earthwork improvements resulting in approximately 800 additional acres of effective treatment area in STA-5 Cells 2A and 3A.

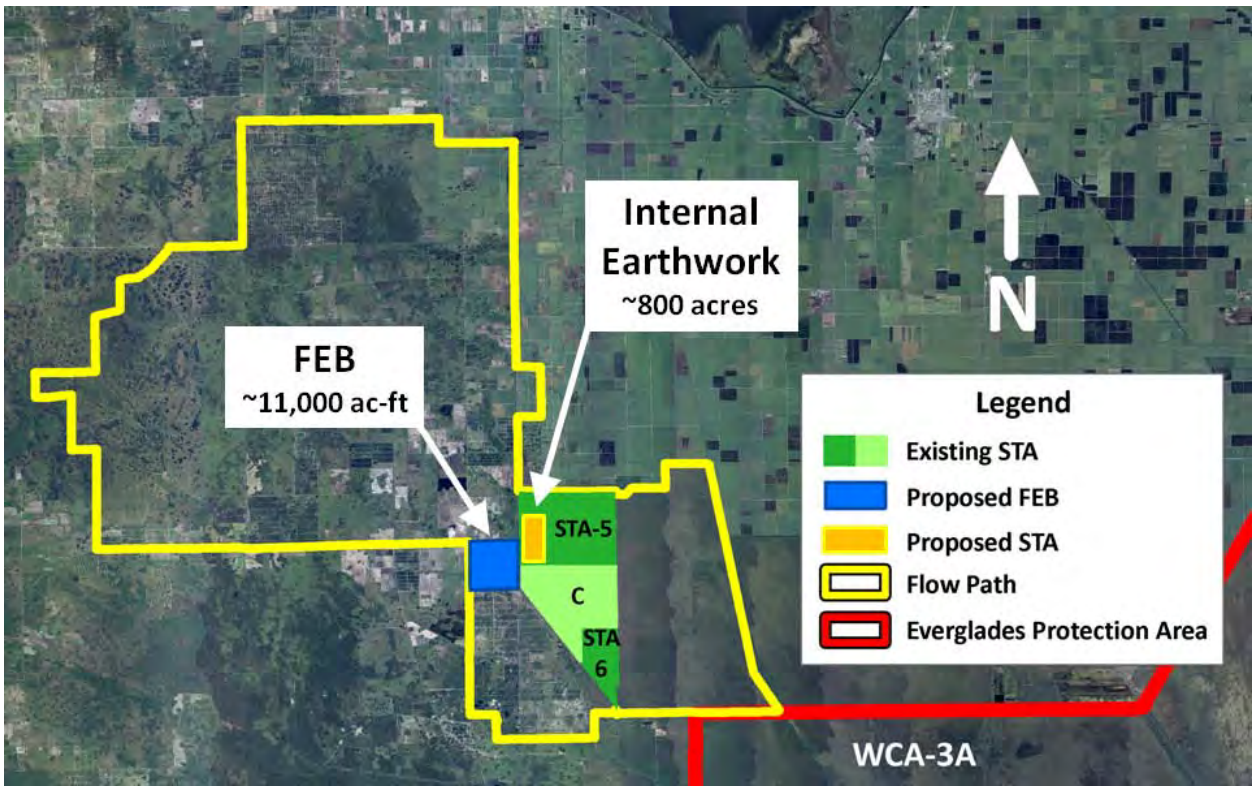

Figure 12. Western Flow Path Projects

3.3.2 Conceptual Engineering and Operations

- **G-508 Pump Station (Existing)**

  The primary purpose of the G-508 Pump Station is to provide flood protection for the upstream C-139 Basin (**Figure 13**). The G-508 Pump Station, which has a design

capacity of 2,080 cfs, conveys surface waters from the C-139 Basin into STA-5 Flowway 3, Compartment C and STA-6.

In this plan, G-508 will continue to be utilized to deliver stormwater runoff from the C-139 Basin at an optimized rate when there is capacity in the STAs. In addition, with the development of the C-139 FEB, G-508 will also be used to convey the discharges from the C-139 FEB and deliver the water to the STAs when required.

- **Deer Fence Canal Dredging (New)**

  The new pump station for the C-139 FEB is sized for delivering approximately 1,000 cfs inflows to the C-139 FEB (**Figure 13**). In order to move this additional water from the L-2 Canal to the new pump station, a hydraulic analysis will be conducted during detailed design to determine if additional dredging will be required.

- **C-139 FEB Pump Station (New)**

  Construction of a new pump station will be required on the northwest corner of the C-139 FEB (**Figure 13**). The pump station will have a capacity of approximately 1,000 cfs capable of lifting water from the Deer Fence Canal and distributing in the C-139 FEB distribution canal.

- **C-139 Flow Equalization Basin (New)**

  Construction of the approximately 11,000 ac-ft C-139 FEB is included on the north end of the C-139 Annex property up to 2,800 acres depending on final investigation of the site and detailed design (**Figure 13**). The site has a significant variation in topography as well as some areas that may need to be avoided or may require engineering solutions. Upon obtaining detailed survey information, the final configuration will be selected. The C-139 FEB will be designed and operated to perform consistent with the WQBEL.

  The conceptual design assumes the new C-139 Pump Station will distribute the water along the western edge of the site to develop sheet flow from the west to the east. Where the topography starts to fall moving from west to east across the site, an interim embankment would be placed to develop two zones within the FEB. The first zone would occupy the majority of the site and would focus on maintaining appropriate vegetation to provide attenuation of stormwater inflows and provide phosphorus treatment. The second zone, which would be considerably smaller (approximately 400 acres) would be entirely for storage with treatment expectation similar to a reservoir. The project will also allow seepage to assist in maintaining natural restoration of the southern portion of the property.

- **C-139 FEB Discharge Structures (New)**

  The C-139 FEB discharge structures will consist of gated structures to the Deer Fence Canal (**Figure 13**). Through distribution of the flows to the Deer Fence canal, the G-508 pump station will be able to distribute the flows to the STAs.

  Additional hydraulic modeling will be conducted during detailed design to determine if the stages developed in the deep portion of the FEB can be leveraged to allow gravity flow to the STAs through an additional structure in the L-3 canal just south of G-406.

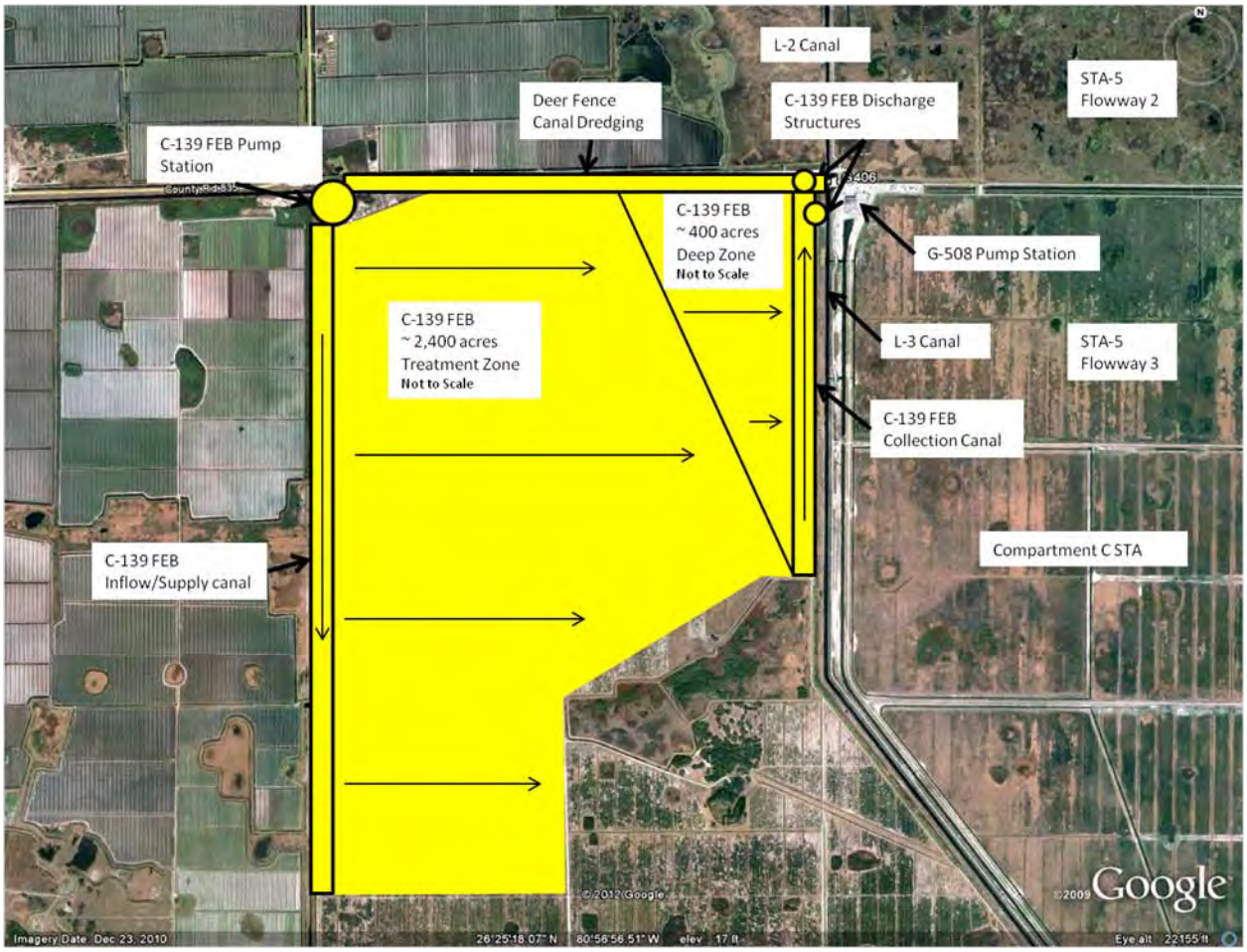

Figure 13. C-139 FEB Conceptual Plan

- **STA-5 Internal Earthwork**

  Construction of STA-5 consists of internal earthwork improvement to cells 2A and 3A (**Figure 14**). The western side of the STA-5 Flowway 2 and STA-5 Flowway 3 adjacent to the L-2 and L-3 canals currently are at an elevation that prevents routine inundation and therefore inhibits the expansion of emergent wetland vegetation. As a result, these areas have previously been considered “non-effective treatment areas”. This project will conduct the earthwork necessary to lower the high-elevation areas down to approximately match the ground elevation of the adjacent effective treatment area to the east and to fill in remnant ditches that cause short-circuiting, thereby increasing the effective treatment area by approximately 800 acres.

Figure 14. STA-5 Internal Earthwork

3.3.3 Model Assumptions and Results Specific to the Western Flow Path

3.3.3.1 DMSTA Calibration Dataset for SAV Cells

Unlike all other SAV cells simulated by DMSTA for this planning effort, the SAV cells of STA-5, STA-6 and Compartment C, utilized DMSTA's pre-existent wetland calibration dataset (PEW_3) instead of the submerged aquatic vegetation calibration dataset (SAV_3).

3.3.3.2 Flow Equalization Basin Operations and Performance

In the DMSTA modeling, the phosphorus removal performance of the Western Flow Path FEB was assumed to be consistent with emergent aquatic vegetation for approximately 85 percent of the area and consistent with a reservoir for approximately 15 percent of the area. This areal allocation results in a net phosphorus settling rate of 15.1 meters per year. In addition, to maximize the treatment efficiency of the Western Flow Path STAs, enhanced FEB operations and release protocols were implemented. The enhanced FEB operations attenuate the impact of peak flows and loads on STAs during wet seasons, attempt to provide optimal inflows to the STAs, and reduce the frequency and severity of dryout conditions in the STAs during dry seasons. Simulation results indicate that FEBs with enhanced operations improve STA phosphorus removal efficiency and provide a more robust system capable of accommodating highly variable hydrologic and phosphorus loading conditions.

3.3.3.3 C-139 Basin Rule

The Everglades Forever Act mandates that the TP load from the C-139 Basin not exceed the phosphorus load during an established historic period, adjusted for rainfall. Chapter 40E-63, Florida Administrative Code, establishes a rainfall adjusted methodology for an annual performance assessment to determine whether the C-139 Basin is achieving the mandate. Using mean monthly TP concentrations observed from the C-139 Basin southern discharge during Water Years 2000-2009 and simulated discharge flow volumes, the period of simulation average annual TP load from the C-139 Basin is estimated to be approximately 58.9 metric tons per year. Therefore, in order to simulate STA inflows with future achievement of mandated historical loads from the C-139 Basin, the concentration dataset was scaled down by approximately 35 percent (to replicate a historical period load of 38.15 metric tons per year). As previously mentioned, WY2000-2009 mean monthly TP concentrations when combined with SFWMD-simulated flows may result in higher TP loads from the C-139 Basin than is currently being observed.

Furthermore, the assumption that the historical period loads will be achieved is justified by the C-139 Basin Rule's recently improved BMP implementation requirements and specific actions necessary if the basin is determined to not meet those levels into the future.

3.3.3.4 C-139 Annex

The objective of C-139 Annex restoration plan is to restore the historic Everglades hydrologic conditions to the greatest extent possible. The project will improve water quality in the Everglades by restoring primarily wetland and associated upland habitat values, diversity, and function while eliminating all agricultural runoff from the site. Approximately 10,000 acres of cultivated area on the site will be restored to a wetland community. Approximately 3,400 acres of undeveloped areas, including tree islands, upland hardwood hammocks, wet prairies and cypress hardwood hammocks will receive hydrologic enhancements as a result of the project. As a result of the restoration plan, the C-139 Annex is not considered a source basin to the STAs in this planning process as flows will continue south.

3.3.3.5 Summary of Western Flow Path Flows and Total Phosphorus Loads and Concentrations

To simulate Western Flow Path scenarios with DMSTA, the SFWMM-simulated source basin daily flows are combined with the corresponding mean monthly TP concentrations. The overall model assumptions described above are then incorporated, which results in a daily flows and TP concentrations for the Western Flow Path that are compatible with DMSTA. **Table 6** provides a summary of the average annual flows and TP loads and concentrations for each source basin that result from this process.

Table 6. Average Annual Flows and Total Phosphorus Loads and Concentrations for the Western Flow Path

Source Basin	Flow (ac-ft per year)	Total Phosphorus Load (metric tons per year)	Total Phosphorus Concentration (ppb)
C-139	187,700	35.4	153
Lake Okeechobee (supplemental water to maintain STA vegetation)	9,900	1.8	147
Total	197,600	37.3	153

Note: The C-139 values above include reductions of TP concentrations due to C-139 Basin Rule

DMSTA Modeling Results

Based on the DMSTA modeling results, the long-term flow-weighted mean outflow TP concentration for this flow path is 11.8 ppb. Due to the uncertainty associated with DMSTA simulated low level annual concentrations, annual values less than 12 ppb were replaced with a value of 12 ppb. When implementing a minimum annual TP concentration of 12.0 ppb, the long-term flow-weighted mean outflow TP concentration is 13.1 ppb.

3.3.4 Safety factors

For the purpose of this plan, safety factors are modeling assumptions or activities that provide greater assurances that the TP WQBEL can be achieved. The safety factors in the western flow path are:

Current vs. Future Performance of STA-5

Historically, STA-5 performance has not equaled that of the other STAs. Experience in operating this STA has indicated poor performance is primarily driven by TP over-loading, short circuiting within the treatment cells, and problems related to dryout. However since 2009, STA-5 performance as a whole has improved, which is believed to be due to internal improvements that were made to STA-5 Cell 1A, reductions in hydraulic and TP loading, decreases in soil phosphorus flux and TP inflow concentrations, and vegetation establishment throughout the STA (Pietro 2011, SFWMD 2012).

In addition to the recent performance improvements, it is anticipated that additional improvements in performance will occur as a result of future projects including: additional internal earthwork that will be conducted to increase effective treatment area and reduce short circuiting (in addition to Compartment C); the recently revised C-139 Basin Rule which will further reduce inflow TP concentrations and loads; and the upstream FEB which will assist in reducing dryout and phosphorus loading/concentrations.

Additionally, there have been concerns that low Calcium (Ca) levels in STA-5 have reduced treatment performance; however, based on an internal analysis of factors affecting treatment performance, and conclusions of Gu et al. (2005); Ca does not seem to be limiting TP reduction in STA-5.

Lake Okeechobee Total Phosphorus Concentrations

For this planning effort, the mean monthly total TP concentrations assumed for STA inflows from Lake Okeechobee were calculated based on TP concentrations measured

at Lake outlet structures. In comparison, TP concentrations measured at STA inflow structures are 50 – 70 ppb lower for the period of record WY2000 – WY2009.

Extreme Event Diversions

It was assumed that all SFWMM-simulated STA diversion flows would be treated by the STAs in the water quality-focused DMSTA modeling. However, it is recognized that there are structural and other constraints that will require STA diversions to occur. Therefore, since the water quality modeling assumes all flows will be treated, the predicted model performance could be considered conservative.

Internal Improvements to STAs

Internal improvements within the STAs, to address short circuiting, vegetation, topographic, and other issues, will continue to be implemented and are expected to further improve treatment performance. This improvement in performance is not accounted for in the DMSTA modeling, therefore current modeled treatment performance is conservative.

4.0 Science Plan

A science plan will be developed and implemented to investigate critical factors that influence phosphorus treatment performance. The science plan will be developed in coordination with key state and federal agencies and experts and will be designed to increase the understanding of factors that affect treatment performance; in particular factors that affect performance at low phosphorus concentrations (<20 ppb TP). These investigations could include, but are not limited to: effects of microbial activity, phosphorus flux, inflow volumes and timing, inflow phosphorus loading rate and concentrations on phosphorus outflow, phosphorus removal by specific vegetation speciation, and the stability of accreted phosphorus. Results from these studies will be used to inform design and operations of treatment projects which will ultimately improve capabilities to manage for achievement of the WQBEL. Results from these studies will be summarized and reported as part of the annual report (South Florida Environmental Report).

