Appendix 2-4: Annual Permit Report for the C-111 Spreader Canal Phase 1 (Western) Project

Permit Report (May 1, 2014–April 30, 2015)
Permit Number: 0293559

Chelsea Qiu

Contributors: Jason Godin, Binhe Gu, and John Shaffer

SUMMARY

Based on Florida Department of Environmental Protection (FDEP) permit reporting guidelines, **Table 1** lists key permit-related information associated with this report. **Table 2** lists the attachments included with this report. **Table A-1** in Attachment A lists specific pages, tables, graphs, and attachments where project status and annual reporting requirements are addressed. This annual report satisfies the reporting requirements specified in the permit.

Table 1. Key permit-related information.

Project Name:	C-111 Spreader Canal Phase 1 (Western) Project
Permit Number:	0293559-009
Issue and Expiration Dates: 0293559-001 (original permit): 0293559-009 (modification):	 Issued: 10/8/2009; Expires: 10/8/2014* Issued: 10/29/2014 ** The District requested a permit renewal, which was received by FDEP on August 1, 2014, and issued in WY2016, on December 16, 2015. This will be reflected in the next annual permit report.*
Project Phase:	Operations
Permit Specific Condition Requiring Annual Report:	35
Reporting Period:	May 1, 2014–April 30, 2015
Report Lead:	Chelsea Qiu (cqiu@sfwmd.gov, 561-682-6196)
Permit Coordinator:	John Shaffer (jshaffe@sfwmd.gov, 561-682-6308)

Table 2. Attachments included with this report.

Attachment	Title
A	Specific Conditions and Cross-References
B	Water Quality Data
C	Hydrologic Data

PROJECT STATUS

During Water Year 2015 (WY2015) (May 1, 2014–April 30, 2015), the project was in the regular operational and monitoring phase.

CONCLUSIONS REGARDING PROJECT SUCCESS

The project has been operating generally as expected. However, because of the relatively short period of operation and monitoring period of record (start-up occurred in 2012), it is too early to fully evaluate the project's success in achieving its objectives. A longer monitoring period and assessment during a wide range of meteorological conditions will reduce uncertainty about the relationship between the project's operations, stages, and flows in Taylor Slough and salinity in Florida Bay.

PROBLEMS ENCOUNTERED

No problems were encountered.

ACTIONS TO ADDRESS PROBLEMS

No actions were required to address problems.

INTRODUCTION

PROJECT OVERVIEW

Project Description and History

The C-111 Spreader Canal Phase 1 (Western) (C-111 SCW) Project is one of the key projects of the Comprehensive Everglades Restoration Plan (CERP). It is the first CERP project constructed with direct benefit to Everglades National Park (ENP) including Florida Bay. The project is located in southern Miami-Dade County, and bounded by ENP, the Florida City-Homestead area and Manatee Bay. The project was implemented by the South Florida Water Management District (SFWMD or District) in cooperation with the United States Army Corps of Engineers (USACE). Construction of the S-199 and S-200 pump stations was completed in January 2012, and start-up occurred in June 2012.

Project Objective

The objectives of the C-111 SCW Project are to improve the quantity, timing, and distribution of water delivered to Florida Bay via Taylor Slough; to improve the hydroperiod and hydropattern in the Southern Glades and Model Lands; and to reduce ecologically damaging flows to Florida

Bay and other receiving waters. These objectives will be accomplished by implementing multiple, often separate, project features in phases.

The initial phase of the C-111 SCW Project is also known as the "Western Components" within the C-111 Spreader Canal Western Project Final Project Implementation Report and Environmental Impact Statement (USACE and SFWMD 2011), hereinafter referred to as the PIR. The "Eastern Components" identified in the PIR are not part of this permit, and are therefore not included in this report.

Project Features

The following features are associated with the C-111 SCW Project (**Figure 1**):

- Frog Pond Detention Area (FPDA) and S-200 inflow pump station
- Aerojet Canal impoundment/modifications including weirs and S-199 inflow pump station
- Plugs in the C-110 canal (north of the C-111 canal)
- Plug in the L-31E canal (south of the S-20A structure)

Two additional features were included within the PIR, but have not been implemented, and will only be implemented if they are anticipated to increase restoration, and if they can be implemented without adversely impacting pre-project levels of flood protection.

- Incremental operational adjustments to structures S-18C and S-20
- Construction of the S-198 control structure

As stated in the C-111 SCW Project PIR, surface water flows will not be discharged from this project directly into Taylor Slough or into ENP. Instead, the FPDA and Aerojet Canal features are intended to work in unison to create an approximately six-mile hydraulic ridge adjacent to ENP. The ridge will serve to prevent groundwater flows moving into the C-111 canal from ENP, and preserve water in Taylor Slough, thereby improving the quantity, timing, and distribution of flows into Florida Bay. Water removed from the C-111 canal to form the hydraulic ridge in the detention areas will gradually infiltrate into the ground, much of which will seep back into the canal, where it can again be pumped via S-199 and S-200, extending the duration of the hydraulic ridge, and further decreasing seepage from ENP.

Frog Pond Detention Area

The FPDA is approximately 516 acres, and includes a 225-cubic feet per second (cfs) pump station (S-200), an aboveground header channel, and three detention cells (Cells 1-3). A cascading header canal retains water until the stage reaches approximately two and a half feet above existing ground level, at which point water can flow into the three cells that make up the detention area. The 225-cfs pump station consists of three 75-cfs pumps to allow stepped operations (for more details, see the *Operation Record* subsection in the *Operations* section of this report).

Aerojet Canal

A second 225-cfs pump station (S-199) was constructed immediately upstream of the existing S-177 structure to route water to the project modified Aerojet Canal. This pump station works in tandem with the FPDA and has similar operating criteria. This pump station discharges water to an aboveground flow-way, which in turn discharges to the Aerojet Canal.

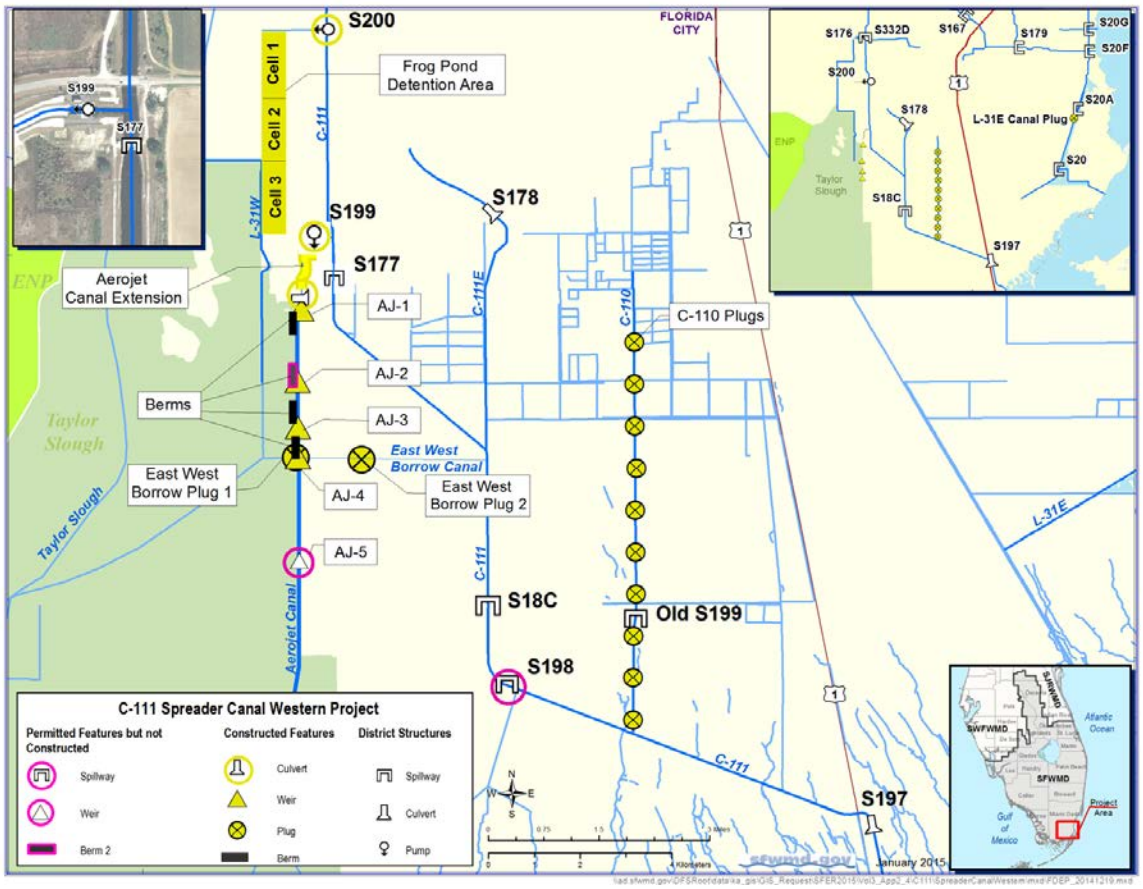

Figure 1. C-111 SCW Project features.

PERMIT HISTORY

The original Comprehensive Everglades Restoration Plan Regulation Act (CERPRA) permit and all modifications issued to SFWMD by FDEP are as follows:

- 0293559-001, issued October 8, 2009, with an expiration date of October 8, 2014.
- 0293559-002, issued March 25, 2010, modified the design plan for the Aerojet Canal.
- 0293559-003, issued April 13, 2010, included the use of public water supply to service field office (trailer) restrooms.
- 0293559-004, issued June 9, 2010, included the use of an additional 1.43 acres adjacent to the FPDA project footprint to stockpile construction material.
- 0293559-005, issued June 20, 2011, included remedial actions within the former Blue Heron Aqua Farm fish farm infiltration pond, and changed the stage and flow monitoring locations.
- 0293559-006, issued December 20, 2011, expanded the project footprint, and clarified start-up monitoring requirements for the FPDA and long-term operational water quality monitoring requirements.
- 0293559-007, issued November 21, 2012, modified routine monitoring plans, including significant monitoring reductions.

- 0293559-008, is a permit renewal requested by the District, which was received by FDEP on August 1, 2014, and issued in WY2016, on December 16, 2015. This will be reflected in the next annual permit report.
- On January 9, 2014, FDEP approved elimination of other toxicants monitoring requirements associated with the permit.
- 0293559-009, issued October 29, 2014, modified the reporting period for inspection.

OPERATIONS

INSPECTION/MAINTENANCE PROGRESS

In October 2014, the permit requirement for inspection reporting was revised to require a report one year post construction and every five years post construction thereafter. As reported in WY2014, an inspection of project features was conducted between September 1, 2013, and February 28, 2014. Therefore, an inspection report was not required in WY2015.

OPERATION RECORD

C-111 SCW project features are intended to operate in conjunction with existing Central & Southern Florida Flood Control Project (C&SF Project) features. The existing features are currently operated as outlined in the USACE's Everglades Restoration Transition Plan (ERTP). The C-111 SCW Project is a restoration project and only redistributes existing water within the lower C-111 basin. The project does not provide any new water to the regional system and, thus, poses no change to existing water supply operations.

The C-111 SCW Project resulted in two new operable pump stations upstream of S-177 (S-200 and S-199). Pump station S-200, which was constructed downstream of S-176, is intended to initiate pumping prior to reaching the open trigger for flood control operations at S-177 [currently when the headwater stage at S-177 reaches elevation 4.2 feet (ft) National Geodetic Vertical Datum of 1929 (NGVD29)]. It consists of three individual 75-cfs electric pumps that will trigger according to the schedule in **Table 3**. More information is available in the Preliminary Project Operating Manual (SFWMD 2013).

Table 3. S-200 pump station on/off headwater triggers.[a]

Pump	Rating	Pump On Elevation	Pump Off Elevation
Unit 1	75 cfs	3.8 ft NGVD29	3.6 ft NGVD29
Unit 2	75 cfs	3.9 ft NGVD29	3.6 ft NGVD29
Unit 3	75 cfs	4.0 ft NGVD29	3.6 ft NGVD29
S-177[b]	1,400 cfs	Open 4.3 ft NGVD29	Close 3.6 ft NGVD29

a. In addition to the headwater criteria listed above, all pumps will be shut off if the tailwater at S-200 reaches 8.5 ft NGVD29. Pumping at S-200 will also cease if ponding at a predetermined representative site, monitoring station R3110, within designated Cape Sable Seaside Sparrow Critical Habitat Unit 2 (C) (Subpopulation C) exceeds ten centimeters (elevation 4.95 ft NGVD29) during the critical portion (March 15 to June 30) of the nesting season, as identified by the United States Fish and Wildlife Service.

b. S-177 on/off triggers are shown for comparison.

During current operation of the S-332D pump station, a significant amount of the pumped water returns to the C-111 canal as seepage from one or more of the S-332D cells. In order to reduce S-177 openings, the S-200 pumps may also be used on a "one-to-one" basis with the 125-cfs pumps at pump station S-332D, at any time that the S-177 headwater is at or above elevation of 3.8 ft NGVD29. For example, if two of the 125-cfs diesel pumps are on at S-332D and the S-177 headwater is at least 3.8 ft NGVD29, then up to two of the S-200 pumps can be turned on independent of the stages in **Tables 3** and **4**. The intent is not to restrict operations to a specific plan, but to allow for flexibility in order to maintain stages within the operating range.

To avoid overtopping and to ensure the stability of the FPDA, pumping will cease if the stage in the header channel reaches 8.5 ft NGVD29. Pumping at S-200 will also cease if ponding at a predetermined representative site, in this case monitoring station R3110, which is within designated Cape Sable Seaside Sparrow (CSSS) Critical Habitat Unit 2 (Subpopulation C), exceeds ten centimeters (elevation 2.36 ft NGVD29) during the critical portion of the nesting season, March 15 to June 30, as identified by the United States Fish and Wildlife Service (USFWS). Operations at pump station S-199, which has been constructed immediately upstream of S-177 [downstream of Ingraham Highway (Florida State Road 9336)], mirror those at S-200, as shown in **Table 4**.

