

# Chapter 5A: Restoration Strategies – Design and Construction Status of Water Quality Improvement Projects

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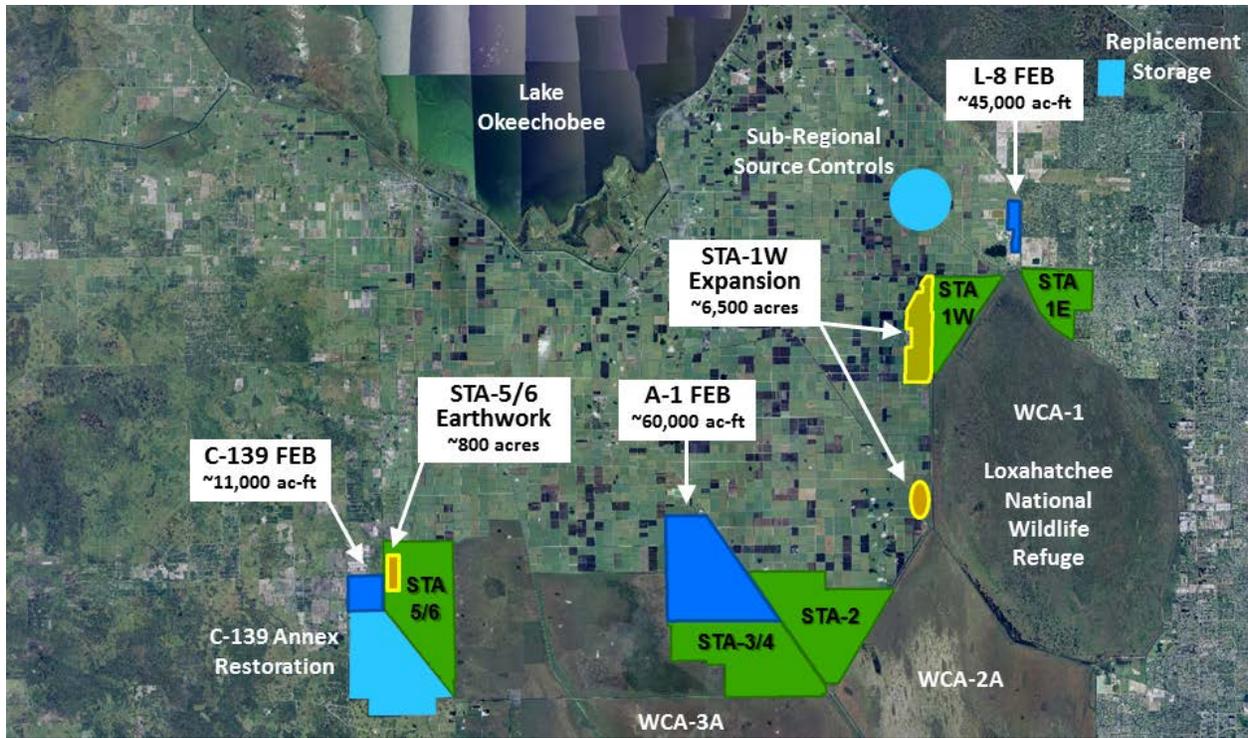
## SUMMARY

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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 total phosphorus (TP) criterion in the EPA and to identify a suite of additional water quality improvement projects to work in conjunction with the existing Everglades Stormwater Treatment Areas (STAs) to meet the WQBEL (SFWMD 2012b). Based on this collaborative effort, a suite of projects (**Figure 5A-1**) was identified that would achieve the WQBEL, as documented in the *Restoration Strategies Regional Water Quality Plan* (SFWMD 2012a).