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Appendix A

Modeling Design Report

RS_Base 2

Model Documentation Report

South Florida Water Management Model
Restoration Strategies Baseline 2

September 27, 2011

1.0 Overview

Identification

This report documents assumptions and decisions made in the development of the Restoration Strategies Baseline 2 (RS_BASE2) scenario using the South Florida Water Management Model (SFWMM or 2x2). This work was completed by the Hydrologic & Environmental Systems Modeling section at the South Florida Water Management District (SFWMD) under the auspices of Model Request Form (MRF) 5041 (included as Attachment B) in support of the SFWMD Restoration Strategies initiative.

Scope and Objectives

The intent of the RS_BASE2 model run is to represent a projection of the south Florida system hydrology as it would be in the future (circa 2015-2020). This projection is dependent on several assumptions, including anticipated completion of current and planned projects, system operating protocols and projections of future consumptive use and environmental demands. Although the entire south Florida regional system is modeled by the SFWMM, the primary area of interest for the Restoration Strategies initiative focuses on basin hydrology in and in the vicinity of the Everglades Agricultural Area (EAA), specifically related to any basins that contribute flow to Stormwater Treatment Areas (STAs) that discharge into the Everglades Protection Area.

Throughout the development of the RS_BASE2 scenario, the modeling and project teams determined the appropriate modeling techniques to be used given the scale and previous formulation of the model and consistent with a reasonable use of the regional SFWMM tool as determined by best professional judgment and established peer review findings (Bras 2005).

Intended Use of Results

The simulation of the RS_BASE2 is required for production of time-series data of flows representative of basin hydrology in and in the vicinity of the EAA. These flows are utilized in subsequent modeling performed using the Dynamic Model for Stormwater Treatment Areas (DMSTA), and its pre-processing tools, in order to assess sizing and operations of proposed project features in support of the SFWMD Restoration Strategies project.

2.0 Basis

Assumptions, Considerations and Constraints

The RS_BASE2 scenario was developed using the Restoration Strategies Baseline (RS_BASE) scenario from May 2010 as a starting point. The RS_BASE scenario was utilized by the Environmental Protection Agency in development of the Amended Determination. The current modeling of RS_BASE2 retains a number of assumptions carried over from the previous scenario including the following key points:

- The RS_BASE and RS_BASE2 runs are generally representative of a future (circa 2015-2020) condition including assumed build-out of projects not currently operating and utilizing future projected consumptive use demands.
- The implementation of STAs in the vicinity of the EAA in the RS_BASE and RS_BASE2 are based on the assumptions of the Long Term Plan for Achieving Water Quality Goals (LTP) objectives for the year 2015 as identified in the EAA Regional Feasibility Study (SFWMD 2005b), without the EAA Conveyance and Regional Treatment (ECART) project.
- The SFWMD Expedited Projects (formerly known as Acceler8) are included with the exception of the Everglades Agricultural Area (EAA-A1) Reservoir.
- Lake Okeechobee is managed with the 2008 Lake Okeechobee Regulation Schedule (LORS08) and Lake Okeechobee Water Shortage Management (LOWSM) operations (F.A.C. 2001 & F.A.C. 2007).
- Tamiami Trail culverts east of the L-67 Extension are explicitly modeled.

In addition to those assumptions already addressed, the RS_BASE2 makes the following refinements to the RS_BASE scenario:

- Updated modeling of the C51 canal and the Lake Worth Drainage District consistent with improvements to SFWMM modeling made in the C51 Reservoir feasibility study.
- Updated representation of the Loxahatchee River Watershed Restoration Project, consistent with project planning circa May 2011 under the Comprehensive Everglades Restoration Project (CERP).
- Improved simulation of 298 District routing to more closely represent observed trends in outflow (e.g. more flow directed south rather than to Lake Okeechobee).
- Improved simulation of Western Basin (C-139 and C-139 Annex) hydrology.

The primary constraints developed by the project team were as follows:

- Modeling done by the U.S. Army Corps of Engineers (USACE 2007 & USACE 2008) in support of development of the LORS08 regulation schedule assumed a limit on Lake Okeechobee releases to the STAs of 60,000 ac-ft per year. In order to be consistent with this modeling the same constraint was followed in this model run.
- Inflow volumes to downstream STAs in the vicinity of the EAA were not constrained despite known limitations of these facilities in providing treatment to volumes of water beyond their design capacities. Although high-level planning constraints are frequently considered in the SFWMM related to long-term STA flow loading, in the case of this modeling exercise, these constraints were not applied. It is anticipated that follow-up DMSTA modeling would identify additional projects to aid in the attainment of water quality objectives.

See Attachment A - Table of Assumptions for a comprehensive listing of SFWMM assumptions.

Model Limitations

The SFWMM is a robust and complex regional scale model. Due to the scale of the model, it is frequently necessary to implement abstractions of system infrastructure and operations that will, in general, mimic the intent and result of the desired project features while not matching the exact mechanism by which these results would be obtained in the real world. Additionally, it is sometimes necessary to work within established paradigms and foundations within the model code (e.g. use available input-driven options to represent more complex project operations).

3.0 Simulation

Modeling Tools Used

- South Florida Water Management Model Version 6.5.1r954 (Linux)
    - SFWMD network model executable location: /nw/oom/sfwmm/workdirs/wca1/models/sfwmm/src_rev954/wmm.exe

Model Set Up

Source run for this scenario (input from which modifications were initiated) = RS_BASE
SFWMD network model output location for source run:
/nw/oomdata_ws/sfwmm/workdirs/wca1/models/sfwmm/RSBase_V6.0_052510_out

Model Input Additions/Modifications

A number of updated assumptions were included in the RS_BASE2 scenario relative to the RS_BASE as listed below. The narrative description below is not intended to be comprehensive of all SFWMM changes, but rather to convey the intent of the modifications. A comparison of SFWMM input sets can be made to identify the complete list of changes required to represent the intended revisions.

- C51 canal and the Lake Worth Drainage District (LWDD) modifications: As part of the SFWMD C51 Reservoir feasibility study, a thorough review of SFWMM assumptions in the C51 and LWDD basins was conducted. SFWMM outputs were compared to historical data and several meetings were held with LWDD staff to crosswalk structures and operational intent from the field to the model. Ultimately, updates were made to the model code and inputs to allow for a more accurate representation of the C51 and LWDD basins (SFWMD 2011a & SFWMD 2011b). For the purposes of Restoration Strategies initiative, the primary change of interest relates to the SFWMM tag “M1Q”. This tag represents outflows from Royal Palm Beach to the C51 Canal. In previous modeling efforts, as a simplifying assumption, this structure had been assumed to discharge downstream of S-155A (the structure dividing the C51 East and C51 West basins) although in the field its outfall is located upstream of S-155A. This assumption was made due to the fact that the operational intent of SFWMD water managers is to immediately discharge outflow from Royal Palm Beach through S-155A to tide. In the

RS_BASE2 and in subsequent modeling, M1Q is now assumed to discharge into C51W and then be passed on through S-155A as would be observed in the field. This change in output also necessitated updates to the DMSTA processing to account for the new routing location in determination of C51 East and C51 West basin runoff. Additionally, it should be noted that a flow divide in the Palm Beach Chain of Lakes south of the S155 structure is now assumed which limits the amount of water available to the S155 location and better distributes flows to S40 and S41. This assumption will reduce the amount of water considered to be part of the C51 East basin.

- Loxahatchee River Watershed Protection Project: In order to better represent the expected outcomes of this CERP initiative, the SFWMM was updated with several operational and structural input and code changes in the North Palm Beach planning area. The overall goal was to represent the project features consistent with the provisional Tentatively Selected Plan 5B scenario modeled with the NPB MODFLOW model (Kuebler 2010). A schematic representation of these features in shown in Figure 3-1. Again, from the Restoration Strategies perspective, the changes of interest involve an anticipated reduction in M1Q flows (due to redirection of Indian Trails runoff) and an expected increase in L8 basin runoff to the south via S5A resulting from wet season drawdown of the L8 Reservoir.

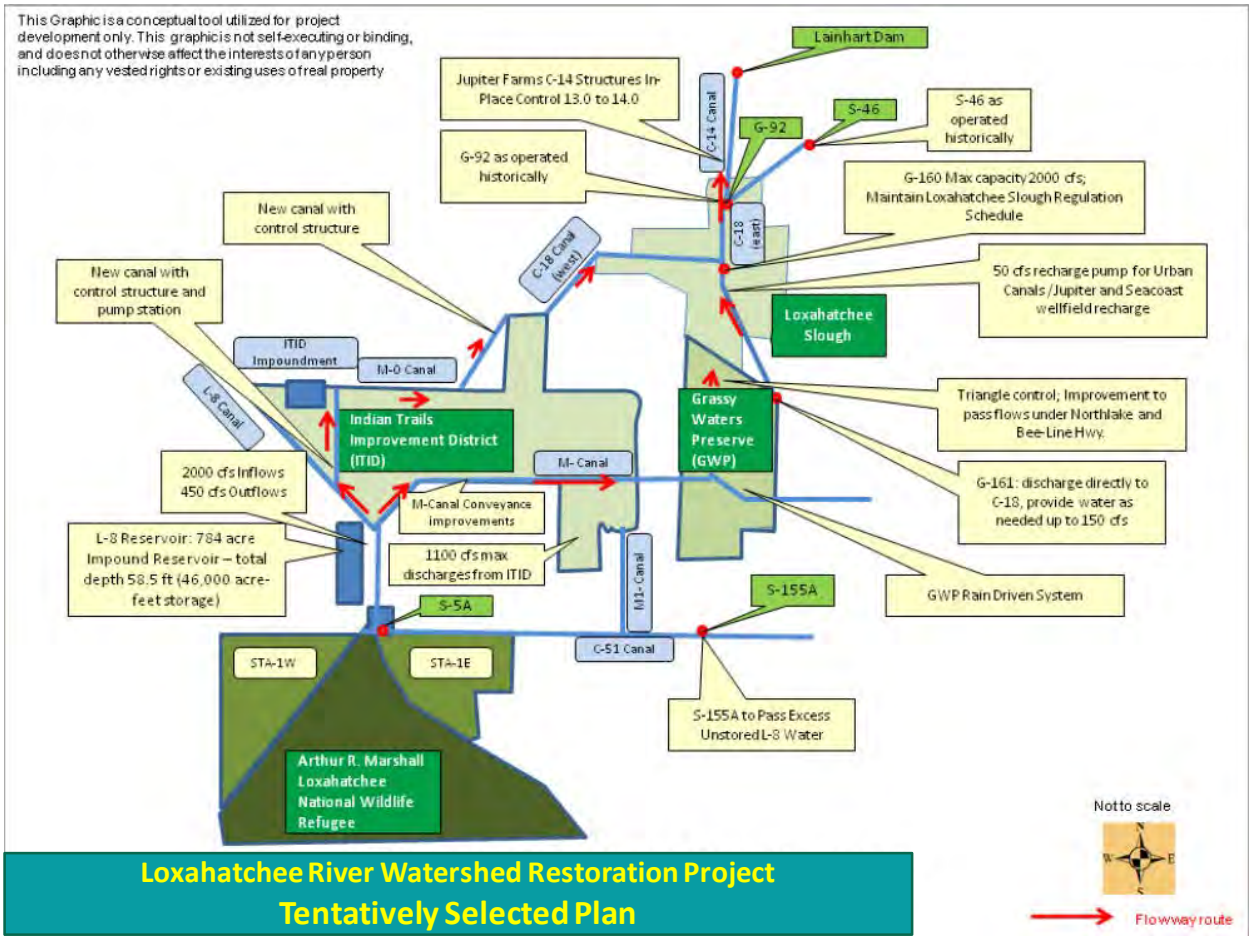

Figure 3-1

- 298 Districts: In the development of RS_BASE2 scenario, an attempt was made to better simulate the flow volumes that the various 298 Districts within the EAA route south toward the STAs. Previous modeling with DMSTA had relied on the methodology outlined in Goforth 2009 to estimate these basin contributions by pro-rating relative to adjacent basins. Iterative testing with the SFWMM indicated limited potential for the model to represent some 298 Districts adequately while others were left to be estimated using the rescaling methodology. Outcomes of the effort are identified in Table 3-1 below for each 298 District.

Table 3-1 – 298 District Hydrology Estimation for DMSTA Using RS_BASE2

298 District	Hydrology Estimate
East Beach WCD	SFWMM
East Shore WCD and 715 Farms	Goforth Method
South Shore Drainage District	SFWMM
South Florida Conservancy District	Goforth Method

- Western Basin (C-139 and C-139 Annex) hydrology: As part of the preparation for the C-139 Basin Feasibility Study, the SFWMD modeling group has developed a Regional Simulation Model (RSM) implementation for the C-139 and C-139 Annex basins (Flaig 2011). This physically based model has been calibrated to historical data for recent periods from 2000 through 2009 and is deemed to be an improvement over the hydrology estimates previously made for these basins that utilized statistical regression approaches. The SFWMM accepts estimates of C-139 and C-139 Annex hydrology as boundary conditions and then routes the resulting flows through the EAA, STAs or into the Everglades Protection Area. Difference between the updated potential inflows in the RS_BASE2 and those in the previous RS_BASE are shown in Table 3-1.

Table 3-2 – Comparison of Previous SFWMM Boundary Condition (BS) and RSM-C139 Model

G136 Flows

Source	Avg. Annual (kac-ft)	Peak flow (cfs)
Previous SFWMM BC	14.1	731
RSM - C139	18.1	425

Potential STA5 Inflows

Source	Avg. Annual (kac-ft)	Peak flow (cfs)
Previous SFWMM BC	177.4	4302
RSM - C139	190.3	2406

C139 Annex Flows

Source	Avg. Annual (kac-ft)	Peak flow (cfs)
Previous SFWMM BC	15.9	430
RSM - C139	46.3	535

Total (no Lake water supply, not accounting for G136 to STA34)

Source	Avg. Annual (kac-ft)
Previous SFWMM BC	207.4
RSM - C139	254.7

4.0 Results

Identification of Simulation

SFWMD network model output location for RS_BASE2 scenario:
/nw/oomdata_ws/sfwmm/workdirs/wca1/models/sfwmm/RSBase2_V6.5.1r954_081811_out

Project Specific Results

The primary objective of the modeling effort was to develop an updated set of flows representing hydrology in and in the vicinity of the EAA for the purposes of providing inputs to the DMSTA model. This objective has been met and summary results are provided on the average annual basis in three forms. Table 4.1 below shows a high-level summary of the flow volumes represented in the RS_BASE and RS_BASE2 scenarios for primary inflow source basins. This table includes some post-processed outcomes or rescaling of SFWMM hydrology (e.g. 298 districts) consistent with methodologies previously utilized in STA design efforts and in the Amended Determination modeling (Goforth 2009). Table 4.2 illustrates the summarized SFWMM flows for source basins as seen by the DMSTA model (including rescaling). A complete listing of all SFWMM tags (without rescaling modifications) used in DMSTA processing is included in Attachment C.

As can be observed in the tables, the anticipated affects of the updated assumptions outlined in Section 3 of this report are observed in the modeling outcomes. In particular, the following key flow observations can be made:

- Consistent with the updates to the C51 and LWDD basins, a reduction in C51 East basin volume is observed. Additionally, the S155A structure increased substantially from 25,000 ac-ft average annual in the RS_BASE to 108,600 ac-ft, average annual in the RS_BASE2 as a result of the updated M1Q routing.
- L8 Basin outflows through S5A increase from 25,000 ac-ft, average annual in the RS_BASE to 48,900 ac-ft, average annual in the RS_BASE2. This is consistent with the expected outcomes of Loxahatchee River Watershed Restoration Project.
- 298 District average annual outflows are more consistent with the historically observed volumes in the 2009 Goforth report in the RS_BASE2 compared to the RS_BASE.
- Total basin inflows to STAs 5 & 6 (STA5IQ +STA6IQ) increase from 204,400 ac-ft, average annual in the RS_BASE to 238,800 ac-ft, average annual in the RS_BASE2. This is consistent with the updated RSM-C139 hydrology assumed as a western basin boundary condition to the SFWMM.

Table 4-1 - Detailed Summary of Source Basin Volumes
(Includes adjustments to SFWMM output hydrology)

Source Basin Name	Average Annual Flow (ac-ft)
C-51 West	169,700
L8 Runoff South	48,900
West Palm Beach (S5A)	293,500
Hillsboro (S-2/S-6)	181,400
North New River (S-2/S-7)	263,900
Miami Canal (S-3/S-8)	218,400
EBWCD	17,000
ESWCD & 715 Farms	22,700
SSDD	11,700
SFCD (S-236)	19,100
C-139	202,400
C-139 Annex	52,000
Lake Okeechobee (Regulatory)	58,300
Lake Okeechobee (Urban Water Supply)	29,200

Table 4-2 - Summarized Flows for Source Basins Used by the DMSTA Model
(Includes adjustments to SFWMM output hydrology)

DMSTA Source	RS_BASE	RS_BASE2	ABS % Diff
S5A Runoff	296,372	293,533	1.0%
S5A Runoff to STA2	60,074	59,839	0.4%
S5A Runoff to WPB	236,298	233,695	1.1%
S361	9,685	9,684	0.0%
C51W_EX_S361	159,686	159,978	0.2%
L8 Runoff South	25,022	48,938	95.6%
C51E_Runoff	202,767	185,250	8.6%
S6 Runoff	181,280	181,359	0.0%
S6 Runoff to STA2	181,280	181,359	0.0%
S7_Runoff	263,712	263,857	0.1%
S7 to STA34	121,503	121,569	0.1%
S7_To_STA2b	142,209	142,288	0.1%
S8 Runoff	219,341	218,440	0.4%
S8 Runoff to STA34	219,341	218,440	0.4%
C139_L3	176,376	186,683	5.8%
C139_G136 to STA5	3,377	987	70.8%
C139_G136 to STA34	12,089	14,684	21.5%
C139_Annex	21,251	52,070	145.0%
EBWCD to WPB	24,088	17,041	29.3%
SSDD to NNR	5,852	4,208	28.1%
SFCD to MC	19,131	19,070	0.3%
ESWCD & 715 to Hills	30,408	22,747	25.2%
SSDD to MC	6,212	7,456	20.0%
LAKE_WS_STA6	6,818	0	100.0%
LAKE_WS_S354	19,644	21,537	9.6%
LAKE_WS_S351	6,186	5,726	7.4%
LAKE_WS_S352	2,327	1,894	18.6%
LAKE_REG_S354	58,547	58,295	0.4%
S4	38,225	38,225	0.0%

Regional-Level Results

A general overview of the modeling from a system performance perspective supports the following observations (Note that in the associated performance measure graphics, the identifiers “RSB1” and “RSB2” are used for the RS_BASE and RS_BASE2, respectively):

- Lake Okeechobee and the Northern Estuaries: Performance between the RS_BASE and RS_BASE2 scenarios is very comparable for Lake Okeechobee and for flows to the Caloosahatchee and St. Lucie Estuaries. The modeling constraint to send less than 60 kac-ft per year in Lake O. regulatory discharge south was honored. A subset of representative northern system performance measures are provided in Figures 4-1 through 4-2.
- Everglades Protection Area: In general, there is slightly more flow entering and passing through the Everglades system in the RS_BASE2 as compared to the RS_BASE. This is primarily a result of additional water entering the system from the C-139 and C-139 Annex due to the updated RSM-C139 modeling boundary conditions. This additional flow affects inundation patterns and hydroperiods throughout the system. A subset of representative Everglades performance measures are provided in Figures 4-3 through 4-5.
- Water Supply: Lake Okeechobee Service Area and Lower East Coast water shortage cutbacks (both frequency and magnitude) are very similar for the RS_BASE and RS_BASE2 scenarios, with the exception of increased frequency of cutbacks in Lower East Coast Service Area 2 in the RS_BASE2. A subset of representative water supply performance measures are provided in Figures 4-6 through 4-7.
- The specific intent of the project changes associated with the C51 review and Loxahatchee River project were observed in the model. These include changes in flows to Lake Worth Lagoon, different utilization of the L8 Reservoir and improved environmental performance in Grassy Waters Preserve (WPBCAT site) and the Loxahatchee Slough. A subset of representative water supply performance measures are provided in Figures 4-8 through 4-11.