Table 4. S-199 pump station on/off headwater triggers.[a]

Pump	Rating	Pump On Elevation	Pump Off Elevation
Unit 1	75 cfs	3.8 ft NGVD29	3.6 ft NGVD29
Unit 2	75 cfs	3.9 ft NGVD29	3.6 ft NGVD29
Unit 3	75 cfs	4.0 ft NGVD29	3.6 ft NGVD29
S-177 [b]	1,400 cfs	Open 4.3 ft NGVD29	Close 3.6 ft NGVD29

a. In addition to the headwater criteria listed above, all pumps will be shut off if the tailwater at S-199 reaches 8.0 ft NGVD29. Pumping at S-199 will also cease if ponding at a predetermined representative site, in this case monitoring station EVER4, within designated CSSS Critical Habitat Unit 3 (D) (Subpopulation D) exceeds ten centimeters (elevation 2.36 ft NGVD29) during the critical portion of the nesting season, from March 15 to June 30, as identified by USFWS.

b. With S-177, open/close is shown for comparison.

Similar to the FPDA, in order to avoid overtopping, and to ensure stability of the Aerojet Canal perimeter berms, pumping will cease if the stage in the Aerojet Canal at the S-199 tailwater reaches 8.0 ft NGVD29. Pumping at S-199 will also cease if ponding at a predetermined representative site, in this case monitoring station EVER4, which is within designated CSSS Critical Habitat Unit 3 (Subpopulation D), exceeds ten centimeters (elevation 2.36 ft NGVD29) during the critical portion of the nesting season, March 15 to June 30, as identified by USFWS.

An annual interagency coordination meeting was held on February 4, 2015. An overview of the project construction, operation, monitoring plans, and monitoring results was presented. Incremental change of trigger stages at S-20 and S-18C, as described in Section 3 of the Preliminary Project Operating Manual, is currently on hold. It was decided to delay the start of incremental testing of higher operating criteria at S-18C due to concerns over local flooding. It is difficult to make a determination at this time whether the project has adversely affected adjacent lands in terms of flooding based on the limited duration of the data set. Ongoing data collection will include collection of groundwater well data, installation of additional wells, and verification of microtopography data.

AJ-3 AND AJ-4 WEIRS

The C-111 SCW Project was constructed without these two weirs. After two years of operating the project it was determined that construction of weirs AJ-3 and AJ-4 was necessary. Field observations and monitoring during the Operational Testing and Monitoring Period indicated that the two existing earthen plugs located at the AJ-3 and AJ-4 locations were a constraint in the Aerojet Canal system, and therefore that they needed to be replaced with weirs at a lower elevation (lowered by about 36 inches), consistent with the PIR and the permit. Conversion of the earthen plugs to weirs began in October 2014 and was completed in January 2015, which allowed additional fresh water to be diverted south, provided connectivity between the northern and southern segments, and reduced high stages observed in the L-31W near the ENP boundary.

HYDROMETEOROLOGICAL MONITORING SUMMARY

FLOODING IMPACTS

During WY2014, through letters and at public meetings, local growers expressed concern about possible adverse effects to their crops within the C-111 basin. Specific condition 13 indicates that the District is responsible for ensuring that the project is constructed and operated so as not to adversely affect adjacent lands outside the project boundary.

SFWMD is continuing to collect data from the existing monitoring network and is in the process of expanding the groundwater data collection network to understand the effect of the project on local groundwater conditions. A description of additional efforts and data associated with groundwater monitoring is included in this section of the report. The additional monitoring stations are marked as “flood constraint” or “flow (objective)” in **Tables 6** and **7** under the “purpose” column.

SFWMD staff also expanded the domain of the existing Water Depth Assessment Tool (WDAT) in 2015, and developed a project-specific post-processing query that enables SFWMD to routinely produce maps comparing groundwater levels to ground surface elevations for the area of interest.

Based on the preliminary analysis (SFWMD 2015), it is difficult to make a determination at this time whether the project has adversely affected adjacent lands in terms of flooding, based on the limited duration of the data set. While regional groundwater changes in south Miami-Dade County have occurred, the C-111 SCW Project appears to have been able to maintain stages in the C-111 canal by pumping water to the FPDA and the Aerojet Canal with two new project pump stations, S-199 and S-200. No adverse effects of the C-110 canal plugs have been observed or shown in the modeling study. Based on ground surface elevation, groundwater levels, soil water content, and locations relative to canals, flooding risks in the project area appear to be unchanged in pre-project compared to post-project operations. However, locations and degrees of risk can be refined based on continued collection of groundwater well data, installation of additional wells, and verification and potential collection of microtopography data.

MONITORING STATIONS AND FREQUENCY

Hydrometeorological monitoring was conducted for rainfall, groundwater level and canal stage, and surface flow at two rainfall monitoring stations (**Table 5**), 25 stage monitoring stations (**Table 6**), and seven flow monitoring stations (**Table 7** and **Figure 2**). Available hydrometeorological data for WY2015 were obtained from databases maintained by the District (DBHYDRO), United States Geological Service (USGS; Everglades Depth Estimation Network), and ENP.

Table 5. Meteorological monitoring stations.

Station	Coordinates (x,y)	Parameter	Unit of Measure	Frequency	Record	Starting Date
S-177	801947.88 388873.35	Rainfall	inches	Day	CR10	18-Mar-91
S-18C	813035.40 362709.17	Rainfall	inches	Day	CR10	10-Jun-03

Table 6. Groundwater level and canal stage monitoring stations.

Station	Coordinates (x,y)	Agency	Starting Date	Reporting Frequency	Purpose
Groundwater Stage Monitoring Stations					
G-613	813214.16 390672.83	USGS; Site number: 252425080320001	1-Oct-1956	Daily Average	Flood constraint
G-1251	799608.47 359179.22	USGS; Site number: 251922080340701	6-May-1971	Daily Average	Flood constraint
G-3356	845012.99 394836.15	USGS; Site number: 252502080253901	23-Oct-1985	Daily Average	Permit requirement and flood constraint
G-3355	820926.48 385501.77	USGS; Site number: 252332080300501	20-Aug-1985	Daily average	Flood constraint
G-3620	807547.83 382586.70	USGS; Site number: 252312080320301	11-APR-1996 to 03-DEC-2013	Daily average	Flood constraint
G-3350	823572.55 371287.29	USGS; to be reactivated in 2016.	25-Oct-1995	Daily average	Flood constraint
G-3621	823553.85 374143.30	USGS; to be reactivated in 2016	17-APR-1996 to 12-APR-2011	Daily average	Flood constraint
C111AW	803487.22 385395.30	IFAS[a], DBKey: 87629	25-Aug-2010	Daily average	Permit requirement and flood constraint
C111AE	807490.82 385196.80	IFAS, DBKey: 87627	25-Aug-2010	Daily average	Permit requirement and flood constraint
C111VC1	804194.41 394496.08	IFAS, DBKey: 63923	13-Aug-2010	Daily average	Flood constraint
C111VC2	804486.42 391907.56	IFAS, DBKey: 63926	13-Aug-2010	Daily average	Flood constraint
C111AK5	807362.07 398157.22	IFAS, DBKey: 63920	13-Aug-2010	Daily average	Flood constraint
C111AK6	804911.47 385229.82	IFAS, DBKey: 63922	13-Aug-2010	Daily average	Flood constraint
NP-EPS (EPSW)	820404.92 344655.51	ENP		Daily average	Permit requirement
R3110	779612.78 404699.25	USGS		Daily average	Permit requirement
EVER4	805959.28 365763.42	USGS		Daily average	Permit requirement

a. IFAS – University of Florida's Institute of Food and Agricultural Sciences.

Table 6. Continued.

Station	Coordinates (x,y)	Agency	Period of Record	Reporting Frequency	Purpose
Canal Stage Monitoring Stations					
S-200 (HW&TW)	801071.92 403950.07	SFWMD, DBKey: AI305 & AI307	11-Jan-2012	Daily average	Permit requirement and flood constraint
S-199 (HW&TW)	801540.06 389071.31	SFWMD, DBKey: 88890 & 88892	21-Dec-2011	Daily average	Permit requirement and flood constraint
S-177 (HW&TW)	801947.88 388873.35	SFWMD, DBKey: 13154 & 13155	16-Jul-1981	Daily average	Permit requirement and flood constraint
S-18C (HW&TW)	813035.40 362709.17	SFWMD, DBKey: V7576 & V7578	5-Aug-1966	Daily average	Permit requirement and flood constraint
S-197 (HW&TW)	840561.25 347070.25	SFWMD, DBKey: HA459 & HA463	1-Oct-1966	Daily average	Permit requirement and flood constraint
S-178 (HW&TW)	813334.07 390825.90	SFWMD, DBKey: P8675 & P8677	1-Jul-1967	Daily average	Flood constraint
S-20 (HW&TW)	862011.98 376186.24	SFWMD, DBKey: 87490 & 87492	28-Dec-1967	Daily average	Flood constraint
S-200 (HW&TW)	801071.92 403950.07	SFWMD, DBKey: AI305 & AI307	11-Jan-2012	Daily average	Permit requirement and flood constraint

Table 7. Surface water flow monitoring sites.

Station	Coordinates (x,y)	Agency	Period of Record	Parameter	Reporting Frequency	Purpose
S-176	800391.28 417903.38	SFWMD, DBKey: 12286	15-Sep-1967	Calculated Flow	Daily	Flow
S-177	801947.88 388873.35	SFWMD, DBKey: 13156	16-Jul-1981	Calculated Flow	Daily	Permit requirement
S-178	813302.39 390875.38	SFWMD, DBKey: SO632	1-Jul-1967	Calculated Flow	Daily	Flood constraint
S-200	801071.92 403950.07	SFWMD, DBKey: AI315	11-Jan-2012	Calculated Flow	Daily	Permit requirement and flood constraint
S-199	801540.06 389071.31	SFWMD, DBKey: 88897	21-Dec-2011	Calculated Flow	Daily	Permit requirement and flood constraint
S-18C	813035.40 362709.17	SFWMD, DBKey: 15760	5-Aug-1966	Calculated Flow	Daily	Permit requirement
S-197	840561.25 347070.25	SFWMD, DBKey: 15763	1-Oct-1966	Calculated Flow	Daily	Permit requirement
S-20	862011.98 376186.24	SFWMD, DBKey: 12293	28-Dec-1967	Calculated Flow	Daily	Flow
NP-TSB (Taylor Slough Bridge)	785947.44 388664.97	ENP	1-Oct-1960	Calculated Flow	Daily	Permit requirement

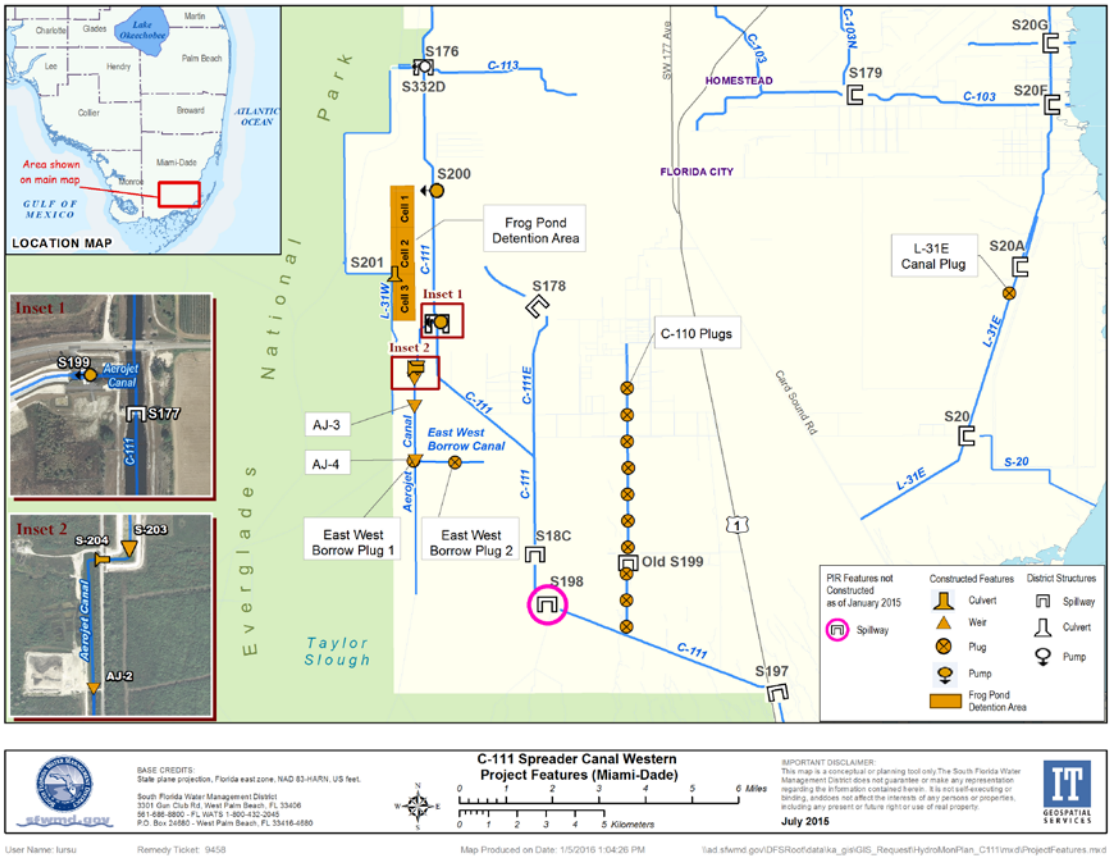

Figure 2. Groundwater, surface water, and rainfall monitoring sites.

METEOROLOGICAL MONITORING

Information about the rainfall reporting stations is listed in **Table 5**. Daily rainfall data at S-177 and S-18C were retrieved from the District's DBHYDRO database. The C-111 SCW Project area received 49 inches of rainfall at S-177, and 50 inches at S-18C during WY2015. Historical annual rainfall in the project area is around 57 inches. WY2015 rainfall was lower than the historical average, and it was also drier than WY2013 and WY2014. Monthly rainfall is shown in **Table 8** and **Figure 3**. About 70 percent of the annual rainfall was received in the wet season (May to October), and the remaining 30 percent in the dry season (November through April).