On September 10, 2012, FDEP issued SFWMD an Everglades Forever Act (EFA) Watershed Permit (FDEP 2012b) and a National Pollutant Discharge Elimination System (NPDES) Watershed Permit (FDEP 2012a) along with associated consent orders for operations of the Everglades STAs and to outline the additional facilities and structures required to achieve the WQBEL. The consent orders contain specific activities for each project identified in the *Restoration Strategies Regional Water Quality Plan* and include deadlines for each activity. In addition, the consent orders recognize that Everglades STA discharges are not anticipated to meet the WQBEL until all the consent order activities are complete and sufficient discharge data exists to assess WQBEL compliance.

Under the District’s Restoration Strategies Program, the water quality improvement projects have been divided into three flow paths—Eastern, Central, and Western—that 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, temporarily store stormwater runoff, and improve inflow delivery rates to downstream STAs, thereby providing enhanced operation and phosphorus treatment performance. FEBs may also be used to assist in maintaining minimum water levels and reducing the frequency of dryout conditions within STAs. The primary purpose of STAs is to utilize biological processes to reduce phosphorus concentrations in order to achieve the WQBEL. Due to the District’s limited experience operating FEBs in conjunction with STAs, an operational testing and monitoring phase will occur upon completion of the FEBs and is intended to allow testing of a variety of subregional and project-specific operational scenarios.



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**Figure 5A-1.** Key projects of the *Restoration Strategies Regional Water Quality Plan*.  
(Note: ac-ft – acre-feet; STA-1E – STA-1 East; STA-1W – STA 1 West; and WCA – Water Conservation Area.)

41 The design and construction of Restoration Strategies projects is occurring in three major phases with  
42 completion of all projects expected by December 2025. In Water Year 2016 (WY2016) (May 1, 2015–  
43 April 30, 2016), seven consent order milestones were completed on four projects: (1) A-1 FEB, (2) STA-1  
44 West (STA-1W) Expansion #1, (3) S-375 Expansion (G-716), and (4) G-341 Related Conveyance  
45 Improvements. Construction of the A-1 FEB was completed in November 2015. The design of STA-1W  
46 Expansion #1 was completed in June 2015 and construction started in November 2015. Design of the S-375  
47 Expansion (G-716) was completed in July 2015 and construction started in November 2015. Construction  
48 of G-341 Related Conveyance Improvements started in August 2015. A detailed overview of current  
49 Restoration Strategies projects, including status and activities completed during the WY2016 reporting  
50 period is summarized below.

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## RESTORATION STRATEGIES PROJECTS

52 In accordance with the EFA and NPDES permits and associated consent orders, the following section  
 53 describes the WY2016 status of Restoration Strategies projects within the Eastern, Central, and Western  
 54 flow paths. The projects and associated components are presented in **Figures 5A-2** through **5A-12**. Specific  
 55 activities, associated deadlines and completion dates during the WY2016 reporting period are summarized  
 56 in **Table 5A-1**. Financial reporting for the Restoration Strategies Program and projects during Fiscal Year  
 57 2015–2016 (October 1, 2015–September 30, 2016) is provided in Appendix 1-5 of this volume.

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**Table 5A-1.** Restoration Strategies project activities completed during WY2016.

Project and Activities	Consent Order Deadline	Date Completed
<b>Eastern Flow Path</b>		
<b>STA-1W Expansion #1</b>		
Complete design	7/30/2015	6/22/2015
Initiate construction	1/31/2016	11/12/2015
<b>S-375 Expansion (G-716)</b>		
Complete design	7/30/2015	7/22/2015
Initiate construction	1/31/2016	11/12/2015
<b>G-341 Related Conveyance Improvements</b>		
Initiate construction	11/30/2022	8/13/2015
<b>Central Flow Path</b>		
<b>A-1 Flow Equalization Basin</b>		
Construction status report	3/1/2016	12/4/2015
Complete construction	7/30/2016	7/24/2015

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## 60 EASTERN FLOW PATH

61 Restoration Strategies projects in the Eastern Flow Path include the following: STA-1W Expansion,  
 62 S-375 Expansion (G-716), L-8 FEB, L-8 Divide Structure (G-541), S-5AS Modifications, G-341 Related  
 63 Conveyance Improvements, and STA-1 East (STA-1E) Repairs and Modifications (**Figure 5A-2**).