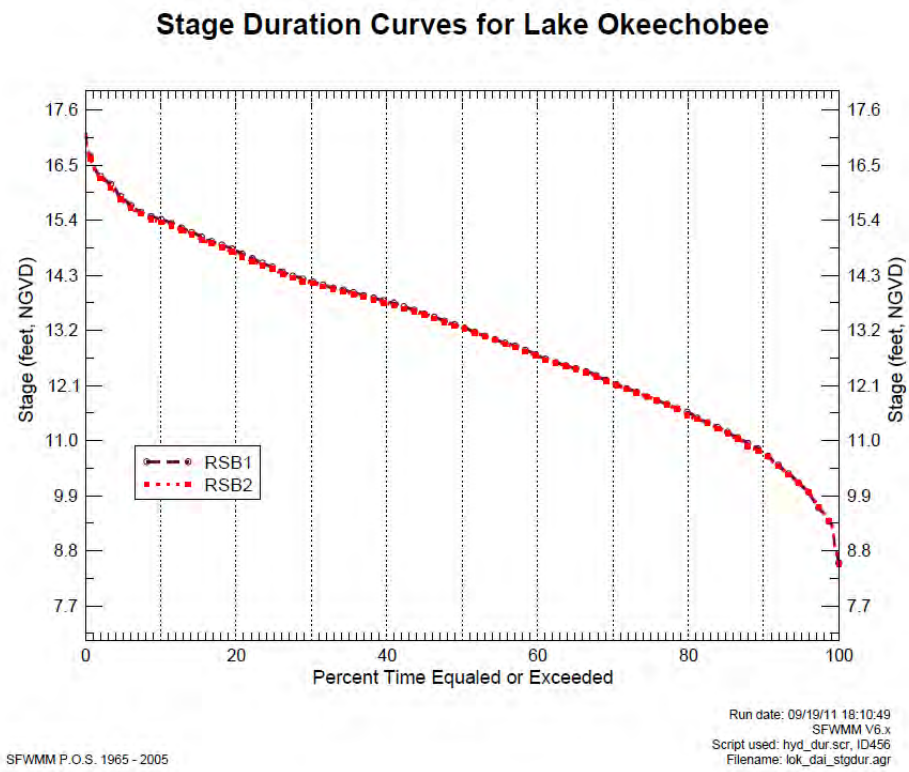

Figure 4-1

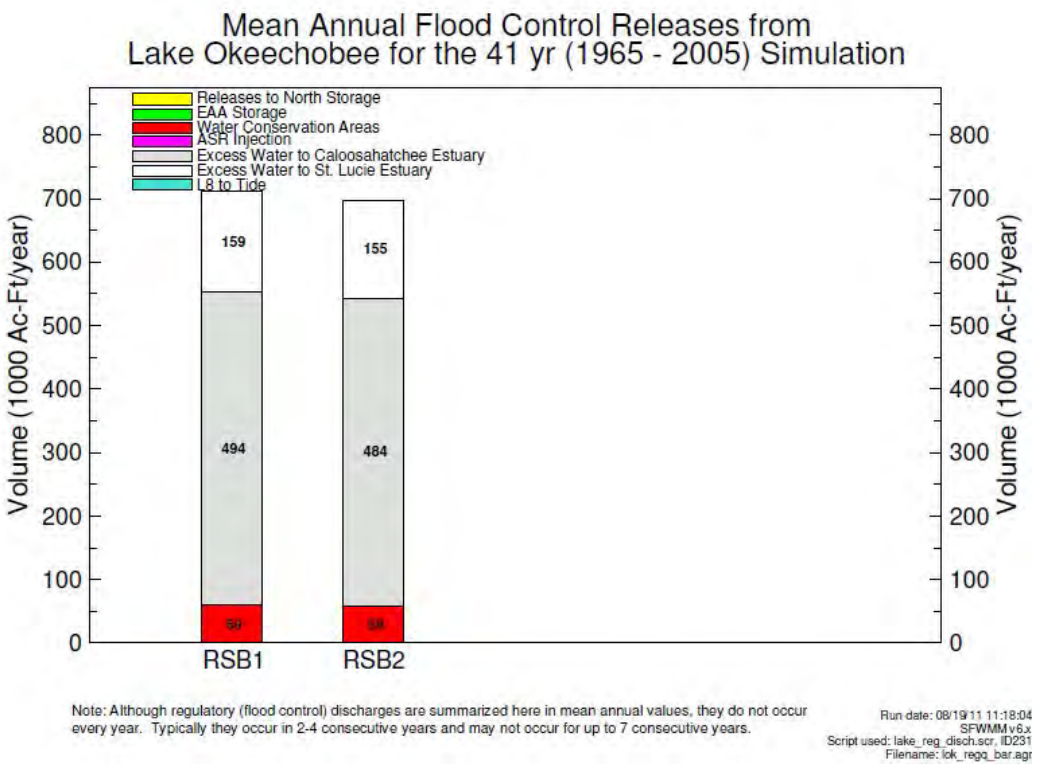

Figure 4-2

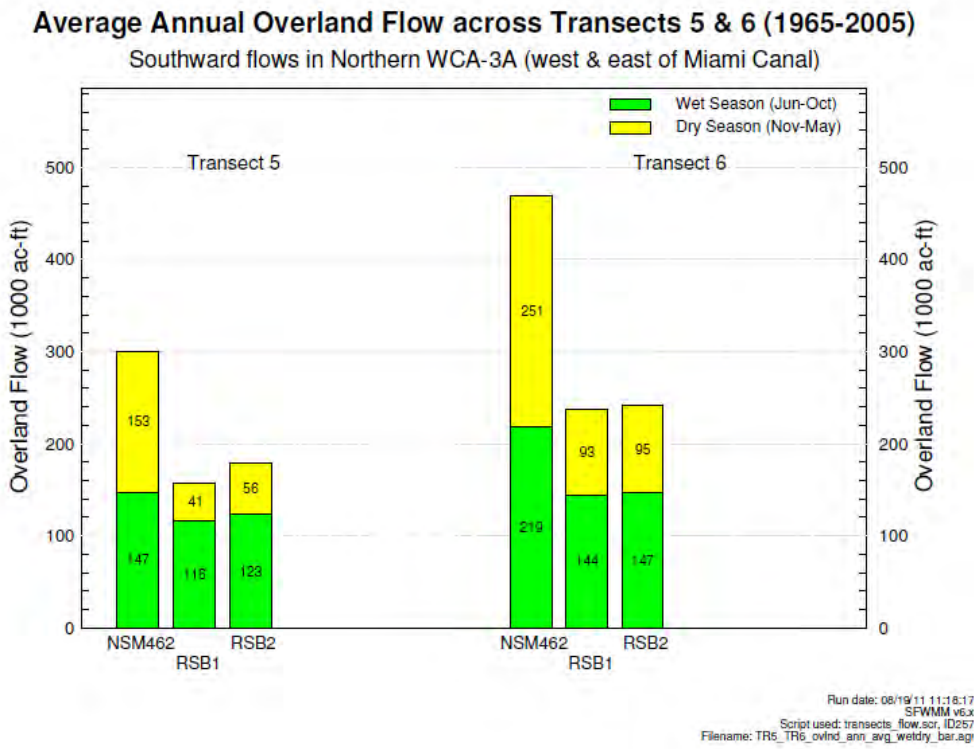

Figure 4-3

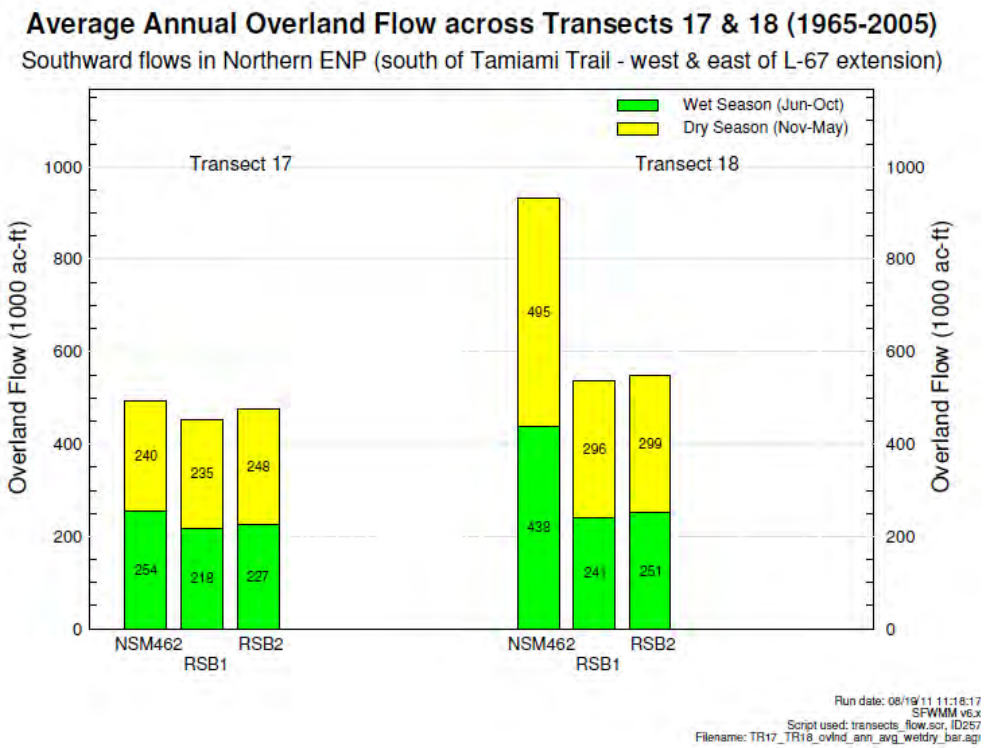

Figure 4-4

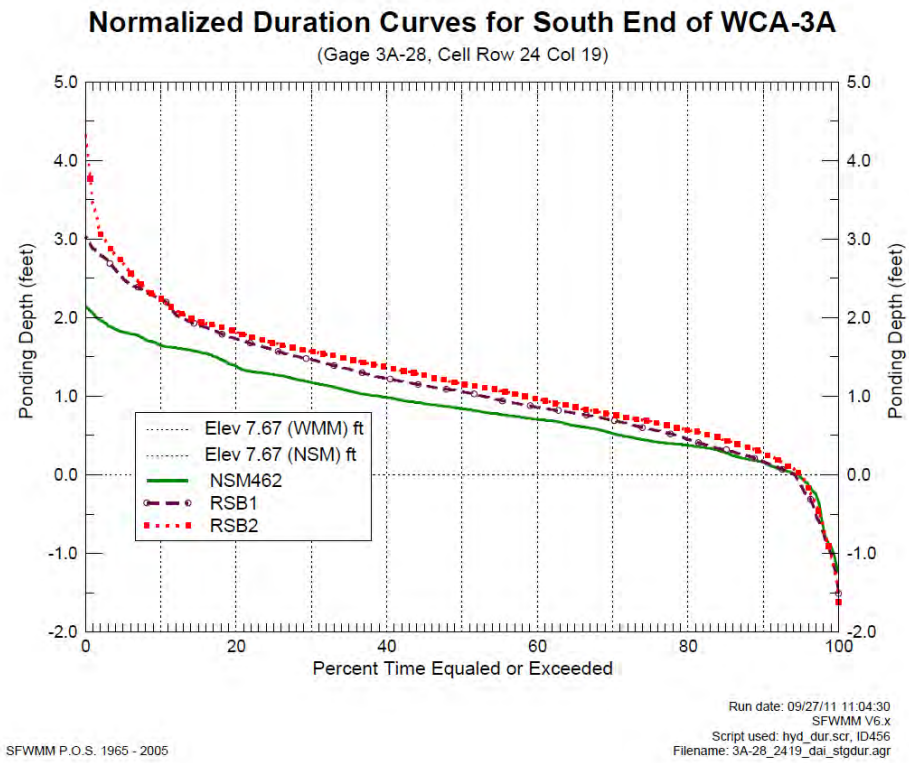

Figure 4-5

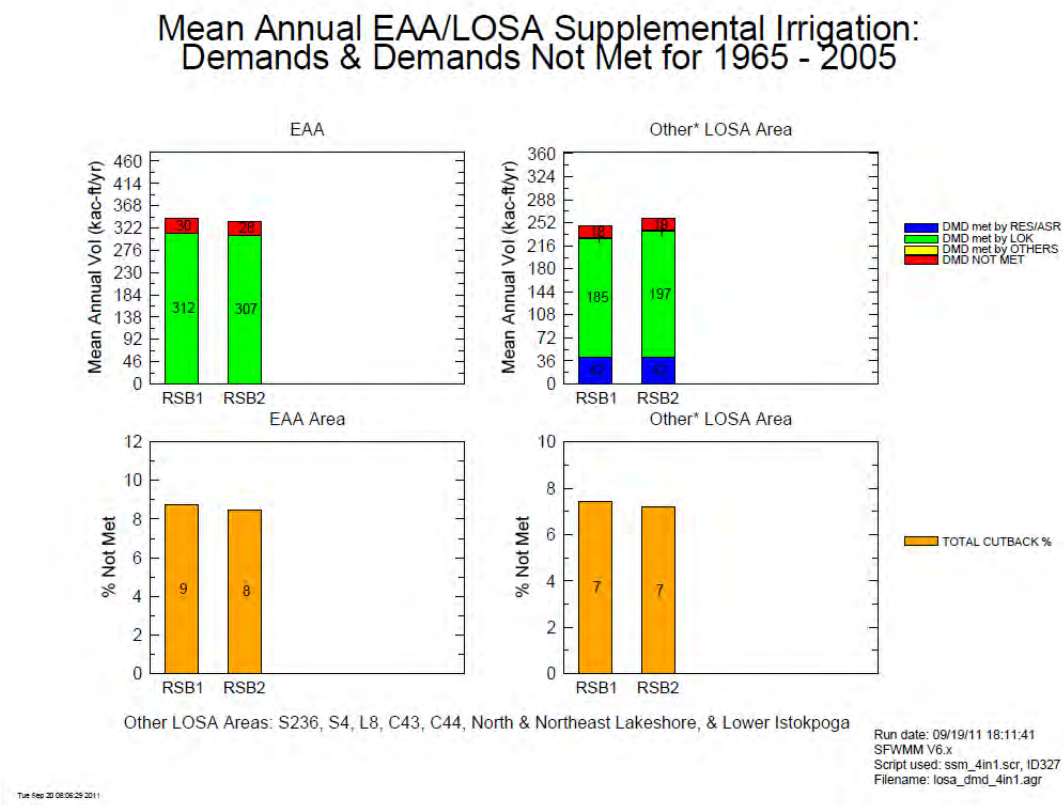

Figure 4-6

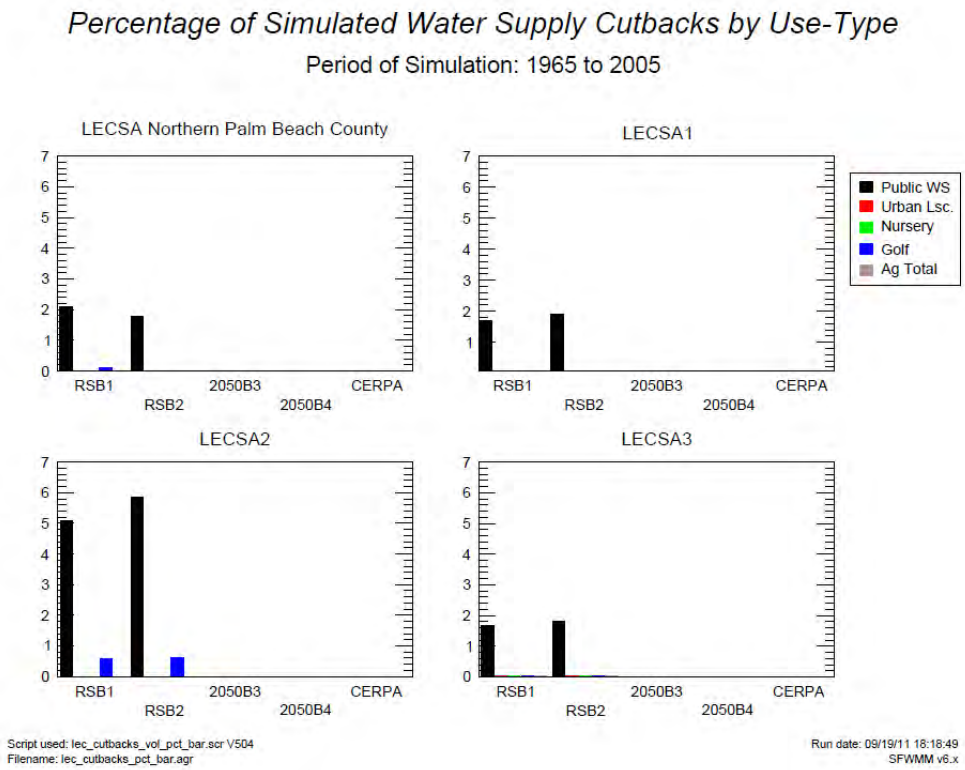

Figure 4-7

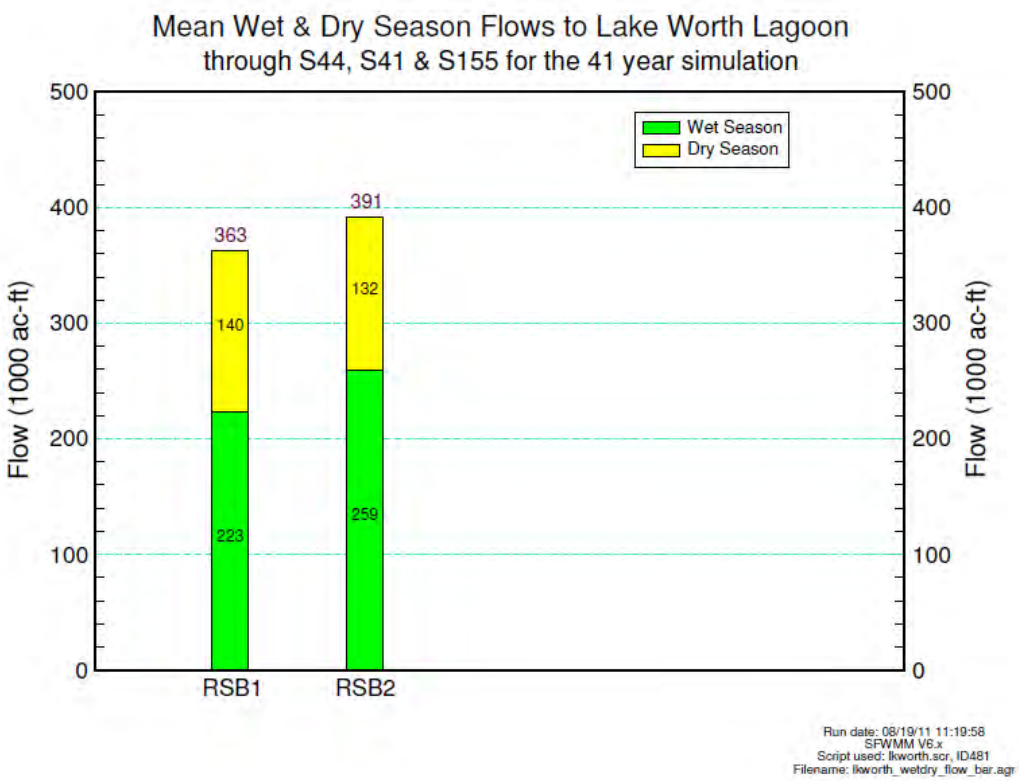

Figure 4-8

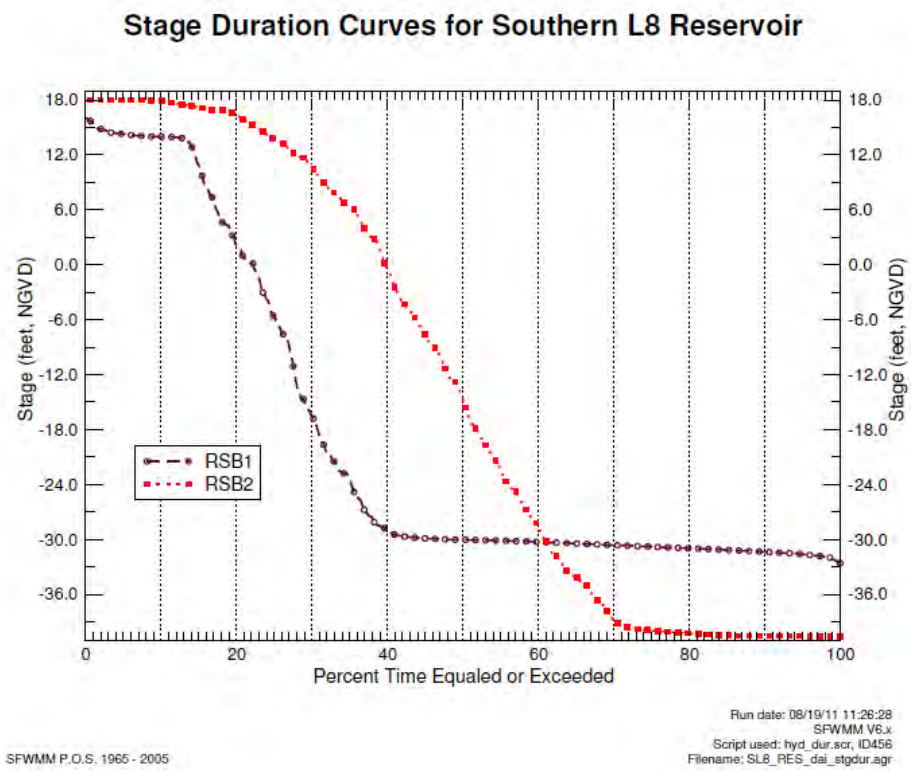

Figure 4-9

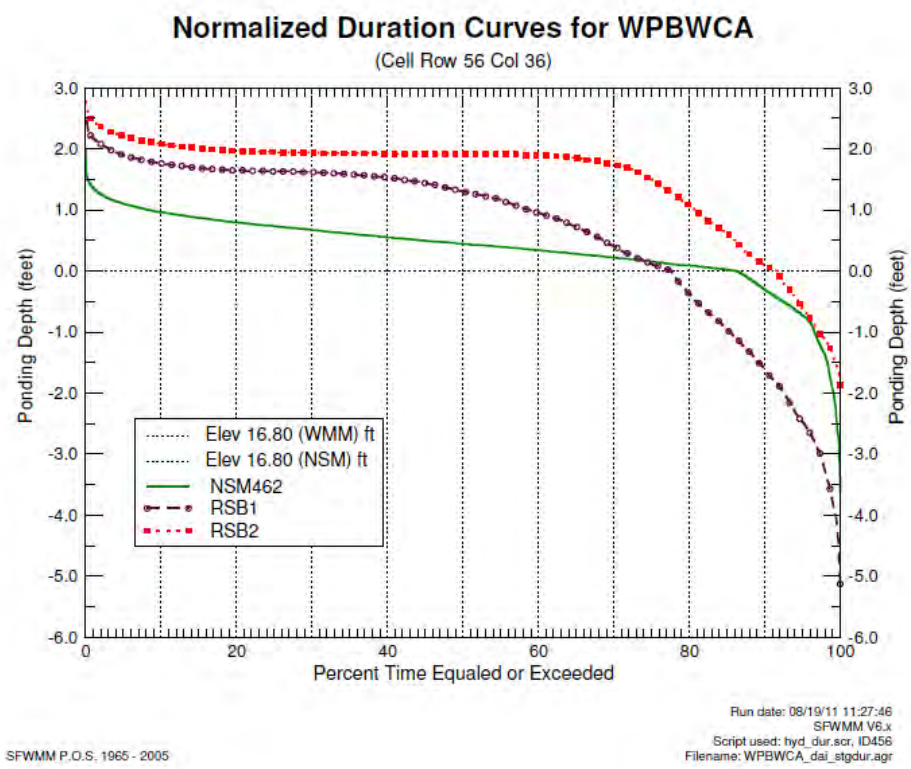

Figure 4-10

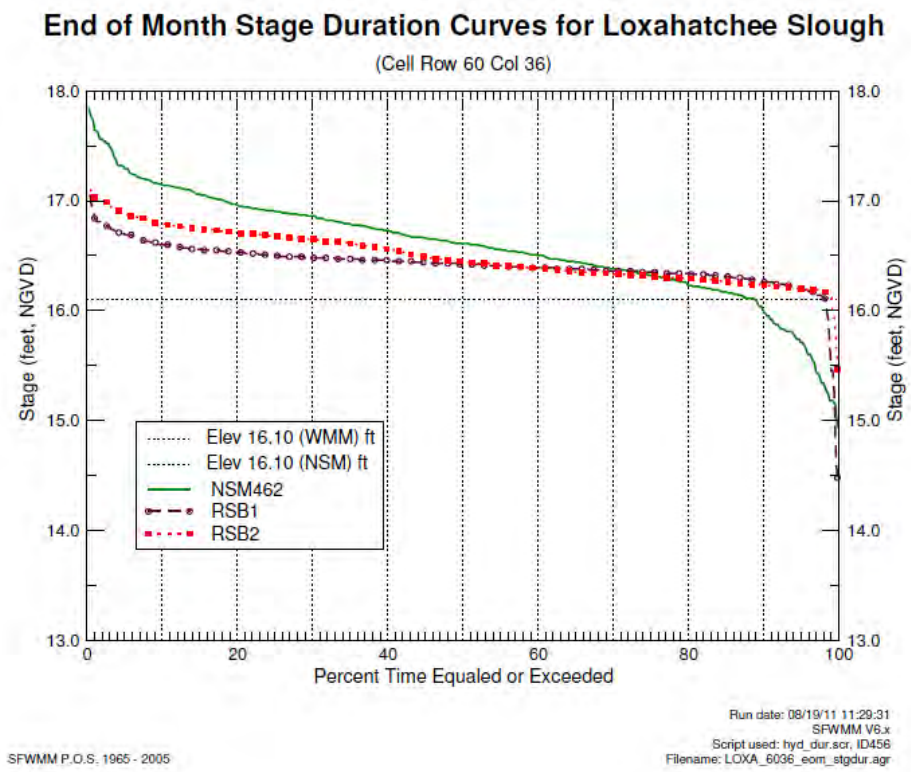

Figure 4-11

Achievement of Modeling Objectives

The overall objectives of the modeling effort were met as identified under MRF 5041. The RS_BASE2 is a valid representation of the future system with planned projects built by circa 2015-2020. All stormwater treatment areas are modeled along with the regional system including Lake Okeechobee. Use of the SFWMM to provide basin hydrology helps to account for critical hydrologic and operational feedback not present in DMSTA modeling alone.

References

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Attachment A – Table of Assumptions

Feature	**Restoration Strategies Baseline 2 Assumptions** 41-Year Simulation Version 6.5.1r954 of SFWMM (Linux)
Climate	• The climatic period of record is from 1965 to 2005. • Rainfall estimates have been revised and updated for 1965-2005. • Evapotranspiration data have been extended up to 2005 using same methods as those used for the 1965-2000 extension.
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. • 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 2005 evaluation period.
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).
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

Feature	**Restoration Strategies Baseline 2 Assumptions** 41-Year Simulation Version 6.5.1r954 of SFWMM (Linux)
	to J. Obeysekera).
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.
Lake Okeechobee	• Lake Okeechobee Interim Regulation Schedule (LORS2008) • Lake Okeechobee Water Shortage Management (LOWSM) Plan for Lake Okeechobee Service Area • Emergency flood control back pumping to Lake Okeechobee from the Everglades Agricultural Area. • Kissimmee River Restoration and Headwaters Revitalization Projects are complete.

CERP Components	• C44 Reservoirs: 9,315 acres, depth 5 .ft.
	• C43 Reservoirs: 11,000 acres, depth 15 ft.
	• Loxahatchee River Watershed Restoration Plan
	  • L-8 Borrow Pit Reservoir: 784 acres; depth 58.5 ft. with Regulation Schedule as in ALT5B
	  • Flowway 1north then east to the C-51 West canal to Loxahatchee River
	  • Flowway 2 west through Grassy Waters Preserve and north to the C-18 canal to Loxahatchee River
	  • Jupiter and Seacoast Utilities wellfield recharge
	• WPA's
	  • Site 1 Impoundment: 1,660 acres; depth 8 ft.
	  • C-9 Impoundment: 1,739 acres; depth 4 ft.
	  • C-11 Impoundment: 1,730 acres; depth 4 ft.
	  • Acme Basin B discharge to C51W and then to STA1E
	• WCA-3A/3B Seepage Management

Caloosahatchee River Basin	• 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 • Public water supply daily intake from the river is included in the analysis.
St. Lucie Canal Basin	• 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 • Basin demands include the Florida Power & Light reservoir at Indiantown.
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 2,414 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.

Feature	**Restoration Strategies Baseline 2 Assumptions** 41-Year Simulation Version 6.5.1r954 of SFWMM (Linux)
	1992), tribal rights to these quantities are preserved. • LOWSM applies to this agreement.
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 2,652 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. • LOWSM applies to this agreement
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.
Everglades Agricultural Area	• Everglades Agricultural Area irrigation demands are simulated using climatic data for the 41 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 Reservoir footprint taken out of sugar cane production (7 cells)