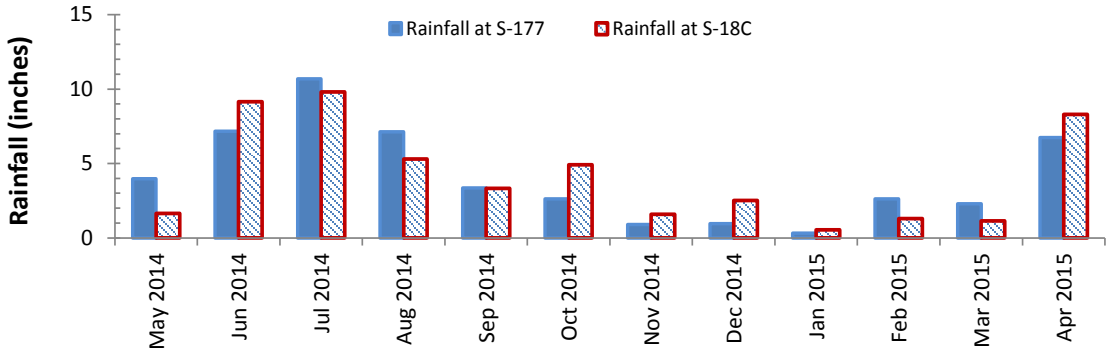

Figure 3. WY2015 monthly rainfall at sites S-177 and S-18C.

Table 8. Monthly and annual rainfall for WY2015.

Month	S-177 Total Rainfall (inches)	S-18C Total Rainfall (inches)
May 2014	4.0	1.7
Jun 2014	7.2	9.2
Jul 2014	10.7	9.8
Aug 2014	7.1	5.3
Sep 2014	3.4	3.3
Oct 2014	2.6	4.9
Nov 2014	0.9	1.6
Dec 2014	1.0	2.5
Jan 2015	0.3	0.5
Feb 2015	2.6	1.3
Mar 2015	2.3	1.1
Apr 2015	6.7	8.3
WY2015 Total	48.8	49.5

Note: The historical annual rainfall in the project area is about 57 inches.

FLOWS

Flows were monitored at nine locations. All flow data were downloaded from the District's DBHYDRO database, except for TSB, for which the data were obtained through ENP. **Table 9** shows the monthly flows at these locations.

Table 9. Monthly flow at the C-111 structures during WY2015.

Month	Average Flow (cfs)							
	S-176	S-177	S-178	S-200	S-199	S-18C	S-197	TSB
May 2014	87	63	0	0	0	5	0	0
Jun 2014	5	9	0	45	46	40	0	0
Jul 2014	8	27	6	105	194	259	0	59
Aug 2014	0	4	0	126	186	311	0	152
Sep 2014	1	0	1	120	152	227	0	46
Oct 2014	1	0	0	108	152	182	0	67
Nov 2014	0	0	1	88	150	177	0	52
Dec 2014	0	0	0	75	81	87	0	9
Jan 2015	0	0	0	51	58	43	0	1
Feb 2015	6	8	0	0	0	12	0	0
Mar 2015	56	47	0	0	0	6	0	0
Apr 2015	135	147	0	0	0	48	0	0
WY2015 Average	25	25	1	60	85	116	0	32

Daily flow variations at S-200 and S-199, the two major structures of the C-111 SCW Project, are depicted in **Figure 4**. S-200 began pumping from the C-111 canal into the FPDA in mid-June 2014, and stopped pumping at the end of January 2015. The annual average flow was 60 cfs. Similarly, S-199 started pumping from the C-111 canal into the Aerojet Canal in late June 2014 and ended in January 2015, with an annual average flow of 85 cfs. S-200 and S-199 were consistently in operation during the wet season. Pumping ceased later in the dry season when the water level in the C-111 canal was too low. In the wet season, S-199 reached its maximum discharge capacities of 225 cfs, while S-200 had peak flow of 150 cfs, a little short of its maximum capacity (**Figure 4**).

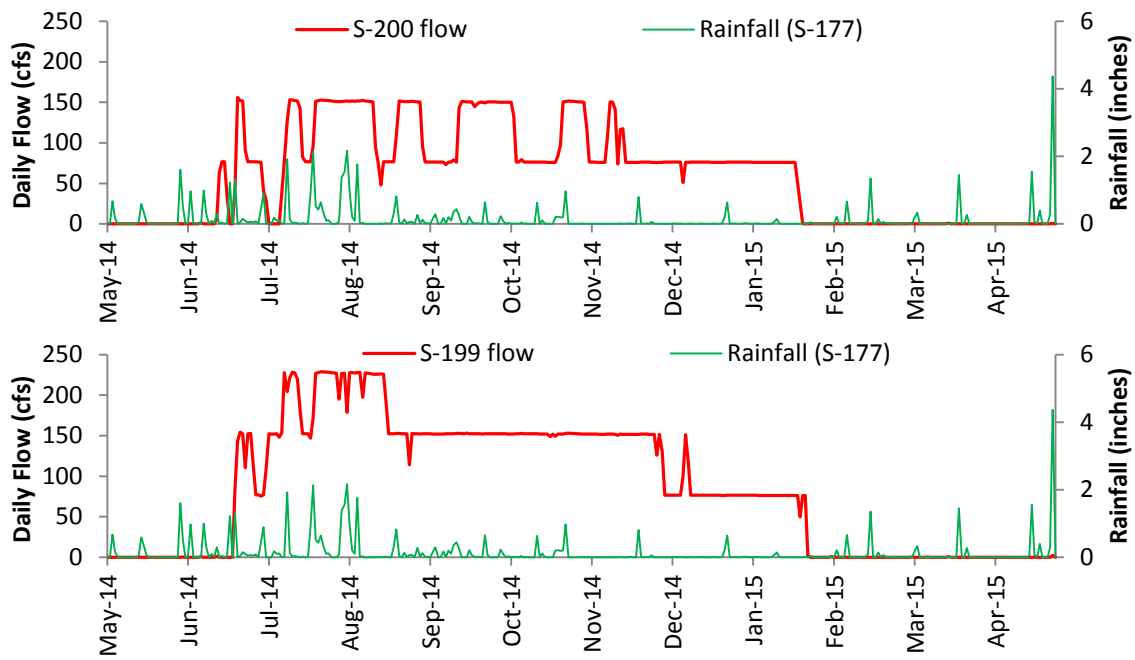

Figure 4. Daily flow at S-200 and S-199 in WY2015.

At S-176 and S-177, the two structures in the C-111 canal, high discharges occurred in May 2014 and April 2015, with an annual mean flow of 25 cfs at each structure. In the remainder of WY2015, flows at these two locations were minimal, particularly in the wet season, because water was pumped from the C-111 canal to several detention areas (**Figure 5**).

S-178 is a culvert controlled by a sluice gate and discharges can go both directions, upstream or downstream, depending on the water level difference. Very small discharges occurred in both directions in WY2015. This pattern was consistent with the historical data over the last decade (**Figure 5**).

At S-18C, WY2015 discharges were sustained with monthly mean flows ranging from as low as 5 cfs to over 300 cfs. The annual average flow in WY2015 was 116 cfs. In general, monthly mean flows in WY2015 were lower than the pre-project flows (2002–2011) (**Figure 5**).

S-197, the southernmost structure of the District, was closed for the entire period of WY2015. The operation of this structure comported with the objective of the C-111 SCW Project, which is to divert water to detention areas and to limit discharges to the south.

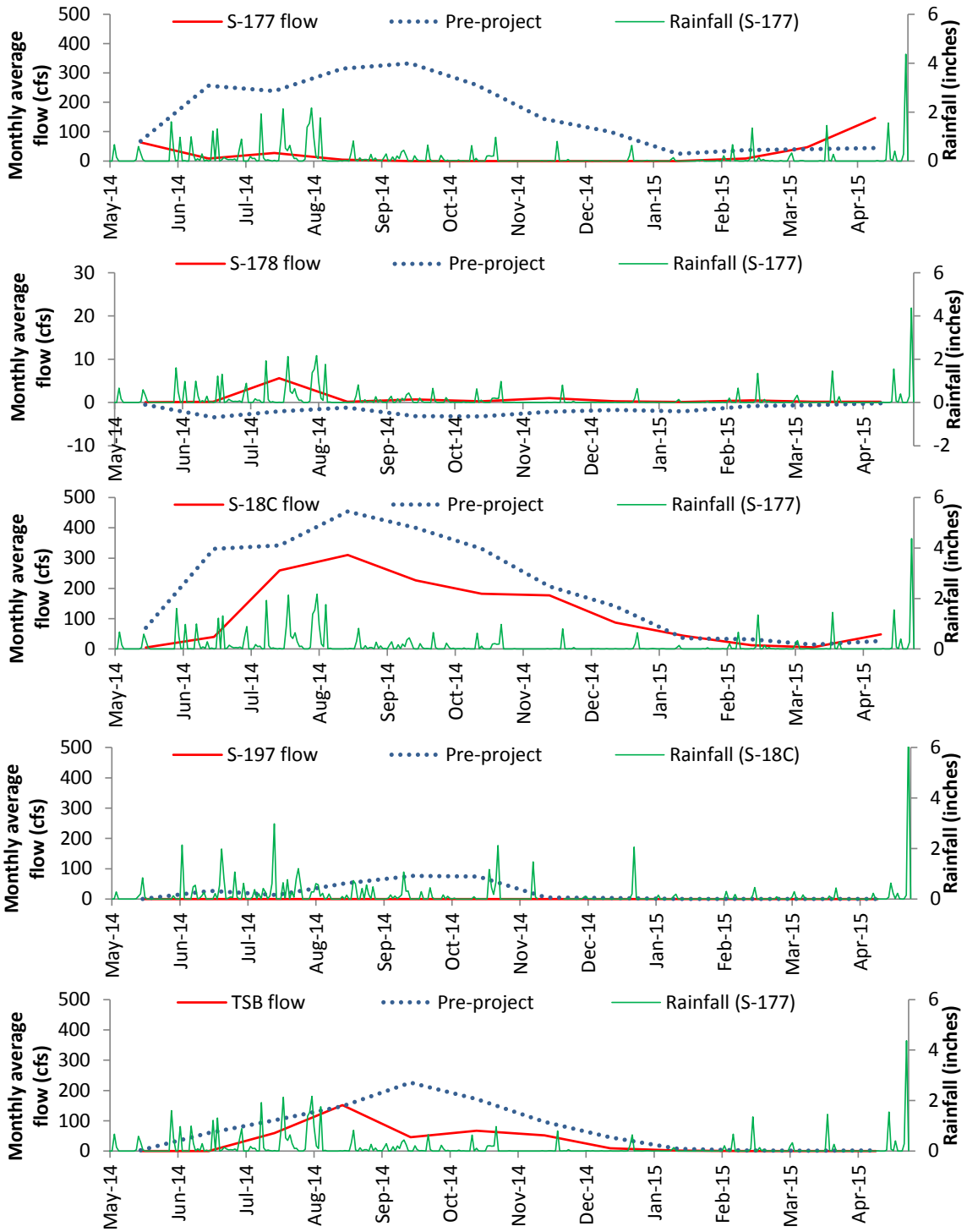

Figure 5. Monthly average flows at C-111 monitoring structures in WY2015 and pre-project (2002-2011).

SB recorded an average flow of 32 cfs in WY2015. Overall, the monthly flows in WY2015 were lower than the pre-project flows (2002–2011) (**Figure 5**). WY2015 was a dry year in South Florida, it was even drier in ENP, and the water conservation areas (see Chapter 6 in Volume I of this South Florida Environment Report [SFER]. Although project features were operated by following the Preliminary Project Operation Manual, TSB still experienced lower than pre-project flows due to low rainfall and dry condition in the region.

A challenge in this region is short- and long-term management of seepage from ENP. Regional groundwater levels have increased over time due to water supply, implementation of restoration projects, operational changes, the combined effects of independently planned projects, and external factors. In Taylor Slough, hydroperiods and water levels at station EPSW (south of S-18C in Southern Glades) have increased under the Interim Operational Plan (IOP), indicating that more water was stored in ENP, due at least in part to restoration efforts. It is worthy to note that the IOP was superseded by the ERTP operational guidance in October 2012, shortly after the start-up of the S-199 and S-200 pumps in May 2012. Increased tailwater at S-18C over the same period is likely due to a variety of factors, including water supply conveyance via the L-31 canal and seepage from nearby marshes (likely Taylor Slough) (RECOVER 2014).

STAGES

The network of groundwater and surface water monitoring stations that supports this project is maintained by SFWMD, University of Florida Institute of Food and Agricultural Sciences (IFAS), ENP, and USGS. **Table 6** provides details regarding individual monitoring stations including coordinates, parameters, period of record, and frequency of data collections. **Table 10** shows the headwater and tailwater levels at seven structures in the C-111 SCW project area. Daily variations are shown in **Figures 6** and **7**, and are compared against pre-project water levels in the period of May 2002 to April 2012. **Table 11** shows monthly water levels at ten monitoring wells in the project area. Daily variations of well data are shown in **Figures 8** and **9**.

The tailwater of S-200 was between 6 and 9 ft NGVD29 when the pump was operational (**Figure 7**). After January, when pumping ceased, the water level returned to 6 feet. Similarly, the tailwater of S-199 remained between 6 and 8 ft NGVD29 from June 2014 to January 2015, during pumping, and returned to 6 ft NGVD29 when pumping ceased in January 2015.

S-200, S-199, and S-177 were operated with similar headwater levels. Occasionally, pumping events caused disturbances to water levels in some local areas, which resulted in slight differences among the three headwater levels. Comparing with the available pre-project data at S-177, headwater at S-177 was between the 75th and 90th percentiles of pre-project levels (**Figure 6**).

The S-177 tailwater and S-18C headwater had similar levels, and were controlled by the downstream structure, S-18C. Through WY2015, levels ranged from the 25th to 75th percentile of pre-project elevations (**Figure 6**).

S-18C tailwater and S-197 headwater were controlled by the S-197 structure to maintain similar water levels during operation. The S-18C tailwater level ranged from the 25th to 75th percentile of pre-project elevations during WY2015 (**Figure 6**). S-197, which discharges directly into Manatee Bay, had the lowest tailwater levels among all of the stage monitoring stations due to its location near the coast (**Table 10**).