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 65 **Figure 5A-2.** Eastern Flow Path project components: L-8 FEB, L-8 Divide Structure (G-541), S-5AS  
 66 Modifications, and STA-1W Expansion #1. Names preceded with an S denote structures constructed by  
 67 the United States Army Corps of Engineers. Names preceded with a G denote structures constructed  
 68 by the District [Note: STA-1E – STA 1 East and WCA-1 – Water Conservation Area 1].

## 69 STA-1W Expansion

70 The STA-1W Expansion project, a 6,500-acre (2,630-hectare) expansion of STA-1W—consisting of  
 71 5,900 acres (2,390 hectares) of effective treatment area—works in conjunction with the existing STA-1W  
 72 and the other Eastern Flow Path projects to assist in achieving the WQBEL. The STA-1W Expansion  
 73 project is being designed and constructed in two phases. Expansion #1 (**Figure 5A-3**), currently under  
 74 construction, consists of approximately 4,300 acres (1,740 hectares) of effective treatment area on 4,600  
 75 acres (1,860 hectares) of land located adjacent to and directly west of STA-1W. Expansion #2 is anticipated  
 76 to provide at least 1,600 acres (650 hectares) of effective treatment area within 2,130 acres (860 hectares)  
 77 of land located north of pump station S-6. Both expansions were conceptualized during the design of  
 78 Expansion #1, but Expansion #1 was permitted, designed, and is being constructed separately.

79 The design of the existing STA-1W was constrained by the available land and the need to maximize  
 80 the effective treatment area while maintaining the necessary hydraulics to move water through the wetland

81 system for both water quality treatment and flood control purposes. Similarly, the design of STA-1W  
82 Expansion #1 integrated the existing STA-1W and the associated infrastructure, configuration, and  
83 operational protocols needed to utilize both facilities in series to optimize performance. The final design of  
84 Expansion #1 also incorporated the best available information to ensure appropriate vegetation partitioning  
85 and water depths.

86 **Project Status:** Construction of Expansion #1 ongoing.

87 **WY2016 Update:** Design of STA-1W Expansion #1 was completed June 22, 2015, and construction  
88 started November 11, 2015, approximately three months ahead of the consent order deadline. Construction  
89 is expected to be completed by December 2018.



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91 **Figure 5A-3.** STA-1W Expansion #1 canal construction and STA-1W outflow pump station G-310,  
92 looking north (photo by SFWMD, June 2016)

### 93 **S-375 Expansion (G-716)**

94 The S-375 Expansion (G-716) project increases the capacity of the existing S-375 structure, located  
95 within STA-1E (**Figure 5A-4**). During high flow events in the C-51 West basin or when STA-1E is already  
96 receiving optimal flows, G-716, in combination with S-375, enables stormwater runoff to be directed to the  
97 L-8 FEB for storage prior to being redirected to STA-1E and/or STA-1W for treatment.

98 **Project Status:** Construction ongoing.

99 **WY2016 Update:** Construction was initiated in November 2015, approximately two months ahead of  
100 the consent order deadline and is anticipated to be complete by April 2017, well ahead of the December  
101 2018 consent order deadline.



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103 **Figure 5A-4.** S-375 Expansion (G-716), looking east (photo by SFWMD, June 2016).