Everglades Construction Project Stormwater Treatment Areas	• Operation of STAs assumes maintenance of a 6" minimum depth. • STA-1E: 5,132 acres total treatment area • STA-1E does not receive flow from L101 Basin • STA-1W: 6,670 acres total treatment area • STA-2: 6,430 acres total treatment area • Compartment B: 9,388 acres total treatment area (includes cell 4 of STA-2) • STA-3/4: 16,543 acres total treatment area • STA-3/4 received Lake Okeechobee regulation releases at or below 60,000 acre-feet annual average for entire POR through the Miami Canal • STA-5: 11,081 acres total treatment area (includes 4916 acres from Compartment C and is expanded with cell 3) • STA-5 uses rain driven operations to send water south to WCA-3 • STA-6: 2,854 acres total treatment area (includes 600 acres from Compartment C and is expanded with phase 2 • STA-6 includes an additional pump (125 cfs) going to Rotenberger Tract

Feature	**Restoration Strategies Baseline 2 Assumptions** 41-Year Simulation Version 6.5.1r954 of SFWMM (Linux)
Holey Land Wildlife Management Area	• As per Memorandum of Agreement between the Florida Fish & Wildlife Commission and the District
Rotenberger Wildlife Management Area	• Interim Operational Schedule as defined in the Operation Plan for Rotenberger (SFWMD Jan 2001)
Water Conservation Areas	
Water Conservation Area 1 (ARM Loxahatchee National Wildlife Refuge)	• Current C&SF Regulation Schedule which 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.
Water Conservation Area 2 A&B	• Current C&SF regulation schedule which 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.
Water Conservation Area 3 A&B	• Structural and operational modifications for L-67 canal conveyance and S-355 structures as in the federally authorized Modified Water Deliveries Project. • 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.
Lower East Coast Service Areas	
Public Water Supply and Irrigation	• Projections based upon population changes by 2010 • Irrigation demands are based upon 2010 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.
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
Upper East	• L-8 Reservoir: 870 acres, depth 44 ft.

Feature	**Restoration Strategies Baseline 2 Assumptions** 41-Year Simulation Version 6.5.1r954 of SFWMM (Linux)
Coast Operational CERP	• 25% of L-8 runoff (L-8 and Indian Trails Upper Basin) is sent to STA-1E.
Western Basins and Big Cypress National Preserve	
Western Basins	• Updated historical inflows from western basins based on DMSTA model; represents potential inflow from the C-139 Basin into STA 5.
Big Cypress National Preserve	• Tamiami Trail culverts are not modeled in SFWMM due to the coarse (2x2 mile) model resolution.
Everglades National Park and Florida Bay	
Everglades National Park	• 8.5 Square Mile Area as per the federally authorized Alternative 6D of the 8.5 Square Mile Area project. • Northern C-111 project (2002 IOP EIS) • Southern C-111 project modeled per C-111 Project 1994 GRR • C111 Spreader Canal (includes) – enlarging S332E pump station, filling southern reach of C-111 Canal, and removing S-18C and S-197 structures.

Attachment B – Model Request Form 5041

Modeling Request Form

Tracking#: 5041 | **CERP Project:** No

Requestor Information

Today's Date:	07/06/2011	*** Due Date:**	07/28/2011
*** Requestor:**	JENNIFER LEEDS	*** Requestor Phone#:**	6088
*** Requestor E-mail:**	jleeds@sfwmd.gov	*** Division Director:**	Temperince Morgan
*** Org. / Dept. Name:**	Everglades Policy and Coordination	*** Division Dir. E-mail:**	tmorgan@sfwmd.gov

Project Information

*** Project Name:**	RESTORATION STRATEGIES		
*** Project Manager:**	Jennifer Leeds	*** Phone #:**	6088
SAP-PS Project#:	100712	**Business Area:**	3312
Timesheet Code:	Network - 5006408 activity - 0120	**Functional Area:**	BH01

Work Description

*** Request Type:** Other

*** Brief Description of Requested Work:** Additional planning level modeling runs to support the Restoration Strategies Regional Planning project for various scenerios of potential water quality facilities. Models discussed that could be used in this effort is the 2X2, DMSTA and RSM.

