Appendix 4-2: Annual Permit Report for the Taylor Creek Stormwater Treatment Area

Permit Report (May 1, 2013–April 30, 2014)
Permit Number: 0194485

Odi Villapando

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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:	Taylor Creek Stormwater Treatment Area
Permit Number:	0194485-011-GL
Issue and Expiration Dates:	Issued: 12/16/2011; Expires: 6/9/2016
Project Phase:	Post Stabilization
Permit Specific Condition Requiring Annual Report:	16
Reporting Period:	May 1, 2013–April 30, 2014
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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 2014 (WY2014) (May 1, 2013–April 30, 2014), the Taylor Creek Stormwater Treatment Area (TC-STA) was in its second year of post-stabilization operation.

CONCLUSIONS REGARDING PROJECT SUCCESS

The project demonstrated net reduction in both total phosphorus (TP) loads and concentrations. Please refer to the *STA Performance Evaluation* section of this report for more details.

PROBLEMS ENCOUNTERED

The project encountered operational challenges during the reporting period. These are detailed in the *Operation and Maintenance* section of the report, in the *Operations* sub-section. There were also performance issues, which are discussed in the *STA Performance Evaluation* section.

ACTIONS TO ADDRESS PROBLEMS

Implementation of the updated vegetation enhancement and management plan will remain the focus of stormwater treatment area (STA) optimization efforts in WY2015.

INTRODUCTION

PROJECT OVERVIEW

The TC-STA operating permit (0194485-002-GL) was issued to the South Florida Water Management District (SFWMD or District) on June 9, 2006, under the authority of the Lake Okeechobee Protection Act (LOPA), Chapter 373.4595, Florida Statutes (F.S.); Title 62, Florida Administrative Code (F.A.C.). Pursuant to Section 373.4595(7) of the LOPA, the FDEP's authority under Chapters 373 and 403, F.S. LOPA was subsumed by the Northern Everglades and Estuaries Protection Program (NEEPP) in 2007. The permit took effect on May 5, 2011 after the TC-STA project was transferred to the District by the United States Army Corps of Engineers (USACE), the federal sponsor of the project.

The TC-STA is one of two pilot-scale STAs being implemented north of Lake Okeechobee as part of the Lake Okeechobee Watershed Construction Project, Phase 1 (**Figure 1**). Constructed in April 2006, this two-celled STA has an effective treatment area of only 118 acres, which is fairly small compared to the Everglades STAs. The TC-STA was designed to remove 2.02 metric tons (mt) of TP from the Taylor Creek drainage basin per year (Goforth, 2005; Stanley Consultants, Inc., 2003).