104 **L-8 FEB**

105 The L-8 FEB is located in a 950-acre (385 hectares) former rock mine in central Palm Beach County  
 106 located north of STA-1E and STA-1W and adjacent to and west of the L-8 canal (**Figure 5A-2**). The site  
 107 has a unique geology, is capable of storing approximately 45,000 acre-feet of water and is designed to  
 108 attenuate peak stormwater flows and improve STA-1E and STA-1W inflow delivery rates. In order to fully  
 109 utilize the L-8 FEB, additional project features—inflow structure, outflow pump station, embankment  
 110 protection measures, and cell connection improvements—are required. Inflow structure G-538  
 111 (**Figure 5A-5**) has a capacity of approximately 3,000 cubic feet per second (cfs) and is able to fill the  
 112 reservoir to its maximum water level of +16.5 feet (ft) North American Vertical Datum of 1988 (NAVD88)  
 113 [+18.0 ft National Geodetic Vertical Datum of 1929 (NGVD29)]. Outflow pump station G-539 (**Figure**  
 114 **5A-6**) has a design capacity of approximately 450 cfs for delivery of flows from the L-8 FEB to the L-8  
 115 canal. The outflow pump station is able to drawdown the FEB to an elevation of -37.0 ft NAVD88 (-35.5 ft  
 116 National Geodetic Vertical Datum of 1929 [NGVD29]), which is approximately 5 feet above the bottom of  
 117 the FEB. In addition, cell connection improvements creates a configuration that maximizes the exchange  
 118 of water among cells.

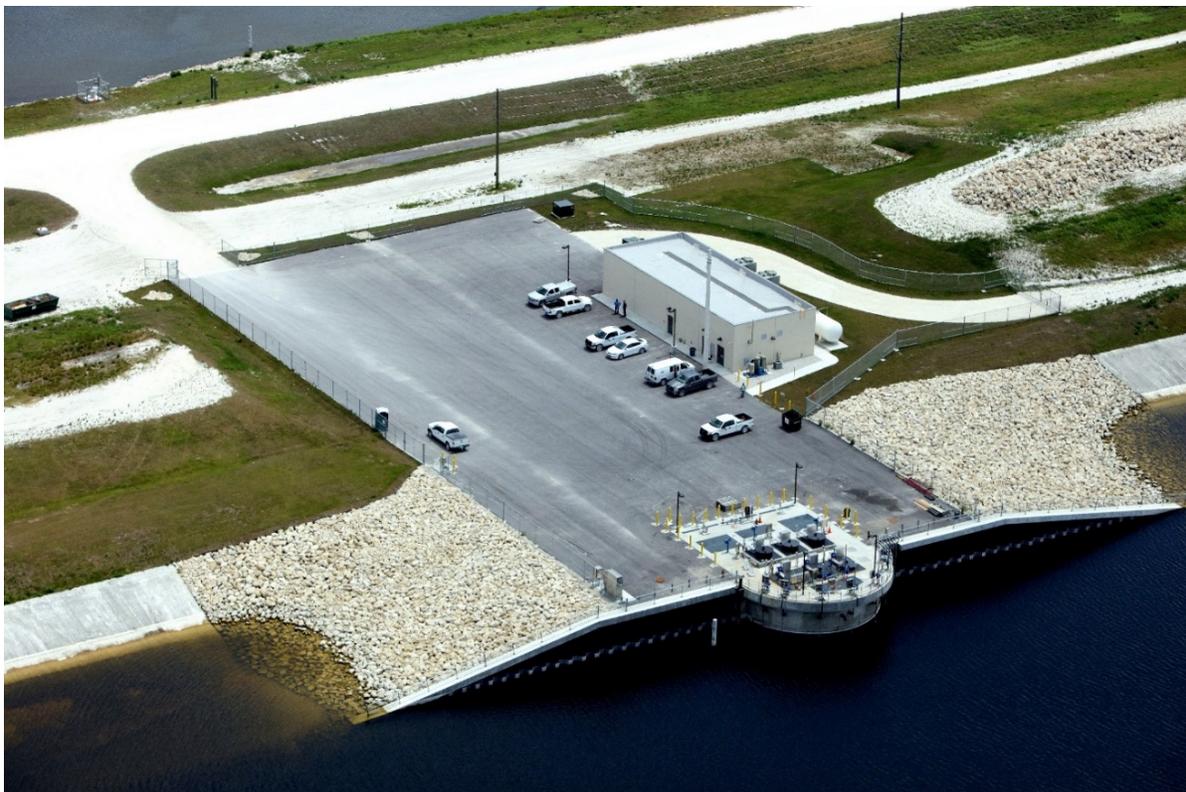
119 **Project Status:** Construction ongoing (nearing completion).