Attachments: **File:**

Description:

Attachment C – SFWMM Tags Used in DMSTA Processing

SFWMM Tag	RS_BASE	RS_BASE2	Diff
S1324P	9,685	9,685	1
S155A	24,967	108,584	83,617
S319	159,726	154,725	-5,001
S5A3SO	25,022	49,085	24,063
WLC352	2,394	2,015	-379
EBDST1	0	17,331	17,331
RFWPBB	239,900	254,670	14,770
ST1EI1	0	0	0
715ST2	1,525	5,664	4,139
DIVERS	60,075	59,852	-223
ESDST2	4,250	9,862	5,612
FLIMPH	0	0	0
RFTST2	247,960	257,613	9,652
ST2REX	8,122	8,560	437
ST2BYP	84	84	0
STA2EO	122,483	127,366	4,883
STA2MO	123,817	128,751	4,934
RFTST2	247,960	257,613	9,652
WSST2M	0	0	0
WSST2E	26	11	-15
S6LCWS	637	527	-110
NNRST2	142,163	142,277	113
WLES7	46	54	8
STA2BO	139,077	139,195	118
WSST2B	124	0	-124
354RG	58,547	58,346	-201
FLIMPM	0	0	0
FLIMPN	0	0	0
351RG	0	0	0
G136SO	12,089	14,680	2,592
MIAST3	243,131	257,373	14,242
NNRST3	121,503	121,594	91
S236SO	10,866	18,711	7,845
S3PMP	4,932	5,133	201
S8BPMR	0	39	39
WLES8	2,522	2,028	-494
SSDST3	3,741	7,562	3,821
ST3QIN	423,034	437,313	14,279
ST3BYP	0	39	39

SFWMM Tag	RS_BASE	RS_BASE2	Diff
G136SO	11,704	14,680	2,976
ST3NEA	135,068	135,179	111
ST3TL4	0	0	0
ST3TNW	0	0	0
ST3TS7	87,959	94,028	6,069
ST3TS8	112,879	119,861	6,982
ST3OT4	78,751	79,918	1,167
S2PMP	20,937	20,960	23
ST3OT1	33,788	33,333	-455
ST3OT2	54,584	55,142	558
ST3OT3	46,703	46,710	8
ST3OT4	78,751	79,918	1,167
ST3TNE	1,126	1,090	-36
ST3REX	27	33	6
ST3S71	87,959	94,028	6,069
ST3S81	112,879	119,861	6,982
STA5IQ	176,376	186,678	10,302
G136EA	3,377	992	-2,385
G136SO	12,089	14,680	2,592
STA6IQ	28,069	52,074	24,006
WSSTA6	6,818	0	-6,817
S155	221,894	232,066	10,171
S155A	24,967	108,584	83,617
S4BTLK	22,079	11,130	-10,949
WL1351	2,614	2,513	-101
WL3351	3,572	3,216	-356
S5AWC1	2,274	1,760	-514
LKTSEM	17,724	16,647	-1,077
WLC354	19,644	21,571	1,927
WSHOLY	149	148	-1
S354PK	0	0	0

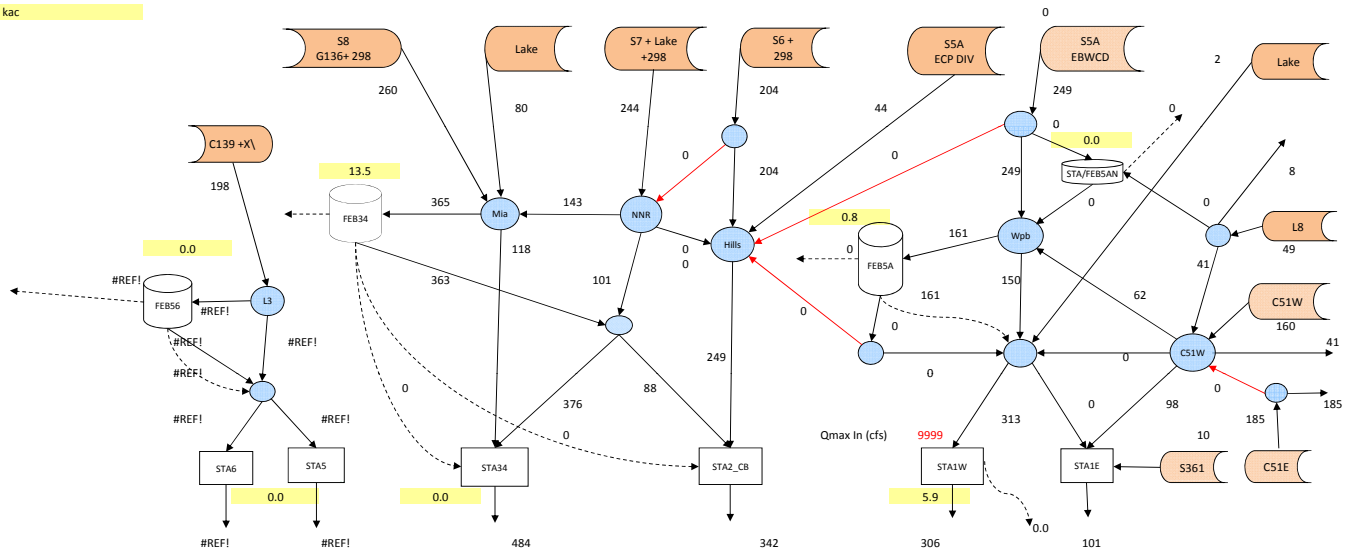
SFWMM Tag	RS_BASE	RS_BASE2	Diff
WL2351	636	503	-133
WSST1W	0	0	0
WSST2B	124	0	-124
WSST2E	26	11	-15
WSST2M	0	0	0
WSST5E	0	203	203
WSSTA	6,837	216	-6,621
WSSTA3	0	0	0
WSSTA5	0	203	203
WSSTA6	6,818	0	-6,817
WST1EE	0	0	0
WST1EW	0	2	2

Appendix B

DMSTA Modeling sheets

Scenario: sfwmd_ec_01mar2012 Min Depth = 5 ft (FEB_S5A), 0.5 ft (FEB34), Lake P, STA1WX = 5,900 ac, 80% SAV Displayed: Flow kac

STA Expansion kac



								Totals
STA Outflow TP ppb	#REF!	#REF!	12.4	12.4	11.1	11.1	#REF!	
STA Expansion kac	0.0		0.0		5.9			5.9
STA Total Area kac	#REF!	#REF!	16.3	15.5	12.4	5.0	#REF!	
STA Outflow kacf/yr	#REF!	#REF!	484	342	306	101	#REF!	
WCA Inflow kacft		#REF!		342	407		#REF!	

Inputs for Scenario sfwmd_ec_01ma Min Depth = 5 ft (FEB_S5A), 0.5 ft (FEB34), Lake P, STA1WX = 5,900 ac, 80% SAV

Starting Date for Simulation 01/01/65
Ending Date for Simulation 04/30/05
Starting Date for Output 05/01/65

Diversion Rules

Mass Balance Summary sfwmd_ec_01m project_sfwmd_ec_01mar2012.xls Run Date 4/4/12 9:50

Diversion	Default	Diverted to	Fraction	Qmax	Description
C51E Diversion	C51W Canal	EAST	0		
S5A Div (ECART)	S5A Div	HILLS_C	0		divert to hills up to qmax
S5A Div (ECART)	S5A Div	HILLS_C	0		low-flow bypass to WPB
S5A Div to FEB North	FEBS5A	FEBS5A_N	0		northern STA.FEB
FEB S5A Outflow	HILLS_C	STA1DW	1	9999	diversion to Hills
C51W Outflow	EAST	STA1E	0.613		direct to STA1E
C51W Outflow	EAST	STA1_DW	0		direct to STA1DW
C51W Outflow	EAST	FEB_S5A	1		remainder to East
STA1W Distrib	STA1W	STA1E	0		WPB C STA1E
S6 Runoff	STA2CB	NNRC	0		S6 divert to NNR
NNR Canal	FEB34	STA34	1	1200	NNR LowQ Bypass to STA34
STA56 Distrib	STA5	STA6	0.365		Balance STA56 Loads, Hint=
L8 to STA1N	North	FEBS5A_N	0		To FEB S5AN (Rest to C51W)
L8 to C51W	North	C51W	1	700	CERP
NNR to CB	STA34	Comp B	0	500	Original Design for Comp B =1
NNR to CB 2	STA34	Comp B	0	500	Additional NNR Diversion to CB
S5A to WS	S5A Div	WS	0	2000	
FEB34 Distrib	STA34	STA2B	0.190	1600	
Other					
Other					

	Inflows Area	Inflows Flow	Inflows Load	Inflows Conc	Outflows Flow	Outflows Load	Outflows Conc	HLR	HLR Max
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d
STA1E	5.0	108	19.7	148	101	1.4	11.1	1.80	13.8
STA1W	12.4	313	67.3	174	306	4.2	11.1	2.10	26.0
STA2B	15.5	337	45.6	110	342	5.2	12.4	1.81	18.5
STA34	16.3	494	40.0	66	484	7.4	12.4	2.53	30.5
STA5	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#VALUE!	#REF!
STA6	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#VALUE!	#REF!
Total STA	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#VALUE!	

STA Areas				
STA1W+E	407.2	5.6	11.1	
STA2+34+B	826.0	12.6	12.4	
STA5+6	#REF!	#REF!	#REF!	

STA1E	R	
STA1W	R	
STA2B	R	
STA34	R	
STA56	W2	

L = Levee; W = Waterbody; P = Published; R = Draft 2011 Revised; AD = USEPA AD 2010; W2 = Comp. C mitigation area removed

Refer to Sheet "STA_Areas" for Effective Treatment Area calculations

FEB Calculations	FEB_S5A	FEB_34	FEB_56	FEBS5A_N
DMSTA calibration	none	EMG_3	RES_3	EMG_3
Area kac	0.786	13.5	0	0
HRT days	30	30	30	30
Bypass Depth ft	58.5	4	4	4
LowQ Bypass cfs	250	200	50	100
Max Qin cfs	2000	5500	1000	2000
Max Qout cfs	450	9999	9999	500
Control Depth ft	5	0.5	1.25	1
Min Release Depth ft	5	0.5	1.25	1
Regulation Schedule	FEB_REG			
STA WS Release	Rel_opt			
Farm WS Release				REL_FARM
Frac Irrig Demand	0.5			0.25
Frac C51 Urban WS	1			
STA Expansion	STA1WX	STA34X	STA56X	Exist Cell Calib
Area kac	5.9	0	0	
Fraction SAV	-0.8	0.67	0.4	
Enhanced	SAV_3	SAV_3	EMG_3	SAV_3
Treat C139 Annex Runoff in STA56	FALSE			
Base Period for Concs	3	1=2005-2009, 2=1995-2009, 3=2000-2009		
Use Lake P Concs	TRUE	for Lake Releases		
C139 Load Reduc	35%	Max TP ppb	0	C139 calc 35.23%
STA Duty Cycle	0.95	New Lake Rel kaf	0	
Target Conc ppb	12.5	Iterations	1	use iter=1 for testing, 2 for final
Output Interval	1	S5A/C51 Cmax	0	
S5A Load Reduc	0%	S678 Cmax	0	
EBWCD Load Reduc	0%	C139 Cmax	0	
Treat Urban WS	TRUE	Modify Lake WS to STA6	TRUE	

Release Mutiplying factor		Input Time Series	Flow kac-ft	Load mt	Conc ppb	Flow cfs	Flow CV -	Flow Max cfs
FEB5A_STA1W	1	FEBS5A_N	0.0	0.0	0	0	#N/A	0
FEB34_STA34	5	FEB_S5A	0.8	161	178	0	#N/A	735
FEB34_STA2B	5	FEB_34	13.5	365	43.0	96	363	15.5	35	53	1
FEB56_STA5	1	FEB_56	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
		Total FEB	14.3	525	78.2	121	363	15.5	35		

Optional:							
See FEB_Design Sheet	Input Time Series	Flow kac-ft	Load mt	Conc ppb	Flow cfs	Flow CV -	Flow Max cfs
See input series sheet							
""	TS_FEBS5A_N	0.0	0.0	0	0	#N/A	0
A1 Res Seep 0	TS_FEBS5A	310.9	66.8	174	429	1.60	5345
	TS_STA1DW	1.9	0.4	176	3	10.59	647
	TS_STA1W	0.0	0.0	0	0	#N/A	0
	TS_STA1E	107.8	19.7	148	149	0.84	1142
1 or <0= Series, 0-0.99 = Paralle	TS_STA2B	248.6	40.2	131	343	1.99	3626
	TS_FEB34	482.7	60.3	101	666	2.08	8222
	TS_STA34	0.0	0.0	0	0	#N/A	0
	TS_FEB56	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Total	#REF!	#REF!	#REF!	0	0.00	0

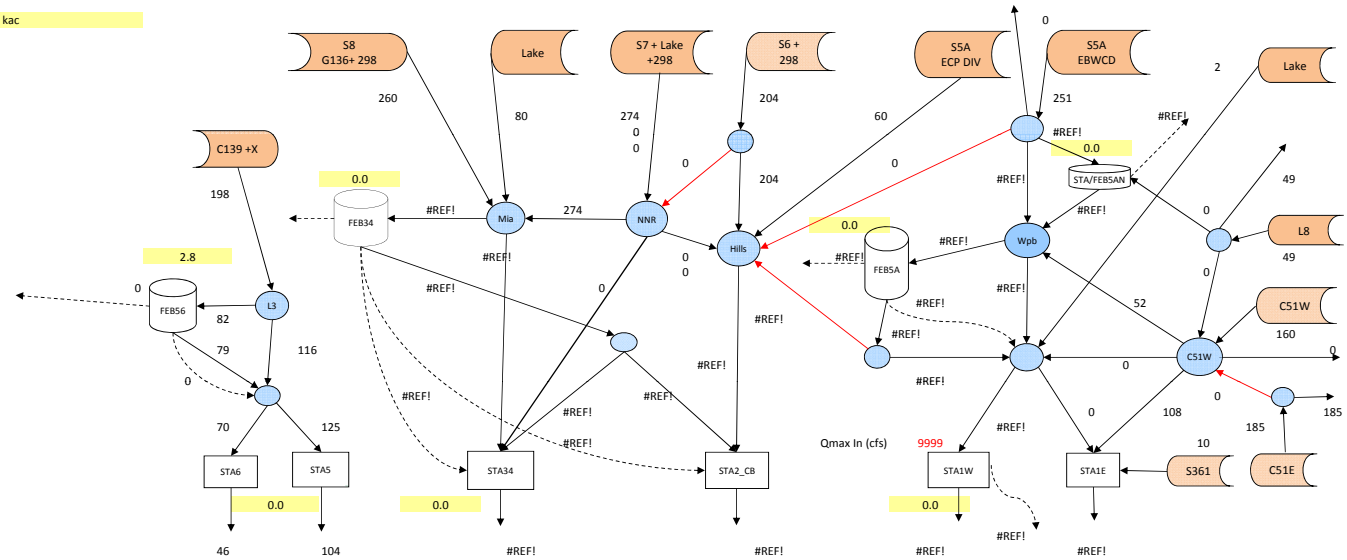
Watershed Areas	Land kac	Fraction	New STA kac	FEB kac	Runoff Rescale
Scale_S5A	107	1	5.9	0.8	0.99
Scale_S6	105	1			1.00
Scale_S7	120	1	0.0	13.5	0.89
Scale_S8	120	0			1.00
Scale_Annex	18	1	0.0	0.0	0.00
Scale_S5A_DIV	23	1	5.9		0.74

S5A Runoff Adj. Location for STA1WX 2 1 = S5A/WBWCD, 2 = S5A ECP DIV

End of Design Input Parameters .....

Scenario: sfwmd_w_01mar2012 C139 Conc 35% Reduc, C139A Not Treated in STA56, 2,800 ac FEB, STA56 PEW Calib Displayed: Flow kac

STA Expansion kac



									Totals
STA Outflow TP ppb	11.8	11.8	#REF!	#REF!	#REF!	#REF!	#REF!		
STA Expansion kac	0.0		0.0		0.0				0.0
STA Total Area kac	5.4	9.1	#REF!	#REF!	#REF!	#REF!	#REF!		
STA Outflow kacf/yr	46	104	#REF!	#REF!	#REF!	#REF!	#REF!		
WCA Inflow kacft			#REF!	#REF!		#REF!	#REF!		

Inputs for Scenario sfwmd_w_01maı C139 Conc 35% Reduc, C139A Not Treated in STA56, 2,800 ac FEB, STA56 PEW Calib

Starting Date for Simulation 01/01/65
Ending Date for Simulation 04/30/05
Starting Date for Output 05/01/65

Diversion Rules

Diversion	Default	Diverted to	Fraction	Qmax	Description
C51E Diversion	C51W Canal	EAST	0		
S5A Div (ECART)	S5A Div	HILLS_C	0		divert to hills up to qmax
S5A Div (ECART)	S5A Div	HILLS_C	0		low-flow bypass to WPB
S5A Div to FEB North	FEBS5A	FEBS5A_N	0		northern STA.FEB
FEB S5A Outflow	HILLS_C	STA1DW	1	9999	diversion to Hills
C51W Outflow	EAST	STA1E	0.672		direct to STA1E
C51W Outflow	EAST	STA1_DW	0		direct to STA1DW
C51W Outflow	EAST	FEB_S5A	1		remainder to East
STA1W Distrib	STA1W	STA1E	0		WPB C STA1E
S6 Runoff	STA2CB	NNRC	0		S6 divert to NNR
NNR Canal	FEB34	STA34	0		NNR LowQ Bypass to STA34
STA56 Distrib	STA5	STA6	0.357		Balance STA56 Loads, Hint=
L8 to STA1N	North	FEBS5A_N	0		To FEB S5AN (Rest to C51W)
L8 to C51W	North	C51W	0		CERP
NNR to CB	STA34	Comp B	0		Original Design for Comp B =1
NNR to CB 2	STA34	Comp B	0		Additional NNR Diversion to CB
S5A to WS	S5A Div	WS	0		
FEB34 Distrib	STA34	STA2B	0.000		
Other					
Other					

Mass Balance Summary sfwmd_w_01m project_sfwmd_w_01mar2012.xls Run Date #REF!

		Inflows			Outflows					
	Area	Flow	Load	Conc	Flow	Load	Conc	HLR	HLR Max
STA	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	cm/d	cm/d
STA1E	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#VALUE!	#REF!
STA1W	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#VALUE!	#REF!
STA2B	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#VALUE!	#REF!
STA34	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#VALUE!	#REF!
STA5	9.1	125	18.0	117	104	1.5	11.8	1.15	11.9
STA6	5.4	70	10.0	117	46	0.7	11.8	1.08	11.1
Total STA	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#VALUE!	