S-178 is a culvert controlled by a sluice gate and discharges can go both directions, upstream or downstream, depending on the water level difference. The headwater and tailwater at S-178 were similar during WY2015 (**Figure 6**).

Table 10. Headwater and tailwater levels at C-111 structures in WY2015. [Note: HW – headwater and TW – tailwater.]

Month	S-200		S-199		S-177		S-18C		S-197		S-178		S-20	
	HW	TW	HW	TW	HW	TW	HW	TW	HW	TW	HW	TW	HW	TW
May-14	2.5	5.9	2.5	6.1	2.5	2	1.6	1.2	1.3	1.3	1.7	1.7	1	1
Jun-14	3.3	6.7	3.3	6.7	3.3	2.4	2.3	1.7	1.8	1	2.5	2.4	1.3	1
Jul-14	3.6	7.7	3.6	8.1	3.8	2.5	2.4	2.2	2.2	1	2.8	2.5	1.8	1.3
Aug-14	3.4	8.1	3.5	8.1	3.6	2.5	2.4	2.3	2.4	1.3	2.6	2.5	1.8	1.5
Sep-14	3.2	8.2	3.3	7.7	3.5	2.4	2.3	2.2	2.3	1.5	2.5	2.5	1.7	1.5
Oct-14	3.3	8.1	3.4	7.8	3.5	2.4	2.3	2.2	2.3	1.6	2.5	2.5	1.9	1.7
Nov-14	3.2	8	3.2	7.9	3.4	2.4	2.3	2.3	2.3	1.6	2.4	2.4	1.8	1.7
Dec-14	3.3	7.8	3.4	7.5	3.4	2.4	2.3	2.1	2.1	1.5	2.4	2.4	1.7	1.6
Jan-15	3.1	7.2	3.2	7.2	3.2	2.3	2.3	2	2	1.2	2.4	2.4	1.6	1.3
Feb-15	2.9	5.8	2.9	6.1	2.9	2.1	2.1	1.8	1.8	1.2	2.1	2.1	1.4	1.3
Mar-15	2.7	5.9	2.8	6.1	2.7	1.9	1.9	1.6	1.6	0.9	1.9	1.9	1.1	0.9
Apr-15	2.4	5.9	2.4	6.1	2.4	1.8	1.8	1.3	1.4	1	1.9	1.9	0.8	0.6

Table 11. Water elevation in ft NGVD29 in C-111 monitoring wells during WY2015. [Note: No monitoring data is available for G-3620, G-3350, and G-3621.]

Month	G-613	G-1251	G-3356	G-3355	C111-AW	C111-AE	C111-VC1	C111-VC2	C111-AK5	C111-AK6	EPSW	EVER4	R3110
May-14		1.1	1.6	1.8	1.7	1.6	2.6	2.2	2.0	1.6	1.1	1.1	1.9
Jun-14		2.1	2.4	2.7	2.4	2.4	3.5	3.1	2.9	2.4	1.3	2.1	4.1
Jul-14		2.3	2.8	3.3	2.7	2.7	4.3	3.7	3.4	2.7	1.6	2.3	5.2
Aug-14		2.5	2.5	3.2	2.7	2.7	4.4	3.6	3.3	2.7	1.8	2.5	5.5
Sep-14	2.6	2.4	2.5	2.8	2.6	2.5	3.7	3.2	3.0	2.5	1.8	2.3	5.3
Oct-14	2.6	2.4	2.3	2.9	2.6	2.5	3.7	3.3	3.0	2.5	1.8	2.4	5.5
Nov-14	2.5	2.4	2.2	2.9	2.5	2.4	3.6	3.2	3.0	2.5	1.8	2.4	5.4
Dec-14	2.4	2.2	2.0	2.9	2.5	2.3	3.5	3.1	2.8	2.4	1.7	2.2	5.0
Jan-15	2.4	2.1	1.8	2.5	2.4	2.3	3.3	3.0	2.8	2.4	1.7	2.1	4.2
Feb-15	2.2	1.8	1.7	2.3	2.1	2.0	3.0	2.7	2.6	2.1	1.6	1.8	3.0
Mar-15	1.9	1.5	1.6	2.1	1.9	1.8	2.9	2.6	2.4	1.9	1.4	1.5	2.5
Apr-15	1.7	1.2	1.3	1.9	1.8	1.7	2.6	2.3	2.2	1.8	1.2	1.3	2.0

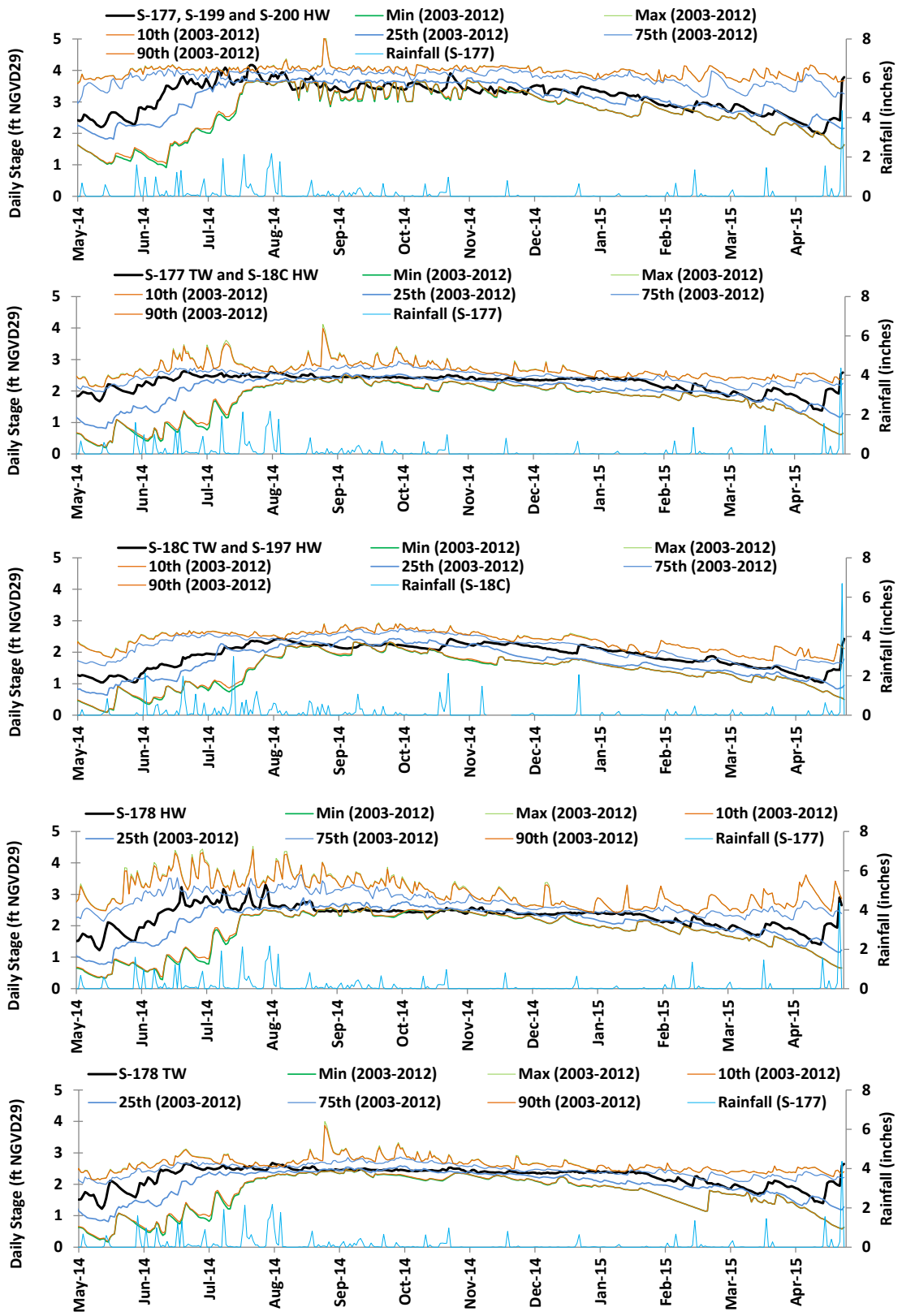

Figure 6. Water stages at multiple C-111 structures.
[Note: HW – headwater, Max – maximum, Min – minimum, and TW – tailwater.]

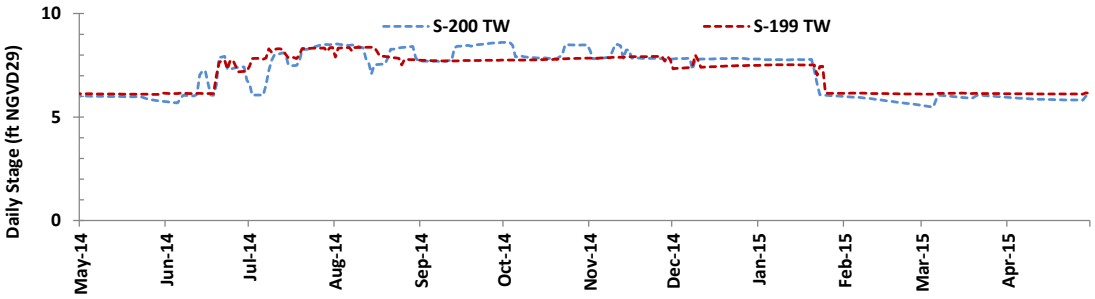

Figure 7. Tailwater levels at S-200 and S-199 structures.

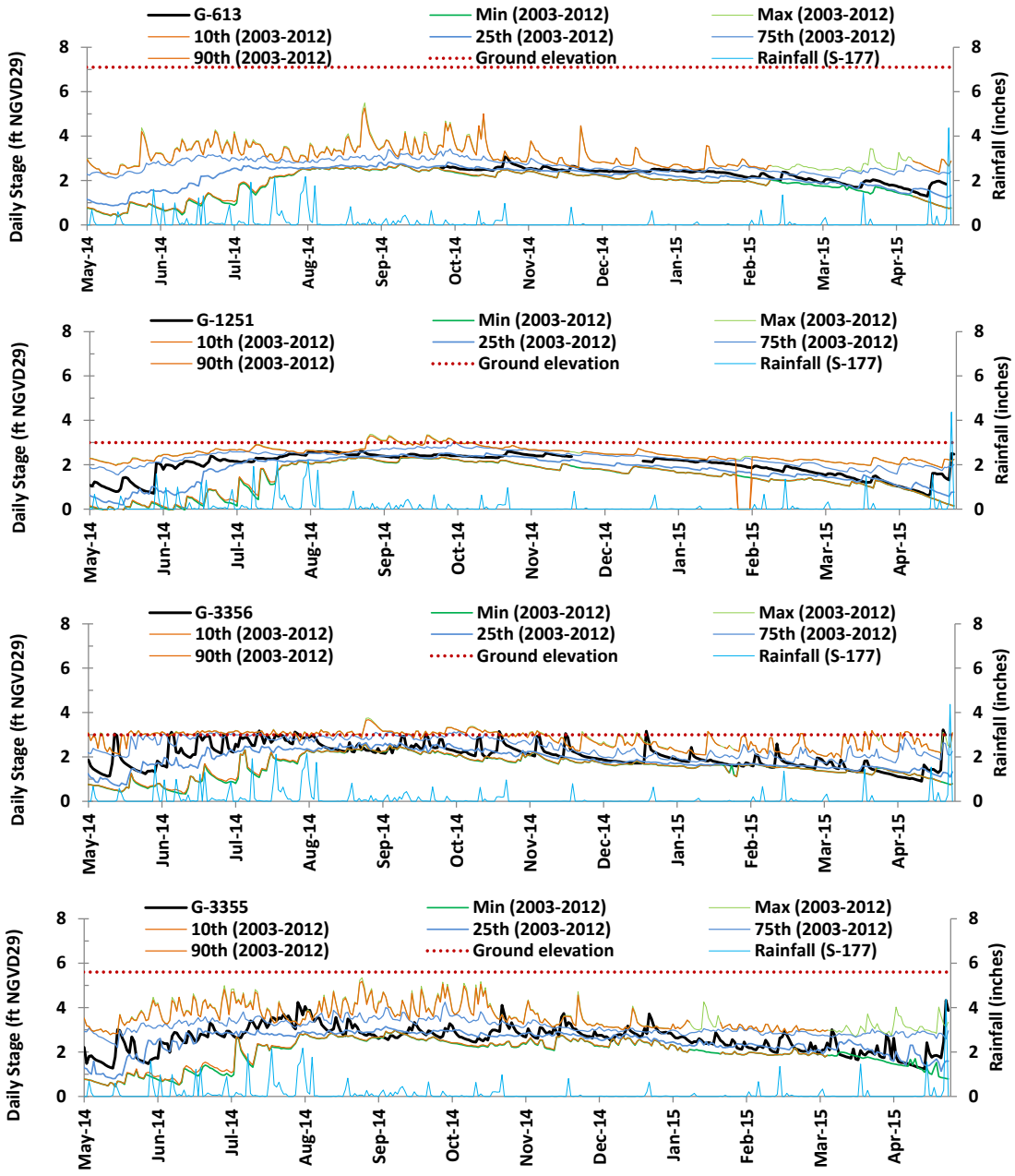

Figure 8. Stage levels at multiple groundwater wells.