120 **WY2016 Update:** Construction of the L-8 FEB is expected to be complete by December 2016 in  
 121 accordance with the consent orders.



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**Figure 5A-5.** L-8 FEB inflow structure G-538 (photo by SFWMD, May 2016).



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**Figure 5A-6.** L-8 FEB outflow pump station G-539 (photo by SFWMD, May 2016).

## 126 L-8 Divide Structure (G-541)

127 The L-8 Divide Structure (G-541) is a fully automated gated spillway located within the L-8 canal, east  
128 of the L-8 FEB (**Figure 5A-7**). G-541 enables the efficient transfer of water to the L-8 FEB from the STA-  
129 1 Inflow Basin, allows for efficient L-8 FEB outflow operations, and enables L-8 FEB water to flow south  
130 to STA-1E and STA-1W. When closed, G-541 allows for L-8 canal stages south of G-541 to be raised and  
131 held but remain within the maximum operating ranges of the L-8 canal during L-8 FEB inflow and outflow  
132 operations. When fully open, G-541 is designed to have minimal head loss through the structure so as to  
133 make it as hydraulically invisible as economically feasible and have no impact on L-8 canal operations.

134 **Project Status:** Construction ongoing (nearing completion).

135 **WY2016 Update:** Construction was initiated in September 2014, approximately two years ahead of the  
136 October 1, 2016, consent order deadline. Construction is ahead of schedule and anticipated to be completed  
137 by July 2016, well ahead of the December 2018 consent order deadline.



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139 **Figure 5A-7.** L-8 Divide Structure, looking north (photo by SFWMD, April 2016).

## 140 S-5AS Modifications

141 Structure S-5AS is an existing gated spillway located at the southern terminus of the L-8 canal and  
142 connects to the STA-1 Inflow Basin (**Figure 5A-2**). Per the *Restoration Strategies Regional Water Quality*  
143 *Plan* (SFWMD 2012a), a majority of the stormwater runoff from the S-5A and C-51 West basins is expected  
144 to be directed north through S-5AS to the L-8 FEB. As such, the frequency of use of S-5AS will increase  
145 and therefore needs to be upgraded. Upgrades include replacing the existing steel gates with stainless steel  
146 gates, implementing a concrete flow deflector at the north end of the structure apron, and excavating the

147 canal just north of the structure to create a larger basin in order to reduce the erosional effects of anticipated  
148 flow velocities (**Figure 5A-8**).

149 **Project Status:** Construction ongoing (nearing completion).

150 **WY2016 Update:** Construction was initiated in September 2014, approximately one month ahead of  
151 the consent order deadline. This project is currently ahead of schedule and is anticipated to be complete by  
152 May 2016, well ahead of the September 2016 consent order deadline.



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**Figure 5A-8.** S-5AS Modifications include gate replacement activities (photo by SFWMD, May 2016).

## 156 **G-341 Related Conveyance Improvements**

157 The G-341 Related Conveyance Improvements project is a multi-phase and multi-year project intended  
158 to improve conveyance within the eastern Everglades Agricultural Area (EAA), specifically in the Bolles  
159 East, Ocean, and Hillsboro canals. The original design intent of structure G-341, which is located in the  
160 Ocean Canal just north of the northwest corner of STA-1W, was to enable the conveyance of up to 600 cfs  
161 of stormwater runoff from the western portion of the S-5A basin west via the Ocean Canal to the Hillsboro  
162 Canal for treatment in STA-2. Due to various constraints, the full intent of the G-341 has not been able to  
163 be implemented. Design, permitting, and construction activities of the G-341 Related Conveyance  
164 Improvements will occur in several phases with all construction activities mandated to be complete by  
165 December 2024. Construction of the first 6,300 linear feet of canal conveyance improvements (Bolles East  
166 [L-16] Canal Segment 1) started in August 2015 (**Figure 5A-9**). The design and construction of conveyance  
167 improvements for additional canal segments and construction of a new Duda Road bridge is anticipated to  
168 start in WY2017.