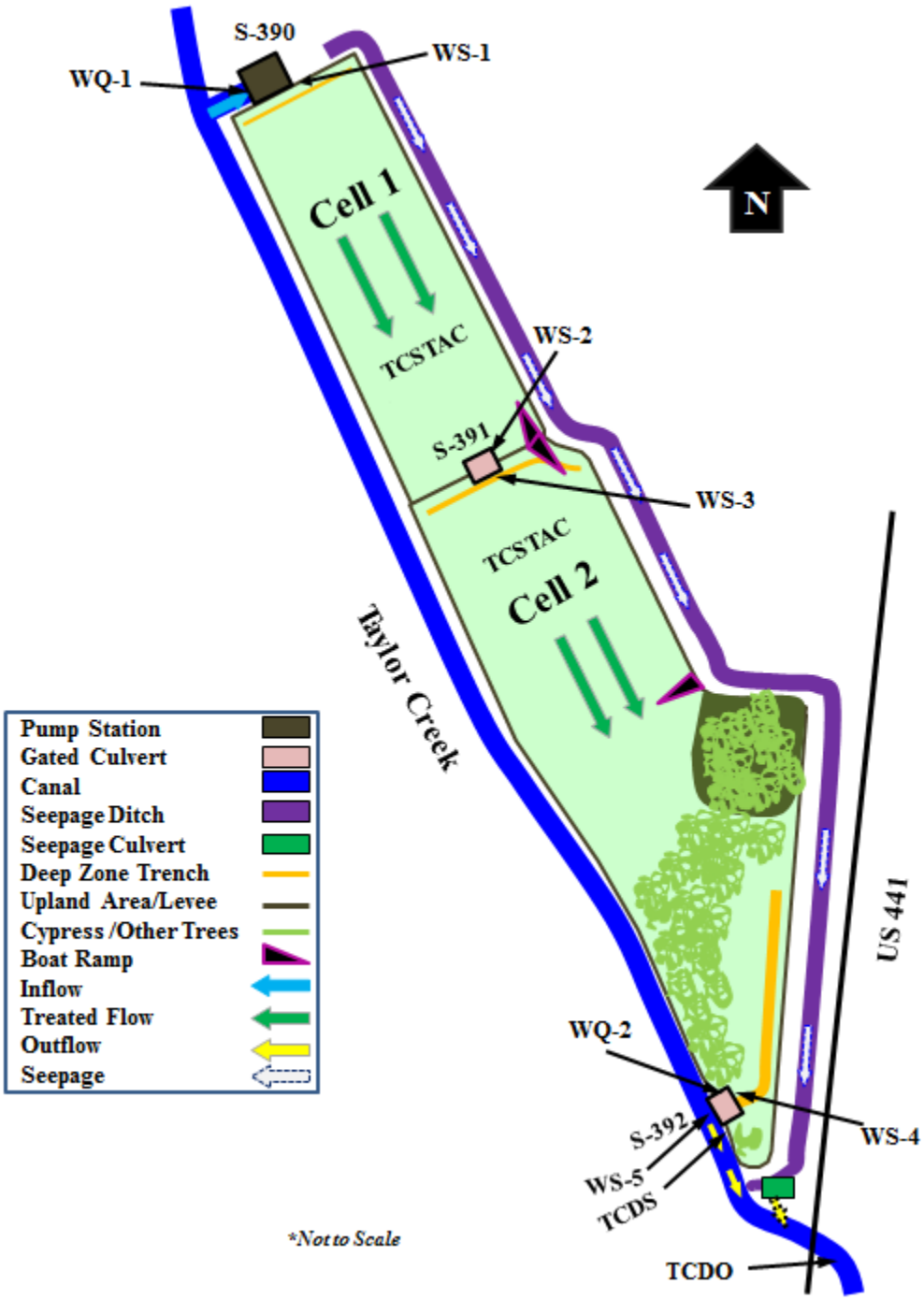

Figure 1. Schematic of TC-STA showing structures, flow, and water quality monitoring stations. [Note: WS - water stage sensor and WQ - water quality sample station; S-390 and S-392 are the permitted stations; TCDO is Taylor Creek downstream; TCSTAC and TCDS are fish-mercury monitoring stations.]

Flow-through operations at the TC-STA commenced on June 26, 2008. By the end of WY2014, the TC-STA had almost 46 months of flow-through. A detailed breakdown of flow-through by water year is provided in the *"STA Performance Evaluation"* section of this report.

This report summarizes TC-STA monitoring activities performed during WY2014, and provides an evaluation of monitoring data for permit compliance and project performance. The report has been submitted to the FDEP in accordance with Specific Condition 16 ("Annual Monitoring Reports") of the permit.

PERMIT HISTORY

The original LOPA permit and all modifications issued to the District and the USACE are as follows:

- 0194485-001, issued September 15, 2003, was the original permit for the construction and preliminary operations of the TC-STA (USACE).
- 0194485-002, issued June 9, 2006, with an expiration date of June 9, 2011, was the original operation permit for the project (District).
- 0194485-003, issued June 29, 2005, was a minor permit modification for dewatering activities during construction (USACE).
- 0194485-004, issued December 16, 2005, was a minor permit modification to change a water quality monitoring station (USACE).
- 0194485-005, issued April 20, 2007, was a minor permit modification to update water quality monitoring conditions (USACE).
- 0194485-006, issued August 22, 2008, was a minor permit modification to change the expiration date of the permit to September 15, 2009 (USACE).
- 0194485-007, issued June 26, 2009, was a minor permit modification to extend the expiration date of the permit to September 15, 2010 (USACE).
- 0194485-008, issued July 22, 2010, was a permit modification to extend the construction permit date through September 15, 2011 (USACE).
- 0194485-009, issued July 21, 2011, with an expiration date of June 9, 2016, was a five-year renewal of the original operation permit (District).
- 0194485-010, issued October 7, 2011, was a permit modification to discontinue pesticides monitoring (District).
- 0194485-011, issued December 16, 2011, was a permit modification for construction of a recreational boardwalk facility (District).