	STA Areas					
0.373	STA1E	R	STA1W+E	#REF!	#REF!	#REF!
	STA1W	R	STA2+34+B	#REF!	#REF!	#REF!
	STA2B	R	STA5+6	150.0	2.2	11.8
	STA34	R				
	STA56	W2				

L = Levee; W = Waterbody; P = Published; R = Draft 2011 Revised; AD = USEPA AD 2010; W2 = Comp. C mitigation area removed
Refer to Sheet "STA_Areas" for Effective Treatment Area calculations

FEB Calculations	FEB_S5A	FEB_34	FEB_56	FEBS5A_N
DMSTA calibration	RES_3	EMG_3	custom	EMG_3
Area kac	0	0	2.8	0
HRT days	30	30	30	30
Bypass Depth ft	58.5	4	4	4
LowQ Bypass cfs	200	400	50	100
Max Qin cfs	2000	9999	1000	2000
Max Qout cfs	320	9999	9999	500
Control Depth ft	1.5	1.5	1.25	0.5
Min Release Depth ft	1.5	1.5	1.25	0.5
Regulation Schedule	FEB_REG	FEB_REG		
STA WS Release	Rel_opt	REL_STA		
Farm WS Release				REL_FARM
Frac Irrig Demand	0.5			0.25
Frac C51 Urban WS	1			
STA Expansion	STA1WX	STA34X	STA56X	
Area kac	0	0	0	
Fraction SAV	1	0.67	0.4	
Ehnanced	SAV_3	SAV_3	PEW_3	
Treat C139 Annex Runoff in STA56	FALSE			
Base Period for Concs	3	1=2005-2009, 2=1995-2009, 3=2000-2009		
Use Lake P Concs	TRUE	for S354 & S351 Lake Rleases		
C139 Load Reduc	35%	Max TP ppb	0	C139 calc 35.23%
STA Duty Cycle	0.95	New Lake Rel kaf	0	
Target Conc ppb	13	Iterations	1	use iter=1 for testing, 2 for final
Output Interval	1	S5A/C51 Cmax	0	
S5A Load Reduc	0%	S678 Cmax	0	
EBWCD Load Reduc	0%	C139 Cmax	0	
Treat Urban WS	TRUE	Modify Lake WS to STA6	TRUE	

ıse Mutiplying factor	
FEB5A_STA1W	1
FEB34_STA34	1
FEB34_STA2B	1
FEB56_STA5	1
FEB56 Seepage	0.001
Seep to STA	0%

Optional:

See FEB_Design Sheet	
See input series sheet	
""	
1 = Series, 0-0.99 = Parallel	

	Treated Inflow			Outflows				
	Area	Flow	Load	Conc	Flow	Load	Conc	Depth cm
FEBs	kac	kac-ft	mt	ppb	kac-ft	mt	ppb	Mean	Min
FEBS5A_N	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
FEB_S5A	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
FEB_34	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
FEB_56	2.8	82	14.9	147	79	5.7	59	79	1
Total FEB	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!		

Input Time Series	Flow	Load	Conc	Flow	Flow CV	Flow Max
	kac-ft	mt	ppb	cfs	-	cfs
TS_FEBS5A_N	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
TS_FEBS5A	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
TS_STA1DW	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
TS_STA1W	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
TS_STA1E	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
TS_STA2B	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
TS_FEB34	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
TS_STA34	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
TS_FEB56	197.5	37.1	152	273	1.08	2584
Total	#REF!	#REF!	#REF!	0	0.00	0

Watershed Areas	Land kac	Fraction	New STA kac	FEB kac	Runoff Rescale
Scale_S5A	107	1	0.0	0.0	1.00
Scale_S6	105	1			1.00
Scale_S7	120	1	0.0	0.0	1.00
Scale_S8	120	0			1.00
Scale_Annex	18	1	0.0	2.8	0.00
Scale_S5A_DIV	23	1	0.0		1.00

S5A Runoff Adj. Location for STA1WX 2 1 = S5A/WBWCD, 2 = S5A ECP DIV

End of Design Input Parameters .....

DMSTA2 - Network Simulation

Model Release: 07/29/11
Current Date: 04/04/12

Forecast Type: Base

Network Name: NET_EAA

Project: PROJECT_SFWMD_EC_01MAR2012V2

Stop after Case Num:

Description: Network for EAA Basins

Routing Table

Enter a downstream CASE name or OUTLET number (1-5) in rows 9-13

Case Name-->	FEBS5A_N	FEB_S5A	FEBS5A_OUT	STA1_DW	STA1W	STA1E	FEB_34	FEB34_OUT	STA2B	STA34
Send Bypass to -->	FEB_S5A	STA1_DW	STA1_DW	STA1E	1	2	STA34	STA34	3	4
Send Release 1 to -->	FEB_S5A	STA1_DW					STA34			
Send Release 2 to -->	5	5					STA2B			
Send Outflow to -->	FEB_S5A	FEBS5A_OUT	STA2B	**STA1W**	1	2	FEB34_OUT	STA2B	3	4
Send Seepage to -->							FEB34_OUT			

Overall Mass Balance

Outlet Number	Outlet Description	Flow hm3/yr	Load kg/yr	FWC ppb	Geo Mn ppb
Outlet 1	STA1W	378.1	4204	11.1	8.0
Outlet 2	STA1E	124.6	1379	11.1	8.6
Outlet 3	STA2B	422.0	5229	12.4	7.4
Outlet 4	STA34	597.6	7393	12.4	8.4
Outlet 5	AGRIC	0.0	0	#N/A	#N/A
Total Outlets		1522.3	18205	12.0	
Watershed Inputs		1546.5	199996	129.3	134.9
Storage Increase		-0.3	319		
Rain - ET		-4.1	8480		
Net Seepage Losses		20.5	1917		
Burial		0.0	188029		
Mass Balance Check		0.0	5		
Input/Outlet Reduction		24.3	181791	117.4	
Reduction %		2%	91%	91%	

Select Network:

Select Simulation Type:

DMSTA2- Inputs & Outputs

Project: PROJECT_SFWMD_EC_01MAR2012

Model Release:
Current Date:

Input Variable	Units	Value	Case Description:								
Design Case Name	-	FEB_S5A	S5A Flow Equalization Basin			Area kac	0.786	Control Z	5	Duty Cyc:	1
Input Series Name		TS_FEBS5A	TS Contains Rule for Irrigation Withdrawal			HRT Days	30	Release Z	5		
Starting Date for Simulation	-	01/01/65	Outflow & Bypass to STA1 Inflow Distr			Byp Depth ft	58.5	Frac to Hill:	1		
Ending Date for Simulation	-	04/30/05	Outflow to Hills			Qin max cfs	2000	Low Byp	250		
Starting Date for Output	-	05/01/65	Bypass to STA1DW			Qo Max cfs	450				
Integration Steps Per Day	-	4	Simulation Type:								
Number of Iterations	-	1	Output Variable	Mean	Lower CL	Upper CL		Diagnostics			
Output Averaging Interval	days	1	FWM Outflow C (ppb)	#N/A	#N/A	#N/A		H20 Balance Error Mean & Max		0.0%	0.0%
Inflow Conc Scale Factor	-	1	GM Outflow C (ppb)	#N/A	#N/A	#N/A		Mass Balance Error Mean & Max		0.0%	0.0%
Rainfall P Conc	ppb	10	Load Reduction %	0%	#N/A	#N/A		Iterations & Convergence		1	0.0%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load (%)	47.2%				Warning/Error Messages		3	

Cell Number -->		1	2	3	4	5	6	7	8	9	10	11	12
Cell Label	-	LowQ Byp	FEB_S5A										
Vegetation Type	-->	none	none										
Inflow Fraction	-	1											
Downstream Cell Number	-	2											
Surface Area	km2		3.18										
Mean Width of Flow Path	km		1.78										
Number of Tanks in Series	-		1.0										
Minimum Depth for Releases	cm		152										
Release 1 Series Name			Rel_opt										
Release 2 Series Name													
Outflow Series Name													
Depth Series Name			FEB_REG										
Outflow Control Depth	cm		9999										
Outflow Weir Depth	cm												
Outflow Coefficient - Exponent	-		1										
Outflow Coefficient - Intercept	-		0.059465										
Bypass Depth	cm		1783.537										
Maximum Inflow	hm3/day		4.896911										
Maximum Outflow	hm3/day	-0.61211387	1.101805										
Inflow Seepage Rate	(cm/d) / cm												
Inflow Seepage Control Elev	cm												
Inflow Seepage Conc	ppb												
Outflow Seepage Rate	(cm/d) / cm												
Outflow Seepage Control Elev	cm												
Max Outflow Seepage Conc	ppb												
Seepage Recycle to Cell Number	-												
Seepage Recycle Fraction	-												
Seepage Discharge Fraction	-												
Initial Water Column Conc	ppb		50										
Initial P Storage Per Unit Area	mg/m2		1079.532										
Initial Water Column Depth	cm		30										
C0 = Conc at 0 g/m2 P Storage	ppb												
C1 = Conc at 1 g/m2 P storage	ppb												
C2 = Conc at Half-Max Uptake	ppb												
K = Net Settling Rate at Steady State	m/yr												
Z1 = Saturated Uptake Depth	cm												
Z2 = Lower Penalty Depth	cm												
Z3 = Upper Penalty Depth	cm												

DMSTA2- Inputs & Outputs

Project: PROJECT_SFWMD_EC_01MAR2012

Model Release:

Current Date:

Input Variable	Units	Value
Design Case Name	-	FEBS5A_OUT
Input Series Name		TS_NULL
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	04/30/05
Starting Date for Output	-	05/01/65
Integration Steps Per Day	-	4
Number of Iterations	-	1
Output Averaging Interval	days	1
Inflow Conc Scale Factor	-	1
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description:

Splits FEB Outflow to Hills or STA1DW

Fraction to STA1DW 1

Max Flow to STA1DW 9999

Bypass goes to STA1DW, Outflow goes to HILLS

Duty Cyc: 1

Simulation Type:

Output Variable	Mean	Lower CL	Upper CL
FWM Outflow C (ppb)	#N/A	#N/A	#N/A
GM Outflow C (ppb)	#N/A	#N/A	#N/A
Load Reduction %	#N/A	#N/A	#N/A
Bypass Load (%)	#N/A		

Diagnostics		
H20 Balance Error Mean & Max	0.0%	#N/A
Mass Balance Error Mean & Max	0.0%	#N/A
Iterations & Convergence	1	0.0%
Warning/Error Messages	5	

Cell Number -->		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Cell Label	-	To STA1DW	To Hills										
Vegetation Type	-->	none	none										
Inflow Fraction	-	1											
Downstream Cell Number	-	2											
Surface Area	km2												
Mean Width of Flow Path	km												
Number of Tanks in Series	-												
Minimum Depth for Releases	cm												
Release 1 Series Name													
Release 2 Series Name													
Outflow Series Name													
Depth Series Name													
Outflow Control Depth	cm												
Outflow Weir Depth	cm												
Outflow Coefficient - Exponent	-												
Outflow Coefficient - Intercept	-												
Bypass Depth	cm												
Maximum Inflow	hm3/day												
Maximum Outflow	hm3/day	-24.48210632											
Inflow Seepage Rate	(cm/d) / cm												
Inflow Seepage Control Elev	cm												
Inflow Seepage Conc	ppb												
Outflow Seepage Rate	(cm/d) / cm												
Outflow Seepage Control Elev	cm												
Max Outflow Seepage Conc	ppb												
Seepage Recycle to Cell Number	-												
Seepage Recycle Fraction	-												
Seepage Discharge Fraction	-												
Initial Water Column Conc	ppb												
Initial P Storage Per Unit Area	mg/m2												
Initial Water Column Depth	cm												
C0 = Conc at 0 g/m2 P Storage	ppb												
C1 = Conc at 1 g/m2 P storage	ppb												
C2 = Conc at Half-Max Uptake	ppb												
K = Net Settling Rate at Steady State	m/yr												
Z1 = Saturated Uptake Depth	cm												
Z2 = Lower Penalty Depth	cm												
Z3 = Upper Penalty Depth	cm												

DMSTA2- Inputs & Outputs

Project: PROJECT_SFWMD_EC_01MAR2012

Model Release:

Current Date:

Input Variable	Units	Value
Design Case Name	-	STA1_DW
Input Series Name		TS_STA1DW
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	04/30/05
Starting Date for Output	-	05/01/65
Integration Steps Per Day	-	4
Number of Iterations	-	1
Output Averaging Interval	days	1
Inflow Conc Scale Factor	-	1
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description:

STA Inflow Distribution - to STA1E, W, X

STA	STA1E	STA1W
Split	0	1
Stream	Bypass	Outflow

Duty Cyc: 1

Simulation Type:

Output Variable	Mean	Lower CL	Upper CL
FWM Outflow C (ppb)	173.8	#N/A	#N/A
GM Outflow C (ppb)	161.8	#N/A	#N/A
Load Reduction %	0%	#N/A	#N/A
Bypass Load (%)	0.0%		

Diagnostics		
H20 Balance Error Mean & Max	0.0%	#N/A
Mass Balance Error Mean & Max	0.0%	#N/A
Iterations & Convergence	1	0.0%
Warning/Error Messages	3	

Cell Number -->		1	2	3	4	5	6	7	8	9	10	11	12
Cell Label	-	To 1W	To 1E										
Vegetation Type	-->	none	none										
Inflow Fraction	-	1											
Downstream Cell Number	-												
Surface Area	km2												
Mean Width of Flow Path	km												
Number of Tanks in Series	-												
Minimum Depth for Releases	cm												
Release 1 Series Name													
Release 2 Series Name													
Outflow Series Name													
Depth Series Name													
Outflow Control Depth	cm												
Outflow Weir Depth	cm												
Outflow Coefficient - Exponent	-												
Outflow Coefficient - Intercept	-												
Bypass Depth	cm												
Maximum Inflow	hm3/day		0.00001										
Maximum Outflow	hm3/day												
Inflow Seepage Rate	(cm/d) / cm												
Inflow Seepage Control Elev	cm												
Inflow Seepage Conc	ppb												
Outflow Seepage Rate	(cm/d) / cm												
Outflow Seepage Control Elev	cm												
Max Outflow Seepage Conc	ppb												
Seepage Recycle to Cell Number	-												
Seepage Recycle Fraction	-												
Seepage Discharge Fraction	-												
Initial Water Column Conc	ppb												
Initial P Storage Per Unit Area	mg/m2												
Initial Water Column Depth	cm												
C0 = Conc at 0 g/m2 P Storage	ppb												
C1 = Conc at 1 g/m2 P storage	ppb												
C2 = Conc at Half-Max Uptake	ppb												
K = Net Settling Rate at Steady State	m/yr												
Z1 = Saturated Uptake Depth	cm												
Z2 = Lower Penalty Depth	cm												
Z3 = Upper Penalty Depth	cm												

DMSTA2- Inputs & Outputs

Project: PROJECT_SFWMD_EC_01MAR2012

Model Release:

Current Date:

Input Variable	Units	Value
Design Case Name	-	STA1W
Input Series Name		TS_STA1W
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	04/30/05
Starting Date for Output	-	05/01/65
Integration Steps Per Day	-	4
Number of Iterations	-	1
Output Averaging Interval	days	1
Inflow Conc Scale Factor	-	1
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description:

STA1W w Series	Expansion		Existing	Expanded	Total	inTotal	Duty Cyc:	0.95
No Seepage Recycle		Area		5.9	12.44065	6.54065		
Fed by STA1 Inflow Distribution Works		SAV% =		-0.8	0.011326			
Expansion Cells 1WX-A & B		Check Total Area			12.44065	Cells 1A,2a,5		EMG_3
For C51E_B: Conv 1A & 2A to SAV		Check Inflow Frac			1		Max. Inflow	05/17/27

Simulation Type:

Output Variable	Mean	Lower CL	Upper CL
FWM Outflow C (ppb)	11.1	#N/A	#N/A
GM Outflow C (ppb)	8.0	#N/A	#N/A
Load Reduction %	94%	#N/A	#N/A
Bypass Load (%)	0.0%		

Diagnostics		
H20 Balance Error Mean & Max	0.0%	0.0%
Mass Balance Error Mean & Max	0.0%	0.0%
Iterations & Convergence	1	0.0%
Warning/Error Messages	13	

Cell Number -->		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Cell Label	-	1A	1B	3	2A	2B	4	5A	5B	1WX-A	1WX-B		
Vegetation Type	-->	EMG_3	SAV_3	SAV_3	EMG_3	SAV_3	SAV_3	EMG_3	SAV_3	EMG_3	SAV_3		
Inflow Fraction	-	0.331754279			0.209199			0.459046					
Downstream Cell Number	-	2	3	9	5	6	9	8	9	10			
Surface Area	km2	2.89	2.34	3.57	2.84	1.25	1.45	2.44	9.72	4.78	19.11		
Mean Width of Flow Path	km	1.10	1.10	1.10	2.40	2.00	1.30	1.78	2.34	2.19	2.19		
Number of Tanks in Series	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0		
Minimum Depth for Releases	cm												
Release 1 Series Name													
Release 2 Series Name													
Outflow Series Name													
Depth Series Name													
Outflow Control Depth	cm	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	40	40		
Outflow Weir Depth	cm												
Outflow Coefficient - Exponent	-	4	4	4	4	4	4	4	4	4	4		
Outflow Coefficient - Intercept	-	1	1	1	1	1	1	1	1	1	1		
Bypass Depth	cm												
Maximum Inflow	hm3/day	8.122043525			5.121639			11.23842					
Maximum Outflow	hm3/day												
Inflow Seepage Rate	(cm/d) / cm	0.0084	0.00432	0.00552									
Inflow Seepage Control Elev	cm	172	172	185									
Inflow Seepage Conc	ppb	20	20	20									
Outflow Seepage Rate	(cm/d) / cm	0.0002	0.0002	0.0051	0.00927	0.004356	0.00787	0.0059	0.00562				
Outflow Seepage Control Elev	cm												
Max Outflow Seepage Conc	ppb												
Seepage Recycle to Cell Number	-												
Seepage Recycle Fraction	-												
Seepage Discharge Fraction	-												
Initial Water Column Conc	ppb	30	30	30	30	30	30	30	30	40	40		
Initial P Storage Per Unit Area	mg/m2	4783.993416	3298.823	1732.969	4616.234	3117.595	1836.039	5157.009	2228.1	1277.017	481.7938		
Initial Water Column Depth	cm	40	40	40	40	40	40	40	40	40	40		
C0 = Conc at 0 g/m2 P Storage	ppb	3	3	3	3	3	3	3	3	3	3		
C1 = Conc at 1 g/m2 P storage	ppb	22	22	22	22	22	22	22	22	22	22		
C2 = Conc at Half-Max Uptake	ppb	300	300	300	300	300	300	300	300	300	300		
K = Net Settling Rate at Steady State	m/yr	16.8	52.5	52.5	16.8	52.5	52.5	16.8	52.5	16.8	52.5		
Z1 = Saturated Uptake Depth	cm	40	40	40	40	40	40	40	40	40	40		
Z2 = Lower Penalty Depth	cm	100	100	100	100	100	100	100	100	100	100		
Z3 = Upper Penalty Depth	cm	200	200	200	200	200	200	200	200	200	200		