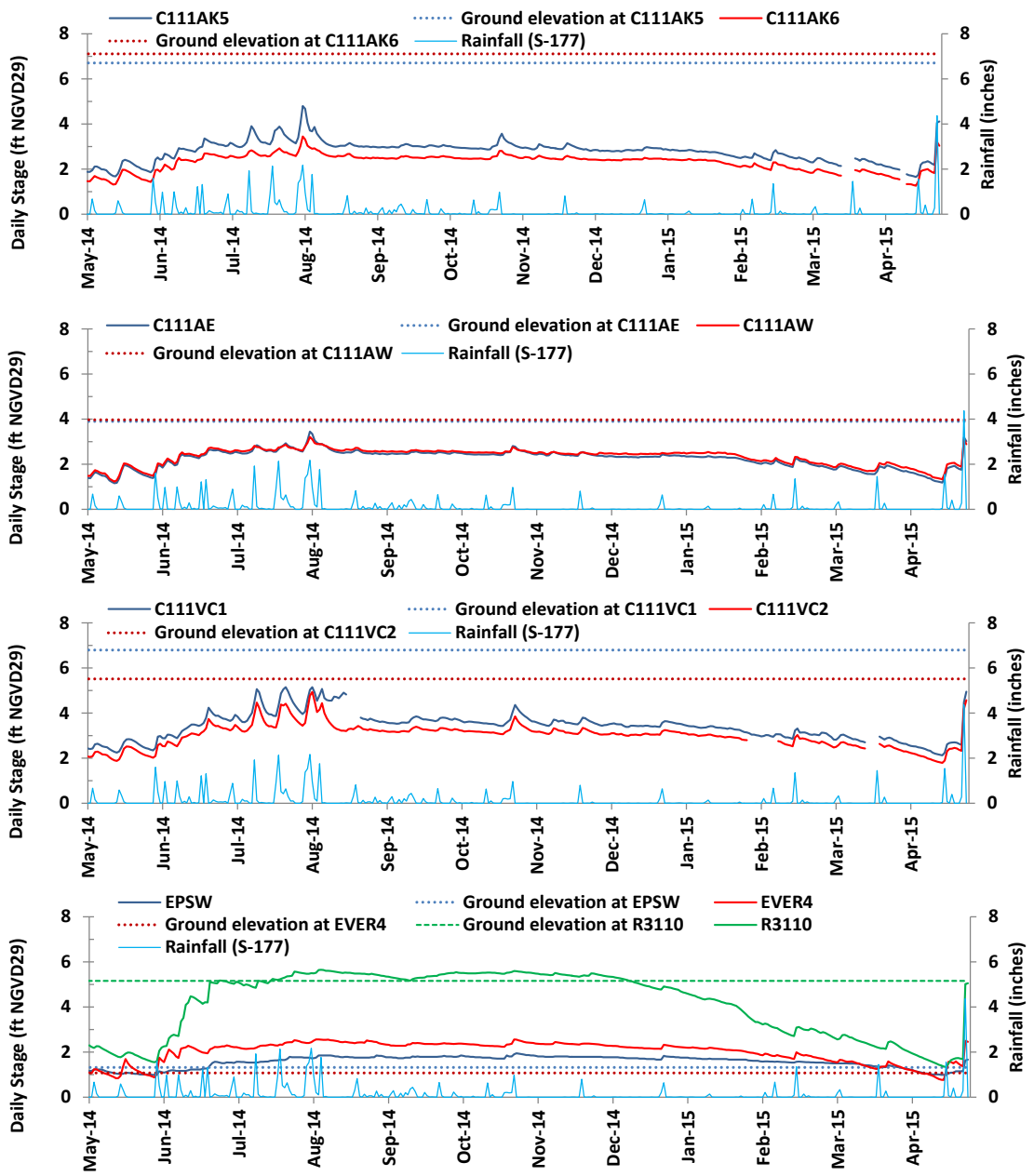

Figure 9. Stage levels at IFAS groundwater wells.

At USGS well sites, water levels ranged from the 25th to 75th percentile of pre-project levels most of the time (**Figure 8**). The changes of groundwater levels at G-613 and G-1251were generally smooth except for several rapid rising events. Water level changes at G-3356 and G-3355 were much more dynamic, showing consistent fluctuations. Areas around G-613, G-1251, and G-3355 stayed dry through WY2015. At G-3356, groundwater could reach above the ground surface occasionally. Groundwater levels at G-3620, G-3350, and G-3621 were not monitored in WY2015.

At IFAS well sites, groundwater levels at C111VC1, C111VC2, C111AK5, C111AE, C111AW, and C111AK6 share similar patterns but with decreasing amplitudes as water flows from north to south. These sites are located between S-177 and S-178, showing similar patterns as S-177 headwater (**Figure 9**).

An ongoing well monitoring and soil moisture study funded by the District has been conducted by the University of Florida. Six agriculture study sites, including C111AW, C111AE, C111VC1, C111VC2, C111AK5, and C111AK6, were chosen and continuously monitored for water table elevations and soil water content. Collected data were used to calibrate modeling tools developed to predict basin-wide water level responses to changes in canal stages. Data from this study are available upon request.

WATER QUALITY MONITORING SUMMARY

In addition to authorizing the operation and maintenance of C-111 SCW Project structures, the permit requires a routine water quality monitoring program to characterize the quality of water discharged through District structures. This section of water quality monitoring and reporting follows the 2012 modified water quality monitoring plan.

Water quality data evaluated in this report were retrieved from the District's DBHYDRO database. The District follows strict quality assurance/quality control procedures, outlined in the District's Chemistry Laboratory Quality Manual (SFWMD 2015a) and Field Sampling Quality Manual (SFWMD 2015b). The laboratory manual was developed in accordance with National Environmental Laboratory Accreditation Conference requirements, and both the laboratory and field manual were developed in accordance with the FDEP Quality Assurance Rule (Chapter 62-160, Florida Administrative Code [F.A.C.]). The quality manuals describe procedures the water quality monitoring program follows to obtain data for assessing the progress being made toward achieving water quality standards.

PERMIT SAMPLING SITES

Currently, the C-111 SCW Project permit requires water quality monitoring at five sites in the project area, as specified in the permit, listed in **Table 12** and shown in **Figure 10**.

Table 12. Water quality monitoring sites in the project area.

Site	Latitude	Longitude	Description
S-332DX	25°28'59.92"	80°33'46.40"	At the eastern end of the land in front of S-332D pump
S-177 (S199)	25°24'10.40"	80°33'30.20"	At the S-177 and S-199 structure
S-200	25°26'38.94"	80°33'37.26"	At the S-200 structure
AJC1	25°22'36.66"	80°33'58.18"	In the Aerojet Canal downstream of the fish farm
FPDAH1	25°26'37.00"	80°34'25.75"	In the FPDA Header Canal

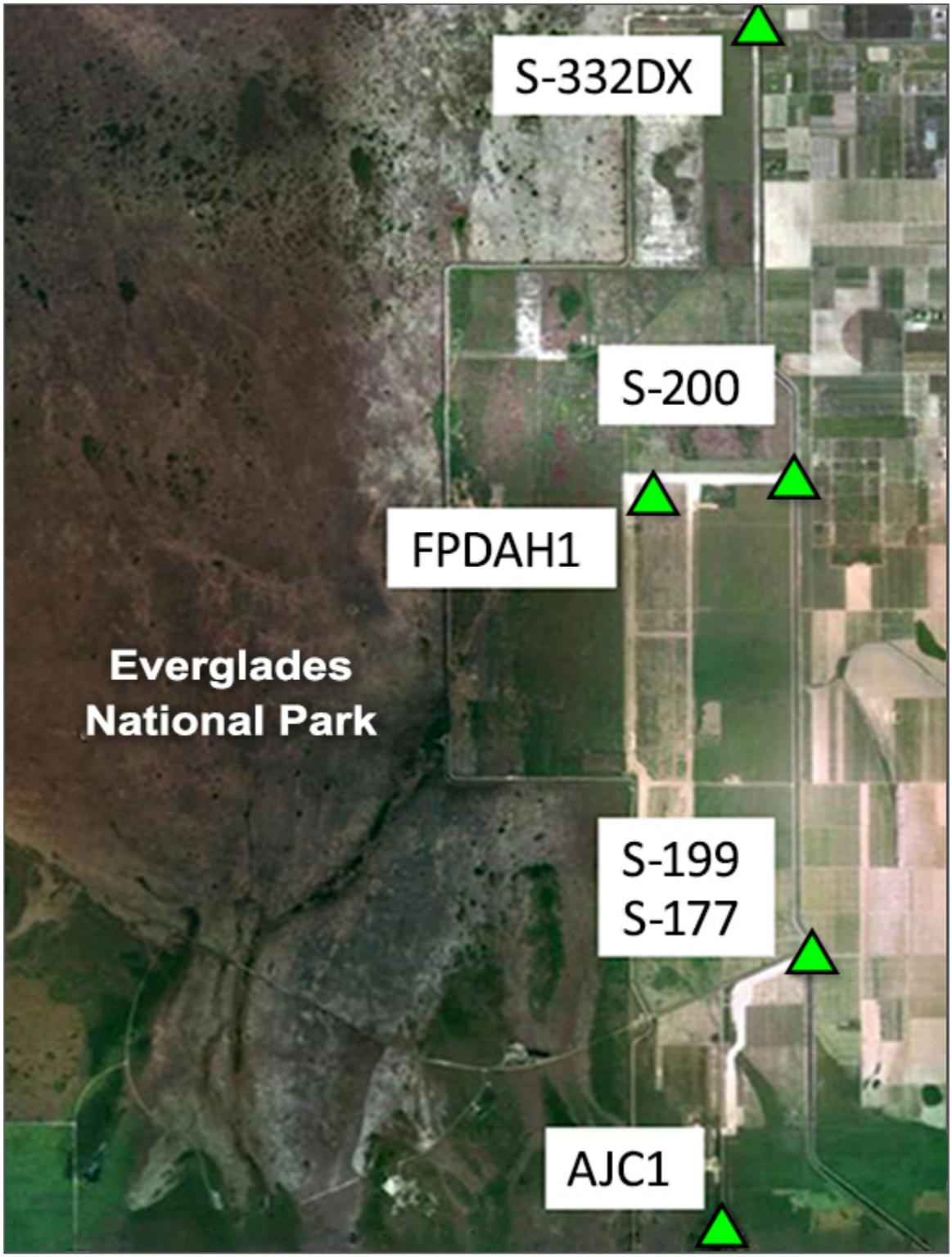

Figure 10. Water quality and fish monitoring sites in the C-111 SCW Project area.

ASSESSMENT OF WATER QUALITY DATA

All water quality samples were collected at a 0.5-meter depth from the water surface. At sampling sites of S-200 and AJC1, physical parameters and grab samples for nutrients were collected weekly if structures recorded flows. At the other monitoring sites, water quality grab samples and physical parameters were collected weekly if flowing, otherwise monthly.

Physical Parameters

Physical parameters analyzed for the project include temperature, dissolved oxygen (DO), pH, specific conductance, turbidity, and total suspended solids (TSS). Temperature, DO, pH, and specific conductance were measured in situ at the time of grab sample collection. Turbidity samples from S-177 were collected quarterly. TSS samples at S-177 were collected weekly if flowing, otherwise monthly. Samples at S-200 and Aerojet Canal were collected weekly if structures recorded flows for laboratory analysis. **Table 13** shows the surface water quality parameters of Florida Class III criteria required by the permit. **Table 14** shows the statistical summary of physical parameters, including the number of samples measured, the average, standard deviation, range of constituent concentrations, and selected data percentiles (25th, median, and 75th).

Table 13. Surface water quality parameters with Florida Class III criteria specified in Section 62-302.530, F.A.C.

Parameter	Units	Florida Class III Criteria
Dissolved Oxygen	milligrams per liter (mg/L)	No more than 10% of daily average DO saturation values shall be below 38% in the Everglades Bioregion or for instantaneous data the %DO values shall not exceed the 10% limit based on the calculated time-day specific translation (FDEP 2013)
Specific Conductance	microsiemens per centimeter (µS/cm)	Not > 50 percent of background or > 1,275 µS/cm, whichever is greater
pH		Not < 6.0 or > 8.5
Turbidity	nephelometric turbidity units (NTU)	≤ 29 NTUs above background conditions

Table 14. Statistical summary of physical parameters measured at C-111 SCW Project monitoring sites.[a]

Temperature (ºC)				Total Suspended Solids (mg/L)			
Statistics	**S-200**	**S-177 (S-199)**	**AJC1**	**Statistics**	**S-200**	**S-177 (S-199)**	**AJC1**
Count	37	44	38	Count	37	44	38
Average	26.3	26.6	26.2	Average	3	3	3
STD	1.1	1.4	1.4	STD	0.0	0.0	0.2
Minimum	22.9	21.7	22.4	Minimum	3	3	3
1st Quartile	25.8	25.7	25.2	1st Quartile	3	3	3
Median	26.4	26.7	26.4	Median	3	3	3
3rd Quartile	26.8	27.4	27.1	3rd Quartile	3	3	3
Maximum	28.7	29.2	28.8	Maximum	3	3	4
pH				**Dissolved Oxygen (mg/L)[b]**			
Statistics	**S-200**	**S-177 (S-199)**	**AJC1**	**Statistics**	**S-200**	**S-177 (S-199)**	**AJC1**
Count	37	44	38	Count	37	44	38
Average	N/A	N/A	N/A	Average	2	3	5
STD	N/A	N/A	N/A	STD	1	2	1
Minimum	7.1	7.1	6.9	Minimum	1	1	3
1st Quartile	7.3	7.4	7.4	Median	2	3	5
Median	7.3	7.5	7.5	Maximum	5	9	7
3rd Quartile	7.4	7.7	7.6	Excursions	31	26	2
Maximum	7.4	7.7	7.6	Excursion Rate	84%	59%	5%
Excursions	0 (41)	0 (42)	0 (43)	Compliance	Exceeds Criterion	Exceeds Criterion	Complies
Turbidity (NTU)				**Specific Conductance (µS/cm)**			
Statistics	**S-200**	**S-177 (S-199)**	**AJC1**	**Statistics**	**S-200**	**S-177 (S-199)**	**AJC1**
Count	N/A	4	3	Count	37	44	38
Average	N/A	1.4	1.0	Average	550	584	533
STD	N/A	N/A	N/A	STD	37	77	18
Minimum	N/A	0.9	0.7	Minimum	525	525	473
1st Quartile	N/A	N/A	N/A	1st Quartile	534	533	531
Median	N/A	1.6	N/A	Median	540	542	535
3rd Quartile	N/A	N/A	N/A	3rd Quartile	546	626	540
Maximum	N/A	0.0	0.0	Maximum	546	626	540
Excursions	N/A	0 (5)	0 (5)	Excursions	0 (41)	0 (42)	0 (43)

a. ºC – degrees Celsius; µS/cm – microsiemens per centimeter; mg/L – milligrams per liter; NTU – nephelometric turbidity units; STD – standard deviation; and N/A – not applicable. For excursions, the first number is the number of excursions and the number in parentheses is the total number of samples analyzed.

b. DO average, standard deviation, minimum, median, and maximum values are reported in mg/L. To be in compliance, a site's DO excursion rate must be less than or equal to 10%. Excursions were determined based on % DO saturation calculations provided in Attachment B.