169 **Project Status:** Construction of Bolles East (L-16) Canal Segment 1 conveyance improvements  
170 is ongoing.

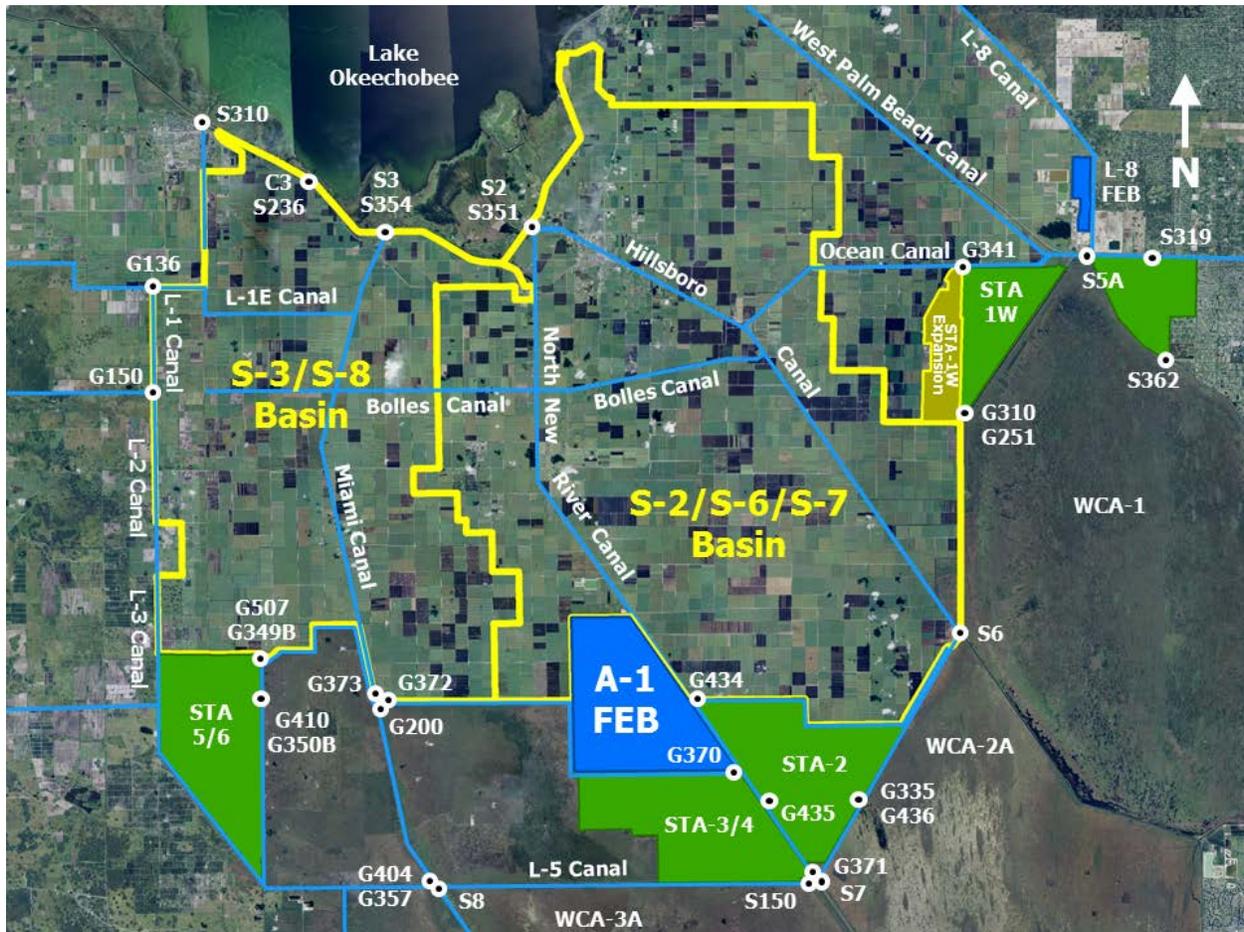
171 **WY2016 Update:** Bolles East (L-16) Canal Segment 1 construction was initiated in August 2015, more  
172 than 7 years ahead of the consent order deadline, and is expected to be completed in WY2017. Design of  
173 Bolles East (L-16) Canal Segment 2 conveyance improvements (5,800 linear feet) will be completed and  
174 construction will begin in WY2017. Construction of a new Duda Road bridge is also expected to begin  
175 in WY2017.