DMSTA2- Inputs & Outputs

Project: PROJECT_SFWMD_EC_01MAR2012

Model Release:

Current Date:

Input Variable	Units	Value	Case Description:
Design Case Name	-	STA1E	GG Update Sept 2009
Input Series Name		TS_STA1E	Calibrated Hydraulics, No Seepage Recycle Area kc=
Starting Date for Simulation	-	01/01/65	No Inflow Distribution Cell SAV% =
Ending Date for Simulation	-	04/30/05	Fed by S361 & C51W Canal
Starting Date for Output	-	05/01/65	No Design Changes
Integration Steps Per Day	-	4	Simulation Type:
Number of Iterations	-	1	
Output Averaging Interval	days	1	
Inflow Conc Scale Factor	-	1	
Rainfall P Conc	ppb	10	
Atmospheric P Load (Dry)	mg/m2-yr	20	

Duty Cyc: 0.95

Output Variable	Mean	Lower CL	Upper CL
FWM Outflow C (ppb)	11.1	#N/A	#N/A
GM Outflow C (ppb)	8.6	#N/A	#N/A
Load Reduction %	93%	#N/A	#N/A
Bypass Load (%)	0.0%		

Diagnostics		
H20 Balance Error Mean & Max	0.0%	0.0%
Mass Balance Error Mean & Max	0.0%	0.0%
Iterations & Convergence	1	0.0%
Warning/Error Messages	10	

Cell Number -->		1	2	3	4	5	6	7	8	9	10	11	12
Cell Label	-	1	2	3	4N	4S	7	5	6				
Vegetation Type	-->	EMG_3	SAV_3	EMG_3	SAV_3	SAV_3	EMG_3	EMG_3	SAV_3				
Inflow Fraction	-	0.21665999		0.388266			0.167276	0.227798					
Downstream Cell Number	-	2		4	5		8	8					
Surface Area	km2	2.19	2.19	2.31	2.57	2.96	1.61	2.19	4.18				
Mean Width of Flow Path	km	1.55	1.55	1.55	1.55	1.55	1.61	1.18	0.75				
Number of Tanks in Series	-	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0				
Minimum Depth for Releases	cm												
Release 1 Series Name													
Release 2 Series Name													
Outflow Series Name													
Depth Series Name													
Outflow Control Depth	cm	38	38	38	38	38	38	38	38				
Outflow Weir Depth	cm												
Outflow Coefficient - Exponent	-	4	4	4	4	4	4	4	4				
Outflow Coefficient - Intercept	-	1	1	1	1	1	1	1	1				
Bypass Depth	cm												
Maximum Inflow	hm3/day												
Maximum Outflow	hm3/day												
Inflow Seepage Rate	(cm/d) / cm						0.0054		0.0057				
Inflow Seepage Control Elev	cm						69		94				
Inflow Seepage Conc	ppb						20		20				
Outflow Seepage Rate	(cm/d) / cm	0.00789	0.00155	0.00155	0.00155	0.013062	0.00155	0.00155	0.00155				
Outflow Seepage Control Elev	cm												
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20	20	20				
Seepage Recycle to Cell Number	-												
Seepage Recycle Fraction	-												
Seepage Discharge Fraction	-												
Initial Water Column Conc	ppb	30	30	30	30	30	30	30	30				
Initial P Storage Per Unit Area	mg/m2	3387.53122	768.3317	3966.34	1527.572	310.6707	3430.848	3474.946	845.8887				
Initial Water Column Depth	cm	40	40	40	40	40	40	40	40				
C0 = Conc at 0 g/m2 P Storage	ppb	3	3	3	3	3	3	3	3				
C1 = Conc at 1 g/m2 P storage	ppb	22	22	22	22	22	22	22	22				
C2 = Conc at Half-Max Uptake	ppb	300	300	300	300	300	300	300	300				
K = Net Settling Rate at Steady State	m/yr	16.8	52.5	16.8	52.5	52.5	16.8	16.8	52.5				
Z1 = Saturated Uptake Depth	cm	40	40	40	40	40	40	40	40				
Z2 = Lower Penalty Depth	cm	100	100	100	100	100	100	100	100				
Z3 = Upper Penalty Depth	cm	200	200	200	200	200	200	200	200				

DMSTA2- Inputs & Outputs

Project: PROJECT_SFWMD_EC_01MAR2012

Model Release:

Current Date:

Input Variable	Units	Value	Case Description:										
Design Case Name	-	FEB_34	S5A Flow Equalization Basin				Area kac		13.5	Control Z	0.5	Duty Cyc:	1
Input Series Name		TS_FEB34	TS Contains Rule for Irrigation Withdrawal				HRT Days		30	Release Z	0.5		
Starting Date for Simulation	-	01/01/65	Outflow & Bypass to STA1 Inflow Distr				Byp Depth ft		4	Low Q Byp	200		
Ending Date for Simulation	-	04/30/05	Network inflow from FEB34_IN				Qin max cfs		5500	Calibration	EMG_3		
Starting Date for Output	-	05/01/65	TS_FEB34 has rainfall, release, reg				Qo Max cfs		9999				
Integration Steps Per Day	-	4	Simulation Type:										
Number of Iterations	-	1	Output Variable	Mean	Lower CL	Upper CL			Diagnostics				
Output Averaging Interval	days	1	FWM Outflow C (ppb)	34.7	#N/A	#N/A			H20 Balance Error Mean & Max			0.0%	0.0%
Inflow Conc Scale Factor	-	1	GM Outflow C (ppb)	29.6	#N/A	#N/A			Mass Balance Error Mean & Max			-0.1%	0.1%
Rainfall P Conc	ppb	10	Load Reduction %	46%	#N/A	#N/A			Iterations & Convergence			1	0.0%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load (%)	28.7%					Warning/Error Messages			2	

Cell Number -->		1	2	3	4	5	6	7	8	9	10	11	12
Cell Label	-	LowQByp	FEB_34		RES_3	EMG_3	EMG_3L						
Vegetation Type	-->	none	EMG_3		RES_3	EMG_3	none						
Inflow Fraction	-	1											
Downstream Cell Number	-	2											
Surface Area	km2		54.66										
Mean Width of Flow Path	km		7.39										
Number of Tanks in Series	-		3.0		1.0	3.0	1.0						
Minimum Depth for Releases	cm		15										
Release 1 Series Name													
Release 2 Series Name													
Outflow Series Name													
Depth Series Name													
Outflow Control Depth	cm		15.24										
Outflow Weir Depth	cm												
Outflow Coefficient - Exponent	-		4		1	4	4						
Outflow Coefficient - Intercept	-		1		0.246443	1	1						
Bypass Depth	cm		121.9512										
Maximum Inflow	hm3/day		13.46651										
Maximum Outflow	hm3/day	-0.4896911	24.48211										
Inflow Seepage Rate	(cm/d) / cm												
Inflow Seepage Control Elev	cm												
Inflow Seepage Conc	ppb												
Outflow Seepage Rate	(cm/d) / cm												
Outflow Seepage Control Elev	cm												
Max Outflow Seepage Conc	ppb												
Seepage Recycle to Cell Number	-												
Seepage Recycle Fraction	-												
Seepage Discharge Fraction	-												
Initial Water Column Conc	ppb		10										
Initial P Storage Per Unit Area	mg/m2		1693.108										
Initial Water Column Depth	cm		15										
C0 = Conc at 0 g/m2 P Storage	ppb		3				3						
C1 = Conc at 1 g/m2 P storage	ppb		22				13						
C2 = Conc at Half-Max Uptake	ppb		300				300						
K = Net Settling Rate at Steady State	m/yr		16.8				10.0						
Z1 = Saturated Uptake Depth	cm		40				40						
Z2 = Lower Penalty Depth	cm		100				100						
Z3 = Upper Penalty Depth	cm		200				200						

DMSTA2- Inputs & Outputs

Project: PROJECT_SFWMD_EC_01MAR2012

Model Release:
Current Date:

Input Variable	Units	Value
Design Case Name	-	FEB34_OUT
Input Series Name		TS_FEB34_OUT
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	04/30/05
Starting Date for Output	-	05/01/65
Integration Steps Per Day	-	4
Number of Iterations	-	1
Output Averaging Interval	days	1
Inflow Conc Scale Factor	-	1
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description:

Splits FEB Outflow to STA34 or STA2B — Duty Cyc: 1

Fraction STA2B 0.19

Max Flow STA34 1600

Bypass goes to STA34 Outflow goes to STA2B

Simulation Type:

Output Variable	Mean	Lower CL	Upper CL
FWM Outflow C (ppb)	48.9	#N/A	#N/A
GM Outflow C (ppb)	37.4	#N/A	#N/A
Load Reduction %	0%	#N/A	#N/A
Bypass Load (%)	81.0%		

Diagnostics		
H20 Balance Error Mean & Max	0.0%	#N/A
Mass Balance Error Mean & Max	0.0%	#N/A
Iterations & Convergence	1	0.0%
Warning/Error Messages	4	

Cell Number -->	Units	1	2	3	4	5	6	7	8	9	10	11	12
Cell Label	-	toSTA2B	toSTA34										
Vegetation Type	-->	none	none										
Inflow Fraction	-	0.19	0.81										
Downstream Cell Number	-												
Surface Area	km2												
Mean Width of Flow Path	km												
Number of Tanks in Series	-												
Minimum Depth for Releases	cm												
Release 1 Series Name													
Release 2 Series Name													
Outflow Series Name													
Depth Series Name													
Outflow Control Depth	cm												
Outflow Weir Depth	cm												
Outflow Coefficient - Exponent	-												
Outflow Coefficient - Intercept	-												
Bypass Depth	cm												
Maximum Inflow	hm3/day		0.00001										
Maximum Outflow	hm3/day	3.917528765											
Inflow Seepage Rate	(cm/d) / cm												
Inflow Seepage Control Elev	cm												
Inflow Seepage Conc	ppb												
Outflow Seepage Rate	(cm/d) / cm												
Outflow Seepage Control Elev	cm												
Max Outflow Seepage Conc	ppb												
Seepage Recycle to Cell Number	-												
Seepage Recycle Fraction	-												
Seepage Discharge Fraction	-												
Initial Water Column Conc	ppb												
Initial P Storage Per Unit Area	mg/m2												
Initial Water Column Depth	cm												
C0 = Conc at 0 g/m2 P Storage	ppb												
C1 = Conc at 1 g/m2 P storage	ppb												
C2 = Conc at Half-Max Uptake	ppb												
K = Net Settling Rate at Steady State	m/yr												
Z1 = Saturated Uptake Depth	cm												
Z2 = Lower Penalty Depth	cm												
Z3 = Upper Penalty Depth	cm												

DMSTA2- Inputs & Outputs

Project: PROJECT_SFWMD_EC_01MAR2012

Model Release:

Current Date:

Input Variable	Units	Value	Case Description:											
Design Case Name	-	STA2B	STA-2/Comp. B										Duty Cycle	0.95
Input Series Name		TS_STA2B	Southern 70% of Cell 2 assumed to be SAV							Area kac = 15.48719				
Starting Date for Simulation	-	01/01/65								No Expansion				
Ending Date for Simulation	-	04/30/05								S6 Runoff Diversion to STA34 =			0.00	
Starting Date for Output	-	05/01/65												
Integration Steps Per Day	-	4	Simulation Type:											
Number of Iterations	-	1	Output Variable		Mean	Lower CL	Upper CL			Diagnostics				
Output Averaging Interval	days	1	FWM Outflow C (ppb)		12.4	#N/A	#N/A			H20 Balance Error Mean & Max			0.0%	0.0%
Inflow Conc Scale Factor	-	1	GM Outflow C (ppb)		7.4	#N/A	#N/A			Mass Balance Error Mean & Max			0.0%	0.1%
Rainfall P Conc	ppb	10	Load Reduction %		89%	#N/A	#N/A			Iterations & Convergence			1	0.0%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load (%)		0.0%					Warning/Error Messages			20	
Cell Number -->		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
Cell Label	-	1	2N	2S	3	5N	5S	6N	6S	4	7-Jan	8		
Vegetation Type	-->	PEW_3	PEW_3	SAV_3	SAV_3	EMG_3	SAV_3	EMG_3	SAV_3	SAV_3	EMG_3	SAV_3		
Inflow Fraction	-	0.11874703	0.153145		0.148176	0.208506		0.178087			0.19334			
Downstream Cell Number	-		3			6	9	8	9		11			
Surface Area	km2	7.45	3.17	6.43	9.29	2.42	6.42	2.07	5.48	7.86	6.22	5.90		
Mean Width of Flow Path	km	1.58	2.00	2.00	2.00	3.51	2.70	2.99	2.30	2.50	2.00	1.50		
Number of Tanks in Series	-	3.0	3.0	3.0	6.0	1.0	2.0	1.0	2.0	3.0	3.0	3.0		
Minimum Depth for Releases	cm													
Release 1 Series Name														
Release 2 Series Name														
Outflow Series Name														
Depth Series Name														
Outflow Control Depth	cm	52.73	29.26	29.26	35.97	42.9768	42.9768	42.9768	42.9768	46.0248	41.45	41.45		
Outflow Weir Depth	cm													
Outflow Coefficient - Exponent	-	4	4	4	4	4	4	4	4	4	4	4		
Outflow Coefficient - Intercept	-	0.815	1	2.098	2.852	1	1	1	1	1	1	1		
Bypass Depth	cm													
Maximum Inflow	hm3/day													
Maximum Outflow	hm3/day													
Inflow Seepage Rate	(cm/d) / cm					0.017819	0.006695			0.0064	0.0133	0.0164		
Inflow Seepage Control Elev	cm					48	48			60	53	63		
Inflow Seepage Conc	ppb					75	75			75	75	15		
Outflow Seepage Rate	(cm/d) / cm													
Outflow Seepage Control Elev	cm													
Max Outflow Seepage Conc	ppb													
Seepage Recycle to Cell Number	-													
Seepage Recycle Fraction	-													
Seepage Discharge Fraction	-													
Initial Water Column Conc	ppb	30	30	30	30	30	30	30	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	1027.49462	2104.605	383.4034	726.5016	2975.279	946.8444	2974.003	936.9114	274.9389	2488.151	624.3963		
Initial Water Column Depth	cm	40	40	40	40	40	40	40	40	40	40	40		
C0 = Conc at 0 g/m2 P Storage	ppb	3	3	3	3	3	3	3	3	3	3	3		
C1 = Conc at 1 g/m2 P storage	ppb	22	22	22	22	22	22	22	22	22	22	22		
C2 = Conc at Half-Max Uptake	ppb	300	300	300	300	300	300	300	300	300	300	300		
K = Net Settling Rate at Steady State	m/yr	34.9	34.9	52.5	52.5	16.8	52.5	16.8	52.5	52.5	16.8	52.5		
Z1 = Saturated Uptake Depth	cm	40	40	40	40	40	40	40	40	40	40	40		
Z2 = Lower Penalty Depth	cm	100	100	100	100	100	100	100	100	100	100	100		
Z3 = Upper Penalty Depth	cm	200	200	200	200	200	200	200	200	200	200	200		

DMSTA2- Inputs & Outputs

Project: PROJECT_SFWMD_EC_01MAR2012

Model Release:
Current Date:

Input Variable	Units	Value	Case Description:					
Design Case Name	-	STA34	STA34 (ArcHydro levee centerline areas) with Expansion Cells				duty cycle	0.95
Input Series Name		TS_STA34						
Starting Date for Simulation	-	01/01/65	Expansion Area =	0	16.31864	16.31864		
Ending Date for Simulation	-	04/30/05	SAV Fraction=	0.67	0.513628	0.513628		
Starting Date for Output	-	05/01/65						
Integration Steps Per Day	-	4	Simulation Type:					
Number of Iterations	-	1	Output Variable	Mean	Lower CL	Upper CL	Diagnostics	
Output Averaging Interval	days	1	FWM Outflow C (ppb)	12.4	#N/A	#N/A	H20 Balance Error Mean & Max	0.0% #N/A
Inflow Conc Scale Factor	-	1	GM Outflow C (ppb)	8.4	#N/A	#N/A	Mass Balance Error Mean & Max	0.0% #N/A
Rainfall P Conc	ppb	10	Load Reduction %	82%	#N/A	#N/A	Iterations & Convergence	1 0.0%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load (%)	0.0%			Warning/Error Messages	16