All of the physical parameters consistently met the water quality criteria specified in Section 62-302.530, F.A.C. (**Table 14**), except DO at S-177 and S-200. **Figure 11** shows variations in the percent DO saturation during WY2015 at the three required monitoring sites. DO conditions at AJC1 were the best, with saturation lower than the limit 5 percent of the time, meeting the 10 percent Florida Class III criterion. DO at S-200 and S-199 showed more occurrences of events where the percent DO saturation was lower than the criterion. However, from the upstream site (S-200) to the downstream site (S-199), the DO excursion rate declined from 84 percent to 59 percent. In addition, AJC1, a downstream site, met the DO criteria and had the best DO condition among the three monitoring sites. The favorable DO conditions at AJC1 and the reduction of the DO excursion rate as water moved from upstream to downstream indicates that the C-111 SCW Project did not contribute to DO degradation in the project area.

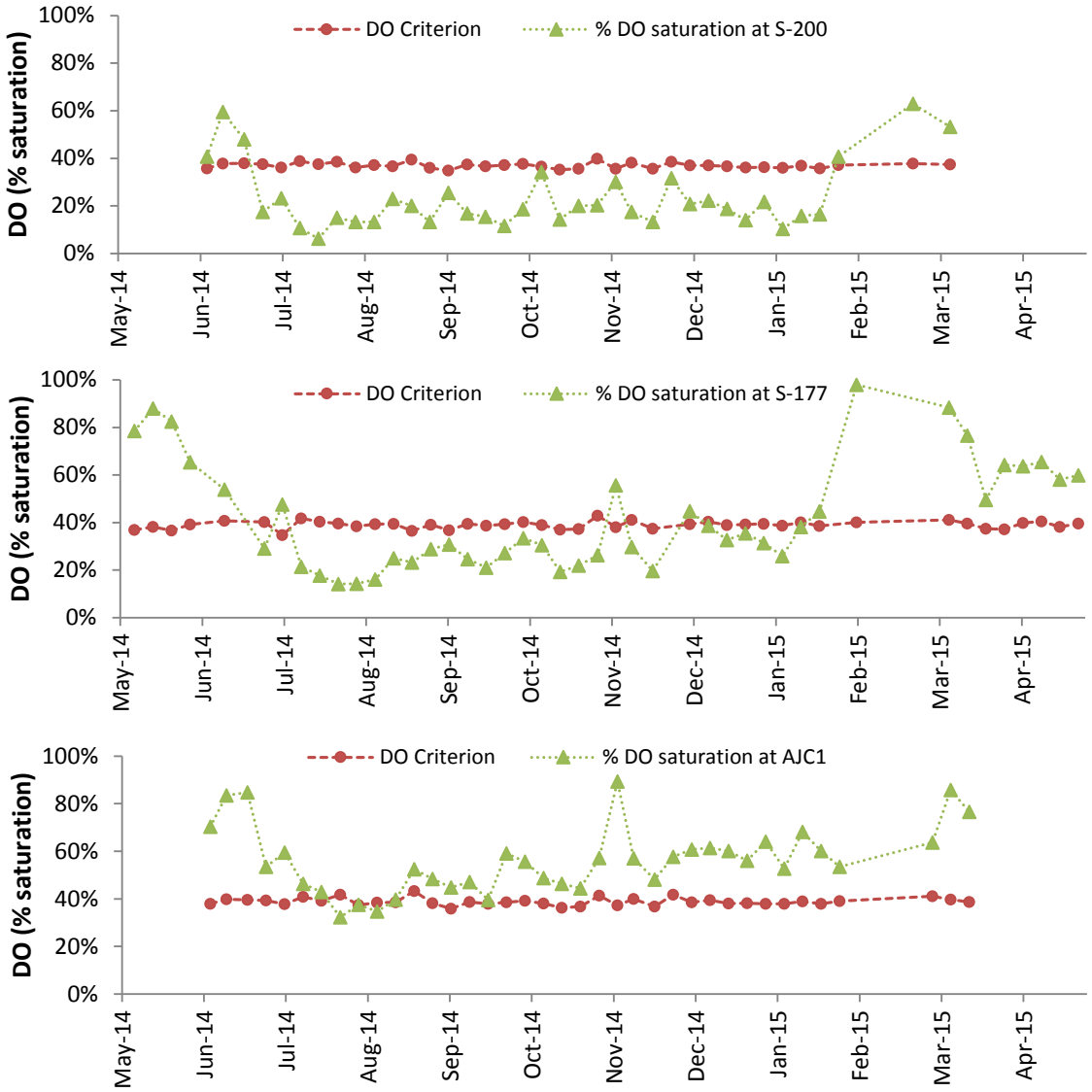

Figure 11. Percent DO saturation at three C-111 SCW Project monitoring sites during WY2015.

Water depths in the FPDA and Aerojet Canal were reported weekly when there were flows. Water level staff gauges were read and recorded when water quality samples were collected. Seasonal variations in water depth are shown in **Figure 12**. FPDA was shallow, with depth up to 3 feet (**Figure 12**, top panel). The maximum design depth in the FPDA is about 5 to 6 feet. If the water level is higher than the maximum depth, water will overflow to the east detention area through weirs. In WY2015, the FPDA started with a complete dry-out condition, and then was filled to 2 to 3 feet in June after pumping started. When S-200 stopped pumping in January 2015, the FPDA dried out quickly. Water depth in the Aerojet Canal varied between 22 and 25 feet (**Figure 12**, bottom panel). When S-199 stopped pumping in the dry season, water depth receded slightly, to about 22 feet.

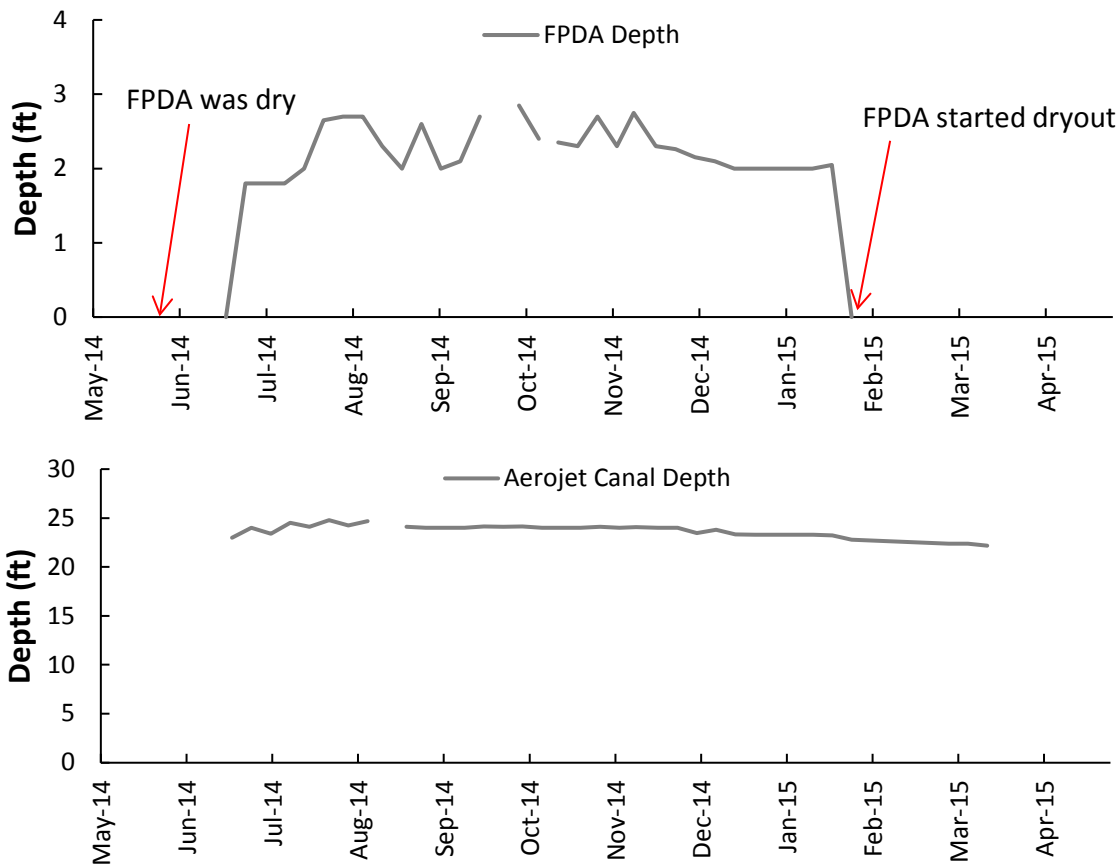

Figure 12. Depth changes in the FPDA (top) and Aerojet Canal (bottom) during WY2015.

Nutrient Parameters

Nutrient parameters analyzed include ammonia, total Kjeldahl nitrogen (TKN), nitrate + nitrite as N (NO_x), orthophosphate, and total phosphorus (TP). Nutrient data are summarized in **Table 15**, with individual measurements included in Attachment B. The statistical summary table reports the number of sample observations, the average, the standard deviation, the range of constituent concentrations, and selected data percentiles (1st quartile, median, and 3rd quartile). Nutrients in Class III criteria have narrative descriptions. The statistical tables provide basic information about water quality conditions in the project area.

For nitrogen constituents, TKN varied in a range of 0.55–1.33 milligrams per liter (mg/L), with higher values occurring in the dry season (**Figure 13**, top panel). Generally, AJC1 had lower concentrations than S-200 and S-177 in the C-111 canal. With respect to phosphorus, orthophosphate concentrations were low in the project area and were consistently below the detection limit, 2 mg/L. TP concentrations showed strong seasonal patterns with lows in the wet season and highs in the dry season. The average TP concentration at AJC1 was 11 mg/L (**Figure 13**, bottom panel), usually lower than the canal water. Because detention areas had lower TKN and TP concentrations than the canal water, the C-111 SCW Project does not appear to have caused or contributed to an increase in phosphorus or nitrogen in the area.

Table 15. Statistical summary of nutrient parameters at C-111 SCW Project monitoring sites for WY2015.[a]

Ammonia (NH_4) (mg/L)				Total Kjeldahl Nitrogen (TKN) (mg/L)			
Statistics	**S-200**	**S-177 (S-199)**	**AJC1**	**Statistics**	**S-200**	**S-177 (S-199)**	**AJC1**
Count	N/A	44	38	Count	37	44	38
Average	N/A	0.052	0.031	Average	0.631	0.730	0.552
STD	N/A	0.015	0.015	STD	0.129	0.268	0.038
Minimum	N/A	0.005	0.008	Minimum	0.530	0.520	0.500
1st Quartile	N/A	0.043	0.016	1st Quartile	0.570	0.560	0.530
Median	N/A	0.053	0.034	Median	0.600	0.580	0.540
3rd Quartile	N/A	0.060	0.042	3rd Quartile	0.620	0.908	0.570
Maximum	N/A	0.097	0.057	Maximum	1.140	1.330	0.680

Nitrate + Nitrite as N (NO_x) (mg/L)				Orthophosphate (OPO_4) (mg/L)			
Statistics	**S-200**	**S-177 (S-199)**	**AJC1**	**Statistics**	**S-200**	**S-177 (S-199)**	**AJC1**
Count	37	41	36	Count	37	44	38
Average	0.022	0.037	0.026	Average	0.002	0.002	0.002
STD	0.026	0.044	0.008	STD	0.000	0.000	0.000
Minimum	0.005	0.005	0.011	Minimum	0.002	0.002	0.002
1st Quartile	0.005	0.007	0.020	1st Quartile	0.002	0.002	0.002
Median	0.012	0.012	0.027	Median	0.002	0.002	0.002
3rd Quartile	0.026	0.070	0.031	3rd Quartile	0.002	0.002	0.002
Maximum	0.120	0.156	0.053	Maximum	0.002	0.003	0.003

Total Phosphorus (TP) (mg/L)				
Statistics	**S-200**	**S-177 (S-199)**	**S-18C**	**AJC1**
Count	36	43	56	37
Average	0.006	0.007	0.004	0.005
STD	0.003	0.005	0.002	0.002
Minimum	0.004	0.004	0.002	0.003
1st Quartile	0.005	0.004	0.002	0.004
Median	0.005	0.005	0.003	0.004
3rd Quartile	0.006	0.007	0.004	0.005
Maximum	0.019	0.030	0.012	0.011

a. mg/L – milligrams per liter; STD – standard deviation; and N/A – not applicable.