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177 **Figure 5A-9.** G-341 Related Conveyance Improvements, Bolles East (L-16) canal segment 1, looking  
178 east from the Duda Road bridge (photo by SFWMD, February 2016).

179 **CENTRAL FLOW PATH**

180 Restoration Strategies projects in the Central Flow Path include the following: A-1 FEB and STA-2  
 181 Expansion: Compartment B (**Figure 5A-10**).



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 183 **Figure 5A-10.** A-1 FEB, Everglades STAs and related canals and structures. Names preceded with an  
 184 S denote structures constructed by the United States Army Corps of Engineers. Names preceded with  
 185 a G denote structures constructed by the District [Note: WCA – Water Conservation Area].

186 **A-1 FEB**

187 The A-1 FEB is a shallow, aboveground impoundment with a capacity of approximately 60,000 acre-  
 188 feet at an approximate maximum operating depth of 4 ft located adjacent to and directly north of STA-3/4  
 189 (**Figure 5A-10**). The primary purpose of the A-1 FEB is to attenuate peak stormwater flows, temporarily  
 190 store stormwater runoff from the central EAA, collected by the North New River (NNR) and Miami canals,  
 191 and improve inflow delivery rates to STA-2 (including Compartment B) and STA-3/4, thereby providing  
 192 enhanced operation and phosphorus treatment performance to assist in achieving state water quality  
 193 standards in the EPA. By managing basin runoff in the Central Flow Path in a more advantageous manner,  
 194 the impacts of storm-driven events would be reduced at STA-2 and STA-3/4. The A-1 FEB project may  
 195 also be used to assist in maintaining minimum water levels and reducing the frequency of dryout conditions  
 196 within STA-2 and STA-3/4, which will also sustain phosphorus treatment performance.

197 Inflows from the Miami Canal are conveyed to the A-1 FEB via the new operable water control  
 198 structure G-720 (**Figures 5A-11**) in conjunction with existing pump station G-372. Inflows from the NNR

199 Canal are conveyed to the A-1 FEB via the new operable water control structure G-721 (**Figure 5A-12**) in  
200 conjunction with existing pump station G-370. After inflows are conveyed to the north end of the FEB,  
201 water sheet flows from north to south. The former STA-3/4 seepage canal (with improvements) now serves  
202 as a collection and conveyance canal and assists in directing FEB outflows to the NNR Canal via new  
203 operable water control structure G-722 and the STA-3/4 inflow canal via new operable water control  
204 structures G-724A through G-724J.

205 **Project Status:** Construction complete; operational testing and monitoring phase ongoing.

206 **WY2016 Update:** Construction of the A-1 FEB was completed in November 2015, well ahead of the  
207 July 2016 consent order deadline. The operational testing and monitoring phase is ongoing and is expected  
208 to be completed by July 2018.



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210 **Figure 5A-11.** A-1 FEB inflow structure G-720, looking southeast (photo by SFWMD, March 2016).



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212 **Figure 5A-12.** A-1 FEB inflow structure G-721 and pump station G-370, looking southeast  
213 (photo by SFWMD, March 2016).