Cell Number -->		1	2	3	4	5	6	7	8	9	10	11	12
Cell Label	-	1A	1B	2A	2B	3A	3B	34X-A	34X-B				
Vegetation Type	-->	EMG_3	SAV_3	EMG_3	SAV_3	EMG_3	SAV_3	EMG_3	SAV_3				
Inflow Fraction	-	0.3966436		0.327617		0.27574							
Downstream Cell Number	-	2		4		6		8					
Surface Area	km2	12.22	13.99	10.14	11.51	9.77	8.45						
Mean Width of Flow Path	km	3.42	4.50	2.89	4.02	4.88	4.88						
Number of Tanks in Series	-	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0				
Minimum Depth for Releases	cm												
Release 1 Series Name													
Release 2 Series Name													
Outflow Series Name													
Depth Series Name													
Outflow Control Depth	cm	38.1	38.1	38.1	38.1	38.1	38.1	40	40				
Outflow Weir Depth	cm												
Outflow Coefficient - Exponent	-	4	4	4	4	4	4	4	4				
Outflow Coefficient - Intercept	-	1	1	1	1	1	1	1	1				
Bypass Depth	cm												
Maximum Inflow	hm3/day												
Maximum Outflow	hm3/day												
Inflow Seepage Rate	(cm/d) / cm												
Inflow Seepage Control Elev	cm												
Inflow Seepage Conc	ppb												
Outflow Seepage Rate	(cm/d) / cm	0.000808	0.000873	7.88E-05	0.000935	7.88E-05	0.001316	0.00075	0.00075				
Outflow Seepage Control Elev	cm												
Max Outflow Seepage Conc	ppb												
Seepage Recycle to Cell Number	-												
Seepage Recycle Fraction	-												
Seepage Discharge Fraction	-												
Initial Water Column Conc	ppb	52	12	55	15	55	15	30	30				
Initial P Storage Per Unit Area	mg/m2	1854.773	511.6099	1853.428	515.5275	1766.466	522.5391	1000	1000				
Initial Water Column Depth	cm	40	40	40	40	40	40	40	40				
C0 = Conc at 0 g/m2 P Storage	ppb	3	3	3	3	3	3	3	3				
C1 = Conc at 1 g/m2 P storage	ppb	22	22	22	22	22	22	22	22				
C2 = Conc at Half-Max Uptake	ppb	300	300	300	300	300	300	300	300				
K = Net Settling Rate at Steady State	m/yr	16.8	52.5	16.8	52.5	16.8	52.5	16.8	52.5				
Z1 = Saturated Uptake Depth	cm	40	40	40	40	40	40	40	40				
Z2 = Lower Penalty Depth	cm	100	100	100	100	100	100	100	100				
Z3 = Upper Penalty Depth	cm	200	200	200	200	200	200	200	200				

DMSTA2 - Network Simulation

Model Release: 07/29/11
Current Date: 04/04/12

Forecast Type: Base
Stop after Case Num:

Network Name: NET_56
Project: PROJECT_SFWMD_W_01MAR2012
Description: STA56 With FEB

Routing Table — Enter a downstream CASE name or OUTLET number (1-5) in rows 9-13

Case Name-->	FEB_56	STA56_DW	STA5	STA6						
Send Bypass to -->	STA56_DW	STA6	1	2						
Send Release 1 to -->	STA56_DW									
Send Release 2 to -->	5									
Send Outflow to -->	STA56_DW	STA5	1	**2**						
Send Seepage to -->	STA56_DW									

Overall Mass Balance		Flow	Load	FWC	Geo Mn
Outlet Number	Outlet Description	hm3/yr	kg/yr	ppb	ppb
Outlet 1	STA5 Out	128.3	1512	11.8	8.0
Outlet 2	STA6 Out	56.9	669	11.8	8.0
Outlet 3		0.0	0	#N/A	#N/A
Outlet 4		0.0	0	#N/A	#N/A
Outlet 5	AGRIC	0.0	0	#N/A	#N/A
Total Outlets		185.2	2182	11.8	
Watershed Inputs		243.9	37144	152.3	115.7
Storage Increase		0.7	560		
Rain - ET		-1.0	2280		
Net Seepage Losses		56.9	1243		
Burial		0.0	35436		
Mass Balance Check		0.0	2		
Input/Outlet Reduction		58.7	34962	140.5	
Reduction %		24%	94%	92%	

Select Network:

Select Simulation Type:

DMSTA2- Inputs & Outputs

Project: PROJECT_SFWMD_W_01MAR2012

Model Release:
Current Date:

Input Variable	Units	Value	Case Description:										
Design Case Name	-	FEB_56	STA56 Flow Equilization Basin				Area kac	2.8	Control Z	1.25	Duty Cyc:	1	
Input Series Name		TS_FEB56	TS Contains Rule for Irrigation Withdrawal				HRT Days	30	Release Z	1.25			
Starting Date for Simulation	-	01/01/65	Outflow & Bypass to STA56				Byp Depth ft	4	LowQ Byp:	50			
Ending Date for Simulation	-	04/30/05	Frac diverted to STA 0.357				Qin max cfs	1000	Seepage	0.001			
Starting Date for Output	-	05/01/65	Seepage Out to STA6				Qo Max cfs	9999					
Integration Steps Per Day	-	4	Simulation Type:										
Number of Iterations	-	1	Output Variable	Mean	Lower CL	Upper CL		Diagnostics					
Output Averaging Interval	days	1	FWM Outflow C (ppb)	57.7	#N/A	#N/A		H20 Balance Error Mean & Max				0.0%	0.0%
Inflow Conc Scale Factor	-	1	GM Outflow C (ppb)	56.6	#N/A	#N/A		Mass Balance Error Mean & Max				0.0%	0.0%
Rainfall P Conc	ppb	10	Load Reduction %	24%	#N/A	#N/A		Iterations & Convergence				1	0.0%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load (%)	60.3%				Warning/Error Messages				2	

Cell Number -->		1	2	3	4	5	6	7	8	9	10	11	12
Cell Label	-	LowQByp	FEB_56										
Vegetation Type	-->	none	none		Res	Emerg							
Inflow Fraction	-	1											
Downstream Cell Number	-	2											
Surface Area	km2		11.34										
Mean Width of Flow Path	km		3.37		3.37	1.92							
Number of Tanks in Series	-		3.0		1.0	3.0							
Minimum Depth for Releases	cm		38										
Release 1 Series Name													
Release 2 Series Name													
Outflow Series Name													
Depth Series Name													
Outflow Control Depth	cm		38.1										
Outflow Weir Depth	cm												
Outflow Coefficient - Exponent	-		1		1	4							
Outflow Coefficient - Intercept	-		0.112235		0.112235	1							
Bypass Depth	cm		121.9512										
Maximum Inflow	hm3/day		2.448455										
Maximum Outflow	hm3/day	-0.122423	24.48211										
Inflow Seepage Rate	(cm/d) / cm												
Inflow Seepage Control Elev	cm												
Inflow Seepage Conc	ppb												
Outflow Seepage Rate	(cm/d) / cm		0.001										
Outflow Seepage Control Elev	cm												
Max Outflow Seepage Conc	ppb												
Seepage Recycle to Cell Number	-												
Seepage Recycle Fraction	-												
Seepage Discharge Fraction	-												
Initial Water Column Conc	ppb		50										
Initial P Storage Per Unit Area	mg/m2		2964.817										
Initial Water Column Depth	cm		30										
C0 = Conc at 0 g/m2 P Storage	ppb		3										
C1 = Conc at 1 g/m2 P storage	ppb		22										
C2 = Conc at Half-Max Uptake	ppb		300										
K = Net Settling Rate at Steady State	m/yr		15.1										
Z1 = Saturated Uptake Depth	cm		40										
Z2 = Lower Penalty Depth	cm		100										
Z3 = Upper Penalty Depth	cm		200										

DMSTA2- Inputs & Outputs

Project: PROJECT_SFWMD_W_01MAR2012

Model Release:
Current Date:

Input Variable	Units	Value	Case Description:
Design Case Name	-	STA56_DW	FEB Outflow to Split to STA5 & STA6
Input Series Name		TS_NULL	
Starting Date for Simulation	-	01/01/65	Fraction to STA6 = 0.357
Ending Date for Simulation	-	04/30/05	Outflow to STA5 bypass to STA6
Starting Date for Output	-	05/01/65	
Integration Steps Per Day	-	12	Simulation Type:
Number of Iterations	-	1	
Output Averaging Interval	days	1	
Inflow Conc Scale Factor	-	1	
Rainfall P Conc	ppb	10	
Atmospheric P Load (Dry)	mg/m2-yr	20	

Duty Cyc: 1

Output Variable	Mean	Lower CL	Upper CL
FWM Outflow C (ppb)	114.9	#N/A	#N/A
GM Outflow C (ppb)	88.4	#N/A	#N/A
Load Reduction %	0%	#N/A	#N/A
Bypass Load (%)	35.7%		

Diagnostics		
H20 Balance Error Mean & Max	0.0%	#N/A
Mass Balance Error Mean & Max	0.0%	#N/A
Iterations & Convergence	1	0.0%
Warning/Error Messages	4	

Cell Number -->		1	2	3	4	5	6	7	8	9	10	11	12
Cell Label	-	To STA5	To STA6										
Vegetation Type	-->	none	none										
Inflow Fraction	-	0.643	0.357										
Downstream Cell Number	-												
Surface Area	km2												
Mean Width of Flow Path	km												
Number of Tanks in Series	-												
Minimum Depth for Releases	cm												
Release 1 Series Name													
Release 2 Series Name													
Outflow Series Name													
Depth Series Name													
Outflow Control Depth	cm												
Outflow Weir Depth	cm												
Outflow Coefficient - Exponent	-												
Outflow Coefficient - Intercept	-												
Bypass Depth	cm												
Maximum Inflow	hm3/day		0.00001										
Maximum Outflow	hm3/day												
Inflow Seepage Rate	(cm/d) / cm												
Inflow Seepage Control Elev	cm												
Inflow Seepage Conc	ppb												
Outflow Seepage Rate	(cm/d) / cm												
Outflow Seepage Control Elev	cm												
Max Outflow Seepage Conc	ppb												
Seepage Recycle to Cell Number	-												
Seepage Recycle Fraction	-												
Seepage Discharge Fraction	-												
Initial Water Column Conc	ppb												
Initial P Storage Per Unit Area	mg/m2												
Initial Water Column Depth	cm												
C0 = Conc at 0 g/m2 P Storage	ppb												
C1 = Conc at 1 g/m2 P storage	ppb												
C2 = Conc at Half-Max Uptake	ppb												
K = Net Settling Rate at Steady State	m/yr												
Z1 = Saturated Uptake Depth	cm												
Z2 = Lower Penalty Depth	cm												
Z3 = Upper Penalty Depth	cm												

DMSTA2- Inputs & Outputs

Project: PROJECT_SFWMD_W_01MAR2012

Model Release:

Current Date:

Input Variable	Units	Value	Case Description:											
Design Case Name	-	STA5	STA5 + Compartment C Cell 4										Duty	0.95
Input Series Name		TS_STA5	No Changes					Enhanced Calib =		PEW_3				
Starting Date for Simulation	-	01/01/65	Expansion modeled as part of STA6											
Ending Date for Simulation	-	04/30/05	Total Area kac	9.066046										
Starting Date for Output	-	05/01/65	PEW%	0.42383										
Integration Steps Per Day	-	4	Simulation Type:											
Number of Iterations	-	1	Output Variable	Mean	Lower CL	Upper CL			Diagnostics					
Output Averaging Interval	days	1	FWM Outflow C (ppb)	11.7	#N/A	#N/A			H20 Balance Error Mean & Max				0.0%	0.0%
Inflow Conc Scale Factor	-	1	GM Outflow C (ppb)	8.0	#N/A	#N/A			Mass Balance Error Mean & Max				0.0%	0.0%
Rainfall P Conc	ppb	10	Load Reduction %	92%	#N/A	#N/A			Iterations & Convergence				1	0.0%
Atmospheric P Load (Dry)	mg/m2-yr	20	Bypass Load (%)	0.0%					Warning/Error Messages				3	
Cell Number -->		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
Cell Label	-	5-1A	5-1B	5-2A	5-2B	5-3A	5-3B	5-4A1	5-4A2	5-4A3	5-4B			
Vegetation Type	-->	EMG_3	PEW_3	EMG_3	PEW_3	EMG_3	PEW_3	EMG_3	EMG_3	EMG_3	PEW_3			
Inflow Fraction	-	0.2665729		0.267675		0.26073		0.205022						
Downstream Cell Number	-	2		4		6		8	9	10				
Surface Area	km2	4.84	4.95	4.84	4.99	5.85	3.72	2.15	1.51	1.97	1.90			
Mean Width of Flow Path	km	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56			
Number of Tanks in Series	-	3.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0			
Minimum Depth for Releases	cm													
Release 1 Series Name														
Release 2 Series Name														
Outflow Series Name														
Depth Series Name														
Outflow Control Depth	cm	38.1	60.96	38.1	60.96	38.1	60.96	38.1	38.1	38.1	60.96			
Outflow Weir Depth	cm													
Outflow Coefficient - Exponent	-	4	4	4	4	4	4	4	4	4	4			
Outflow Coefficient - Intercept	-	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5			
Bypass Depth	cm													
Maximum Inflow	hm3/day													
Maximum Outflow	hm3/day													
Inflow Seepage Rate	(cm/d) / cm													
Inflow Seepage Control Elev	cm													
Inflow Seepage Conc	ppb													
Outflow Seepage Rate	(cm/d) / cm	0.002	0.005	0.0015	0.00541	0.0015	0.00541	0.0015	0.0015	0.0015	0.00719			
Outflow Seepage Control Elev	cm													
Max Outflow Seepage Conc	ppb													
Seepage Recycle to Cell Number	-													
Seepage Recycle Fraction	-													
Seepage Discharge Fraction	-													
Initial Water Column Conc	ppb	30	30	30	30	30	30	30	30	30	30			
Initial P Storage Per Unit Area	mg/m2	2119.5836	435.4698	2128.175	437.5349	1893.337	426.0265	2583.462	1621.142	927.3413	352.5148			
Initial Water Column Depth	cm	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1			
C0 = Conc at 0 g/m2 P Storage	ppb	3	3	3	3	3	3	3	3	3	3			
C1 = Conc at 1 g/m2 P storage	ppb	22	22	22	22	22	22	22	22	22	22			
C2 = Conc at Half-Max Uptake	ppb	300	300	300	300	300	300	300	300	300	300			
K = Net Settling Rate at Steady State	m/yr	16.8	34.9	16.8	34.9	16.8	34.9	16.8	16.8	16.8	34.9			
Z1 = Saturated Uptake Depth	cm	40	40	40	40	40	40	40	40	40	40			
Z2 = Lower Penalty Depth	cm	100	100	100	100	100	100	100	100	100	100			
Z3 = Upper Penalty Depth	cm	200	200	200	200	200	200	200	200	200	200			

DMSTA2- Inputs & Outputs

Project: PROJECT_SFWMD_W_01MAR2012

Model Release:

Current Date:

Input Variable	Units	Value
Design Case Name	-	STA6
Input Series Name		TS_STA6
Starting Date for Simulation	-	01/01/65
Ending Date for Simulation	-	04/30/05
Starting Date for Output	-	05/01/65
Integration Steps Per Day	-	4
Number of Iterations	-	1
Output Averaging Interval	days	1
Inflow Conc Scale Factor	-	1
Rainfall P Conc	ppb	10
Atmospheric P Load (Dry)	mg/m2-yr	20

Case Description:

STA6 + CompC Cell5 + STA56 Expansion — Duty 0.95

	Existing	Expansion	Total		PEW_3	
Area kac	5.391473	0	5.391473	5.391473	0.542731	0.542731
	0.542731	0.4	0.542731	1	2.629903	
Rescale HLR to Cells	1					

Simulation Type:

Output Variable	Mean	Lower CL	Upper CL
FWM Outflow C (ppb)	11.7	#N/A	#N/A
GM Outflow C (ppb)	7.9	#N/A	#N/A
Load Reduction %	93%	#N/A	#N/A
Bypass Load (%)	0.0%		

Diagnostics		
H20 Balance Error Mean & Max	0.0%	#N/A
Mass Balance Error Mean & Max	0.0%	#N/A
Iterations & Convergence	1	0.0%
Warning/Error Messages	15	

Cell Number -->		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Cell Label	-	5-5A1	5-5A2	5-5A3	5-5B	6-4	6-2	6-3	6-5	S56X_A	S56X-B		
Vegetation Type	-->	EMG_3	EMG_3	EMG_3	PEW_3	EMG_3	PEW_3	PEW_3	PEW_3	EMG_3	PEW_3		
Inflow Fraction	-	0.4877893				0.352225		0.044863	0.115123				
Downstream Cell Number	-	2	3	4		6				10			
Surface Area	km2	2.63	2.00	3.17	2.85	2.18	5.51	0.98	2.51				
Mean Width of Flow Path	km	2.34	2.34	2.34	2.34	2.34	2.34	0.61	1.31				
Number of Tanks in Series	-	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0		
Minimum Depth for Releases	cm												
Release 1 Series Name													
Release 2 Series Name													
Outflow Series Name													
Depth Series Name													
Outflow Control Depth	cm	38.1	38.1	38.1	60.96	38.1	60.96	38.3922	39.3063	40	40		
Outflow Weir Depth	cm							38.3922	39.3063				
Outflow Coefficient - Exponent	-	4	4	4	4	4	4	1.5	1.5	4	4		
Outflow Coefficient - Intercept	-	0.5	0.5	0.5	0.5	1	1	1.3	1.3	1	1		
Bypass Depth	cm												
Maximum Inflow	hm3/day												
Maximum Outflow	hm3/day												
Inflow Seepage Rate	(cm/d) / cm												
Inflow Seepage Control Elev	cm												
Inflow Seepage Conc	ppb												
Outflow Seepage Rate	(cm/d) / cm	0.0015	0.0015	0.0015	0.009854	0.003048	0.007204	0.009182	0.008211	0.01	0.01		
Outflow Seepage Control Elev	cm	15	15	15	-59.436	15	-30	-30	-30				
Max Outflow Seepage Conc	ppb	20	20	20	20	20	20	20	20				
Seepage Recycle to Cell Number	-												
Seepage Recycle Fraction	-												
Seepage Discharge Fraction	-												
Initial Water Column Conc	ppb	30	30	30	30	30	30	30	30	30	30		
Initial P Storage Per Unit Area	mg/m2	2645.5762	1686.214	901.5547	290.552	2595.647	440.5526	584.3545	604.1687	1000	1000		
Initial Water Column Depth	cm	38.1	38.1	38.1	38.1	38.1	38.1	10	10	40	40		
C0 = Conc at 0 g/m2 P Storage	ppb	3	3	3	3	3	3	3	3	3	3		
C1 = Conc at 1 g/m2 P storage	ppb	22	22	22	22	22	22	22	22	22	22		
C2 = Conc at Half-Max Uptake	ppb	300	300	300	300	300	300	300	300	300	300		
K = Net Settling Rate at Steady State	m/yr	16.8	16.8	16.8	34.9	16.8	34.9	34.9	34.9	16.8	34.9		
Z1 = Saturated Uptake Depth	cm	40	40	40	40	40	40	40	40	40	40		
Z2 = Lower Penalty Depth	cm	100	100	100	100	100	100	100	100	100	100		
Z3 = Upper Penalty Depth	cm	200	200	200	200	200	200	200	200	200	200		