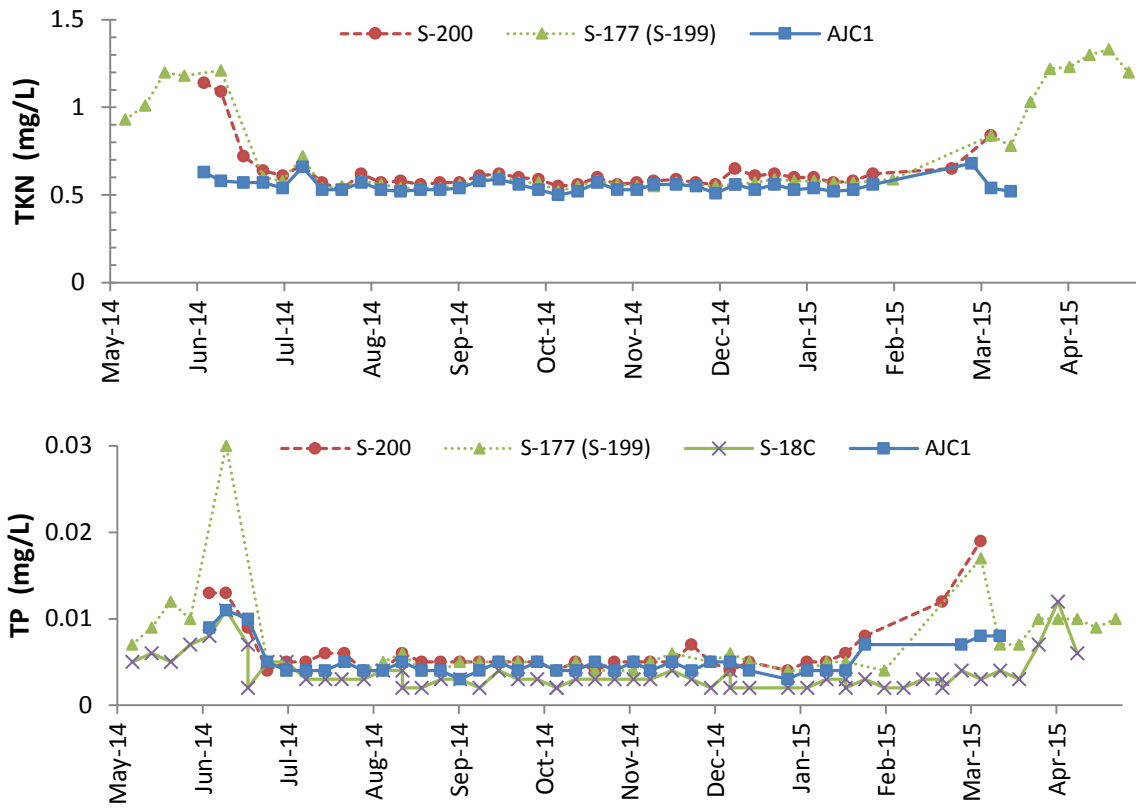

Figure 13. TKN (top) and TP (bottom) variations at C-111 SCW Project monitoring sites during WY2015.

ECOLOGICAL MONITORING SUMMARY

For this project, ecological monitoring includes (1) hydroperiods in the Southern Glades and Model Lands and (2) coastal zone salinities in Florida Bay. Additional reporting on Taylor Slough and Florida Bay can be found in Chapter 6 of Volume I of this SFER.

HYDROPERIODS

C-111 SCW Project features are intended to restore more natural (pre-drainage) hydroperiods within the Southern Glades and Model Lands. Through partnerships between SFWMD and other government agencies, including ENP, USGS, and USACE, real-time water level data are collected at hundreds of water level gauges throughout the District's boundaries. In order for these data to be meaningful for reporting hydroperiods within the Southern Glades and Model Lands, SFWMD staff expanded the domain of the existing South Florida Water Depth Assessment Tool (SFWDAT), and developed a project-specific post-processing query for the project area, which routinely produces annual hydroperiod maps for the area of interest.

The SFWDAT interpolates between hundreds of existing water level gauges to produce spatially continuous estimates of mean daily surface water elevations for hydrologically distinct basins. Water depth surfaces are calculated by subtracting the best available ground surface elevation (or gridded elevation models) from the interpolated water elevation surfaces, and the resultant water depths are summarized by color ramped hydroperiod maps.

Inundated days (**Table 16**) represent the average of tens of thousands of cells for the two zones, the Southern Glades and Model Lands, in a 30-day period. Therefore, the annual hydroperiod is calculated in terms of a total of 360 days. The Southern Glades was inundated most of the wet season. In April of the dry season, scattered areas of higher ground were exposed. The hydroperiod of the Model Lands was shorter than that of the Southern Glades. Even in the wet season, a small area in the Model Lands remained exposed. The average hydroperiod in WY2015 was 262 days in the Southern Glades, and 181 days in the Model Lands. **Figure 14** shows a map of hydroperiods around the C-111 SCW Project area for WY2015.

Table 16. Hydroperiods in the Southern Glades and Model Lands.

Month	Days Inundated (30-day period)	
	Southern Glades	Model Lands
May 2014	10	9
Jun 2014	23	15
Jul 2014	27	19
Aug 2014	27	20
Sep 2014	26	21
Oct 2014	26	19
Nov 2014	26	17
Dec 2014	25	16
Jan 2015	24	15
Feb 2015	20	13
Mar 2015	15	9
Apr 2015	12	7
WY2015 Hydroperiod (360-day period)	262	181

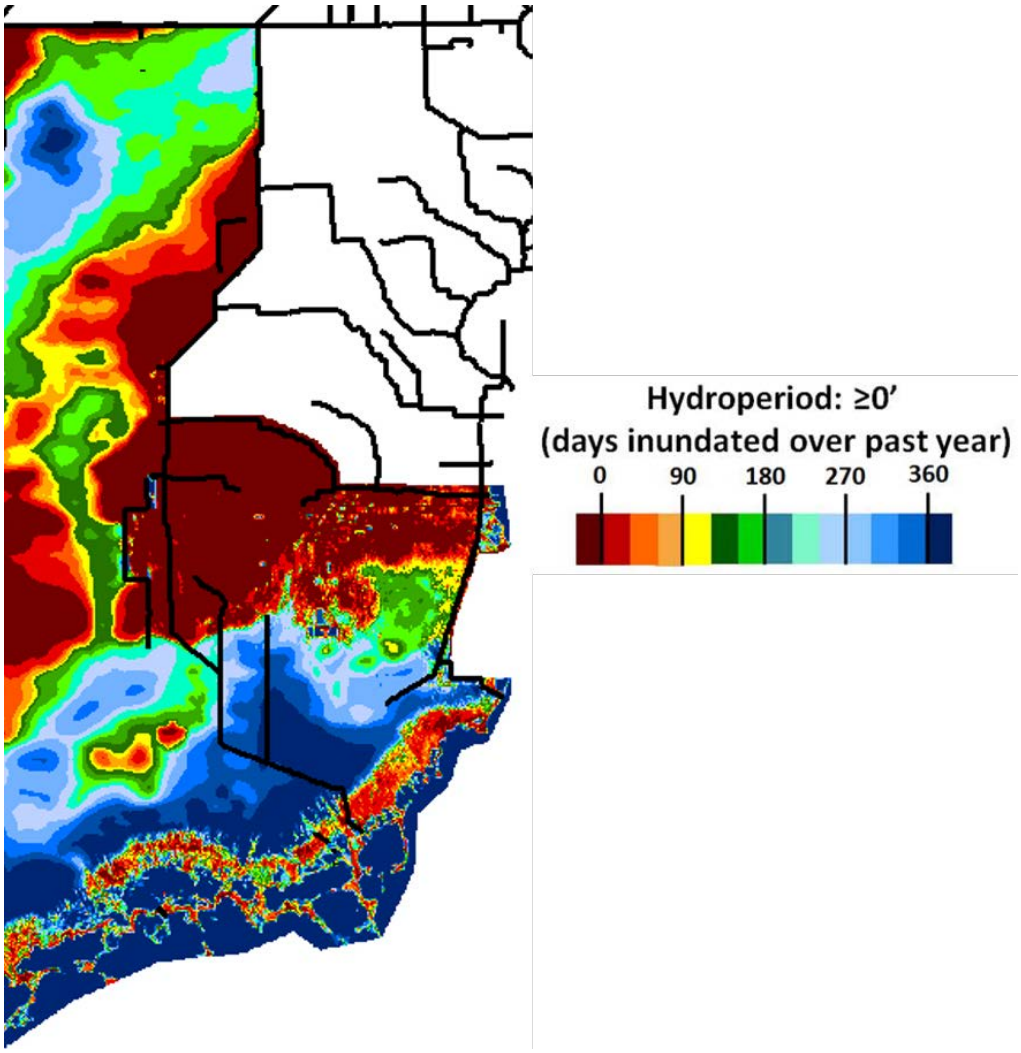

Figure 14. WY2015 hydroperiods in the C-111 SCW Project area.

COASTAL ZONE SALINITY

Because of improved timing, distribution, and flows within Taylor Slough, the C-111 SCW Project is expected to improve (reduce) salinities within the nearshore Florida Bay embayments. Modeling associated with the project indicated that the net improvement of salinity concentrations in the nearshore embayments could be about 3 percent. With less frequent gate openings at S-197, salinities within Manatee Bay are anticipated to increase correspondingly. However, salinity can be affected by a multitude of factors, including freshwater inflows, tides, wind, and currents. Long-term monitoring data, covering both with and without project conditions, are needed to detect the overall impact of the project on salinity in Florida Bay. This section summarizes salinity monitoring data collected in WY2015.

Continuous measurements of salinity were recorded at five stations: four in the lower Taylor Slough by USGS (McCormick Creek at Terrapin Bay, Upper Taylor River, Taylor Mouth, and Trout Creek at Joe Bay), and one in Manatee Bay by the District. USGS data were collected as part of the CERP Restoration Coordination and Verification Program/USGS funded Coastal Gradients project. The locations of these sites are shown in **Table 17** and **Figure 15**. Salinity data were recorded every 15 minutes at all stations.

Table 17. Salinity monitoring sites in the C-111 SCW Project area.

Site	Latitude	Longitude	Agency	Description
TB – Terrapin Bay (USGS site name: McCormick Creek)	25°10'05.50"	80°44'00.92"	USGS	Approximately 500 feet upstream of the mouth, 17 miles east of Flamingo.
TR – Taylor River (USGS site name: Upstream Taylor River)	25°12'37.07"	80°38'51.60"	USGS	Located upstream on the left bank, approximately 12 miles northwest of Key Largo.
TM – Taylor Mouth (USGS site name: Taylor River Mouth)	25°11'26.14"	80°38'20.59"	USGS	Located at the mouth of Taylor River on the left bank, approximately 10 miles northwest of Key Largo.
TC – Trout Creek (USGS site name: Trout Creek)	25°12'53.66"	80°32'00.61"	USGS	Located on left bank, 100 feet upstream of mouth of Trout Creek, 10 miles northwest of Key Largo.
MBTS – Manatee Bay Temperature & Salinity	25°14'21.9"	80°25'18.1"	SFWMD	Manatee Bay, approximately 4 miles from Gilbert's Resort, Overseas Highway boat ramp, Key Largo.

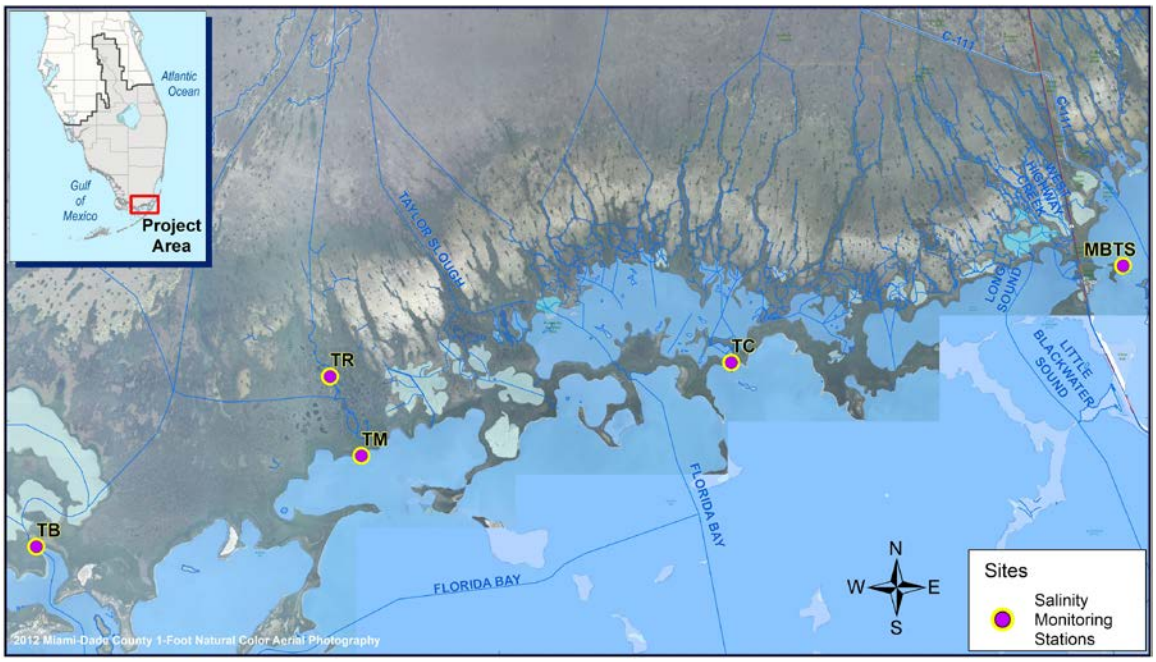

Figure 15. Salinity monitoring stations in Florida Bay.
[Note: TB – Terrapin Bay; TR – Upstream of Taylor River; TM –Taylor Mouth; TC – Trout Creek; and MBTS – Manatee Bay.]

Table 18 shows a statistical summary of daily salinity data collected in WY2015, and **Figure 16** shows monthly average salinity at the five monitoring sites during WY2015 versus the historical monthly average salinity during May 2002 to April 2012. Overall, salinities at all stations

showed a strong seasonal pattern, with lower salinity in the wet season and higher salinity in the dry season. Hypersalinity (higher than 35), a typical phenomenon in Florida Bay, lasted 5 months at Manatee Bay and Terrapin Bay in May–July 2014 and March–April 2015. Trout Creek experienced 4 months of hypersalinity in May–June 2014 and March–April 2015. Salinity also varied greatly with location. The Taylor River station, located in the upstream Taylor Slough, had the lowest mean and median salinity among the five monitoring sites due to freshwater discharges from Taylor Slough. At the downstream sites, such as Taylor Mouth, salinity increased. Trout Creek and Terrapin Bay also had relatively low salinity in the wet season. Manatee Bay, the northernmost station, had the highest salinity among the five sites due to reduced freshwater inputs from the C-111 canal (S-197 was closed in WY2015).

Because WY2015 was a dry year, salinity in Florida Bay was higher than the pre-project period and the recent post-project years (2013 and 2014) for most of the water year (**Figure 16**). This is contrary to what was observed since implementation of the C-111 SCW Project in June of 2012, which indicated conditions in Taylor Slough had been wetter than average (lower salinity and higher flow than historical averages). Determination of the relative contribution of rainfall and the C-111 SCW Project will require additional data collection and assessment during a wide range of meteorological conditions covering both wet and dry years.

Table 18. Statistical summary of salinity in Florida Bay in WY2015.