## 214 **ADDITIONAL COMPONENTS**

### 215 **Subregional Source Controls**

216 The primary objective of Restoration Strategies subregional source control projects is to build upon the  
217 success of the District's existing Best Management Practice (BMP) Regulatory Program by focusing on  
218 projects with the greatest potential to further improve water quality in the S-5A basin thereby reducing  
219 phosphorus loads to the STAs. These activities will be focused downstream of where existing BMP  
220 Regulatory Program requirements are implemented within the S-5A basin.

221 Potential subregional source control projects within the S-5A basin will be considered based on a  
222 combination of factors, including water quality of farm discharges, proximity and potential impact to STAs,  
223 potential positive impact to the Arthur R. Marshall Loxahatchee National Wildlife Refuge (also known as  
224 Water Conservation Area 1) and having willing local participants.

225 An initial subregional source control project, through a three-year cooperative agreement between  
226 SFWMD and the East Beach Water Control District (EBWCD), consisted of implementing a subregional  
227 canal cleaning demonstration project within the S-5A basin. The intent was to build upon promising  
228 preliminary results on comprehensive canal management research conducted by the University of Florida.  
229 This project included evaluation of data associated with water quality, floating aquatic vegetation, and canal  
230 sediment conditions under current practices, in contrast with feasible alternative canal management  
231 practices. The data being collected will be analyzed to determine whether canal cleaning activities affected  
232 water quality. The demonstration project implementation activities have been completed, however, limited  
233 monitoring will continue to ensure that potential delayed impacts to water quality are captured.

234 Another ongoing subregional source control project is summarizing data and historical documentation  
235 for Eastern Flow Path water quality. The goal is to consolidate historical information and existing water  
236 quality data to reference and facilitate development of additional subregional source control projects in the  
237 EBWCD and the S-5A basin.

238 **Project Status:** Conceptual project planning and monitoring phase.

239 **WY2016 Update:** The District continues to collect samples from the main EBWCD discharge structure  
240 that is a part of the demonstration project to determine if there are effects from the project activities.  
241 Monitoring data collected to date are under review to discern preliminary impacts. Once the S-5A basin  
242 historical water quality summary is completed in October 2016, conceptual project planning will be initiated  
243 with stakeholders followed by a proposed feasibility study. More information related to these ongoing  
244 activities is available in Chapter 4.

### 245 **C-18 West Basin Impoundment (Mecca Impoundment)**

246 The Mecca property (**Figure 5A-1**) is approximately 1,920 acres (775 hectares) of former citrus grove  
247 that was purchased by SFWMD from Palm Beach County in December 2013. The proposed conceptual  
248 plan for the site is to construct a shallow impoundment approximately 5 ft deep that will enable the storage  
249 of excess stormwater runoff from the western portion of the C-18 basin. Water stored in the impoundment  
250 would then be directed back to the C-18 canal and conveyed to the Loxahatchee River, a federally  
251 designated National Wild and Scenic River, to supplement flows and assist in reducing the number of  
252 exceedances and violations to minimum flows and levels and to better meet restoration targets for the river.

253 **Project Status:** Design documentation report preparation ongoing.

254 **WY2015 Update:** The preparation of a design documentation report is ongoing, which will inform the  
255 preliminary through final design process.

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## 256 **LITERATURE CITED**

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257 FDEP. 2012a. *STA Everglades Forever Act (EFA) Watershed Permit (Number 0311207) and Associated*  
258 *Consent Order (OGC 12-1149)*. Florida Department of Environmental Protection, Tallahassee, FL.  
259 September 10, 2012.

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261 *FL0778451) and Associated Consent Order (OGC 12-1148)*. Florida Department of Environmental  
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263 SFWMD. 2012a. *Restoration Strategies Regional Water Quality Plan*. South Florida Water Management  
264 District, West Palm Beach, FL. April 27, 2012.

265 SFWMD. 2012b. *Technical Support Document for Derivation of the Water Quality Based Effluent Limit*  
266 *for Total Phosphorus in Discharges from Everglades Stormwater Treatment Areas to the Everglades*  
267 *Protection Area*. South Florida Water Management District, West Palm Beach, FL. June 27, 2012.