Daily Average Salinity	Terrapin Bay	Taylor Mouth	Upstream of Taylor River	Trout Creek	Manatee Bay
Minimum	18	8	1	6	29
Mean	32	25	15	28	34
Maximum	47	38	37	40	40
< 15	0	11	203	32	0
≥ 15 & < 25	48	169	56	96	0
≥ 25 & < 30	88	88	39	54	8
≥ 30 & < 35	106	69	51	105	230
≥ 35	120	27	16	78	127
Pre-project Mean	24	19	11	21	29
Range of Pre-project Data	2002–2011	2002–2011	2007–2011	2002–2011	2002–2011

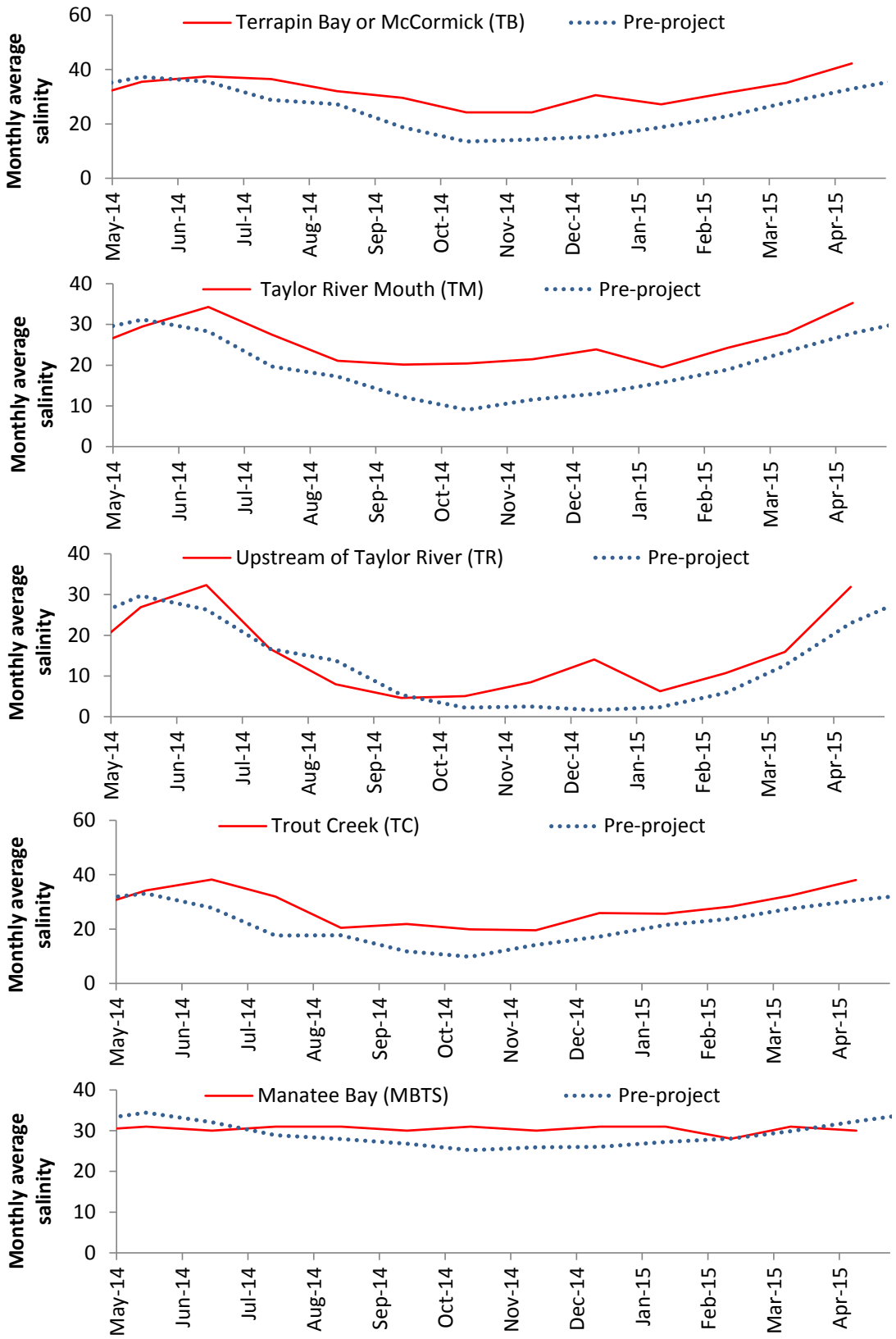

Figure 16. Monthly average salinity in WY2015 versus pre-project (2002–2011) in Florida Bay.

BIOLOGICAL OPINION

The C-111 SCW Project operation implemented the terms and conditions described in the biological opinion. Results were reported to the USFWS and are available upon request.

MERCURY

The District is mandated to implement tier-wise monitoring and evaluation of mercury in specific media in restoration projects as described in A Protocol for Monitoring Mercury and Other Toxicants (Protocol) (FDEP and SFWMD 2011). The C-111 SCW Project is currently under Phase 2 - Tier 1: Routine Monitoring during Stabilization Period. Surface water is collected quarterly for total mercury (THg) and methylmercury (MeHg) analysis. Mosquitofish (*Gambusia holbrooki*) composite samples will be collected quarterly while large-bodied fish (sunfish, *Lepomis sp.* and largemouth bass, *Micropterus salmoides*) will be collected annually for THg analysis at designated stations described in the C-111 SCW Project mercury and other toxicants monitoring plan. Surface water samples were collected at station S332DX located at the eastern end of the land in front of the S-332D structure. Mosquitofish composite and large-bodied fish were collected at station AJC1 in the Aerojet Canal south of the fish farm, and station FPDAH1 in the FPDA Header Canal. Preliminary results and evaluation of samples taken during the second year of Phase 2 – Tier 1 monitoring are presented below.

SURFACE WATER ASSESSMENT

Surface water samples were collected at station S332DX quarterly for THg and MeHg analysis (**Table 19**). THg levels ranged from 0.31 to 1.20 nanograms per liter (ng/L), with an average of 0.55 ng/L, well below the United States Environmental Protection Agency (USEPA) standard of 12 ng/L. The THg level fluctuated over time and there was no apparent trend of change during WY2015. MeHg levels ranged from 0.022 to 0.035 ng/L, with an average of 0.027 ng/L. The MeHg level increased within a narrow range for three consecutive quarters during WY2015.

Table 19. Surface water THg and MeHg levels in station S332DX during the quarterly collection in WY2015.

Collection Date	THg (ng/L)	MeHg (ng/L)
7/23/2014	0.32	0.022
10/30/2014	0.36	0.022
2/11/2015	0.31	0.028
4/15/2015	1.20	0.035

MOSQUITOFISH ASSESSMENT

Quarterly composite samples (n = 1 per station) of mosquitofish (≥ 100 fish/composite) were collected at stations AJC1 and FPDAH1 for THg determinations during WY2015. The THg level for mosquitofish varied from 0.026 to 0.035 milligram per kilogram (mg/kg), with an average of 0.025 mg/kg at AJC1. Only three composite samples were collected at FPDAH1, with an average of 0.021 mg/kg. None of the values exceeded the USEPA standard for trophic level 3 (TL3) fish (THg = 0.077 mg/kg) for wildlife protection (**Table 20**).

Table 20. THg (mg/kg) in quarterly mosquitofish composite samples collected during WY2015.

Collection Date	AJC1	FPDAH1
7/31/2014	0.026	0.041
10/7/2014	0.008	0.007
1/22/2015	0.032	0.016
4/6/2015	0.035	ND[a]
Average	0.025	0.021

a. ND – No collection due to dry out.

LARGE-BODIED FISH ASSESSMENT

Annual collection of sunfish (n = 5) and largemouth bass (n = 5) at AJC1 and FPDAH1 was performed during WY2015. Five bluegill sunfish and five largemouth bass were collected at AJC1, while no largemouth bass were collected at FPDAH1. The target size range (total length) for sunfish is from 102 millimeter (mm) to 178 mm. The target size range for largemouth bass is from 307 mm to 385 mm (FDEP and SFWMD 2011). All five sunfish collected from each site were bluegill sunfish (*Lepomis macrochirus*) and were within the target size ranges. Three of the five largemouth bass collected at AJC1 were also within the target size range, while no bass were collected from FPDAH1 as the result of dry out.

Results show that at AJC1, the bluegill sunfish THg level ranged from 0.049 to 0.338 mg/kg, with an average of 0.171 mg/kg, while the largemouth bass THg level ranged from 0.591 to 1.130 mg/kg, with an average of 0.802 mg/kg. At FPDAH1, the sunfish THg level varied from 0.008 to 0.015, with an average of 0.010 mg/kg (**Table 21**). Both sunfish and largemouth bass collected at AJC1exceeded the USEPA THg standard (0.077 mg/kg for TL3 fish, and 0.346 mg/kg for TL4 fish).

Table 21. THg (mg/kg) in large-bodied fish collected on October 8, 2014.

Species	AJC1			FPDAH1		
	Average	SD[a]	Count	Average	SD	Count
Bluegill Sunfish	0.171	0.119	5	0.010	0.004	5
Largemouth Bass	0.802	0.238	5	ND[b]	ND	0

a. SD – standard deviation
b. ND – no data

SUMMARY

In summary, mercury levels in surface water and fish samples were measured during the project second year Phase 2 - Tier 1 monitoring period (WY2015). Surface water THg levels were below the USEPA standard, and mosquitofish THg levels at both stations did not exceed USEPA standard. Bluegill sunfish and largemouth bass collected at AJC1 exceeded the USEPA TL3 and TL4 fish standard.

LITERATURE CITED

FDEP. 2013. Technical Support Document, Derivation of Dissolved Oxygen Criteria to Protect Aquatic Life in Florida's Freshwaters and Marine Waters. DEP-SAS-001/13, Florida Department of Environmental Protection, Tallahasee, FL. March 2013.

FDEP and SFWMD. 2011. A Protocol for Monitoring Mercury and Other Toxicants. Florida Department of Environmental Protection, Tallahasee, FL, and South Florida Water Management District, West Palm Beach, FL.

RECOVER. 2014. 2014 Systems Status Report. Restoration Coordination and Verification Program, United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2013. Preliminary Project Operating Manual, C-111 Spreader Canal Western Project. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2015a. Chemistry Laboratory Quality Manual, SFWMD-LAB-QM-2015-01, South Florida Water Management District, West Palm Beach, FL. Effective February 6, 2015.

SFWMD. 2015b. Field Sampling Quality Manual, SFWMD-FIELD-QM-001-08.2, South Florida Water Management District, West Palm Beach, FL. Effective January 15, 2015.

SFWMD. 2015. Summary and Conclusion of Effects of C-111 SCW Project on Adjacent Land, letter to USACE regarding C-111 Spreader Canal Phase I Western (C-111 SCW) Project, January 2015. South Florida Water Management District, West Palm Beach, FL.

USACE and SFWMD. 2011. Central and Southern Florida Project Comprehensive Everglades Restoration Plan C-111 Spreader Canal Western Project Final Integrated Project Implementation Report and Environmental Impact Statement. United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.

Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions, actions taken, and cross-references presented in this report for the C-111 Spreader Canal Phase 1 (Western) Project (CERPRA permit 0293559-009).

Specific Condition	Description	Applicable Phase	Action Taken	Included in This Report in:			
				Narrative (page #s)	Figure	Table	Attachment
2	Threatened and Endangered Species	Construction and Operation	No action needed				
3	Contaminated Sites and Residual Agrichemicals	Construction and Operation	No contamination found after initial operations.				
4	Wetland Impact and Restoration	Operation	Routine operation followed the Preliminary Project Operating Manual (SFWMD 2013).				
13	Water Quantity, Water Quality, and Flooding Impacts	Operation	Hydrometeorological monitoring has been expanded, and more data will be collected to determine whether the project adversely impacts adjacent lands in terms of flooding.	7–27	2–13	5–15	B, C
22	Project Operation Plan	Operation	Operation was consistent with the Preliminary Project Operating Manual (SFWMD 2013).	5–6		3–4	
23	Water Quality Compliance, Hydrometeorological and Ecological Monitoring Plans	Operation	Water quality and ecological monitoring plans, as well as compliance reporting, were consistent with those approved in the November 2012 permit modification. Reporting of hydrometeorological monitoring was expanded to address potential flooding impacts associated with Specific Condition 13.	11, 19, 27	2		
24	Pump Testing and Maintenance	Operation	Pumps were in operation most of the time.				
25	Emergency Discharge Frog Pond Detention Area	Operation	No action needed.				
26	Public Health, Safety, and Welfare	Operation	Discharges did not pose a serious danger to public health/safety/welfare.				
27	Water Quality Monitoring	Operation	Water quality monitoring was conducted as required.	19–27	10–13	12–15	B, C
28	Start-up Monitoring for Frog Pond Detention Area (modified in 0293559-006)	Operation	Not needed				

Table A-1. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Included in This Report in:			
				Narrative (page #'s)	Figure	Table	Attachment
29	Mercury and Pesticide Monitoring	Operation	Mercury monitoring was conducted as required.	33–34		19–21	B
30	Removal of Monitoring Requirements	Operation	Not needed				
31	Addition of Monitoring Requirements	Operation	Not needed				
32	Facility Inspection Plan and Reports	Operation	Not needed; permit modification 0293559-009, issued October 29, 2014, changed the inspection reporting period to every five years.	4–5			
33	Construction Status Report	Construction	Not needed				
34	As-Built Certification and Record Drawings	Construction	Not needed				
35	Annual Reports	Operation	Annual report completed and submitted as required	All	All	All	All
36	Emergency Suspension of Sampling	Operation	Not needed				
39	Permit Renewal	All	The District requested a permit renewal, which was received by FDEP on August 1, 2014, and issued in WY2016, on December 16, 2015.	1, 4–5		1	

Attachment B: Water Quality Data

This project information is required by Specific Condition 35 of the C-111 Spreader Canal Phase 1 (Western) Project permit (0293559-009), and is available upon request.

Attachment C: Hydrologic Data

This project information is required by Specific Condition 35 of the C-111 Spreader Canal Phase 1 (Western) Project permit (0293559-009), and is available upon request.