OPERATION AND MAINTENANCE

OPERATIONS

During the first quarter of WY2014, the TC-STA was in the midst of a drawdown, in a continuing effort to enhance vegetation conditions in the STA. Pumping was suspended while water levels in the STA were being incrementally drawn down. By the end of May 2013, water levels were down to 0.30 and 0.50 feet (ft) in Cells 1 and 2, respectively (**Figure 2**). New plantings were completed in mid-June 2013, and pumping operation was resumed on July 30, 2013. Initially, pumping was done with one unit only to gradually bring the water levels back to normal stage while allowing the new plants to be established. The STA returned to normal operations on August 21, 2013. Two of the four 6-cubic feet per second (cfs) pumps were operated continuously, except for a few days in September 2013, when the STA was taken offline for another planting activity in Cell 2. During this period, water levels were maintained at about 1.30 ft in both cells (**Figure 2**). In late-October 2013, the STA started to show reversals in weekly TP concentrations. As a management strategy, the pumping rate was reduced from 12 to 6 cfs per day in an attempt to help the STA rebound by increasing the hydraulic retention time (HRT) within the STA. Pumping rate was maintained at 6 cfs per day for the remainder of WY2014. There were sightings of migratory birds in the STA during WY2014 that required operational changes. Water depths were maintained near 0.3 ft in Cell 1, and 0.6 ft in Cell 2, between June 5 and June 22, 2013, to avoid negative impacts (e.g., flooding) to the ground-nesting black-necked stilts (*Himantopus mexicanus*).

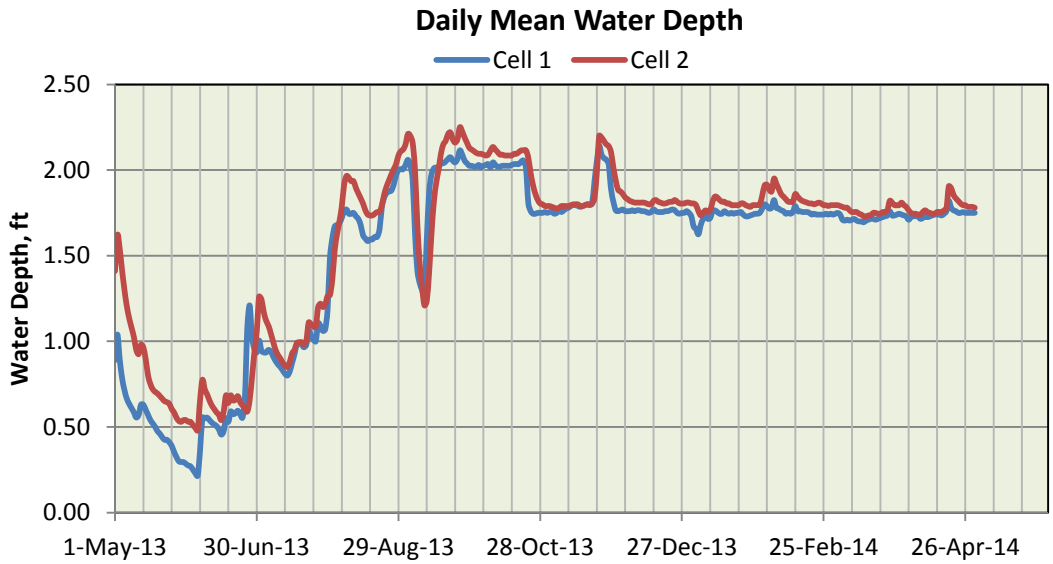

Figure 2. Daily mean water depth in feet (ft) in Cells 1 and 2 of the TC-STA during WY2014.

VEGETATION MANAGEMENT

The implementation of the updated Interim Vegetation Management Enhancement and Maintenance Plan for Taylor Creek STA (Toth, 2012) continued in WY2014 with drawdown activities conducted from mid-April 2013 through the end of July 2013. Drawdown is a routine practice in the management of wetlands that helps rejuvenate existing emergent vegetation such as bulrush (*Schoenoplectus californicus*) and cattail (*Typha spp.*), and allows the colonization and recruitment of cattail seedlings. Water levels in the TC-STA were drawn down to encourage more cattail growth and to plant emergents in areas where there was little or no vegetation and associated permanent phosphorus (P) removal mechanisms. Prior to WY2013, emergent vegetation covered only about 20 percent of Cell 1, with the remainder of the cell being dominated by dense beds of submerged aquatic vegetation such as hydrilla (*Hydrilla verticillata*) and coontail (*Ceratophyllum demersum*). The natural recruitment of cattail and plantings of alligator flag (*Thalia geniculata*) and bulrush conducted in both cells of the STA during drawdown increased the emergent vegetation coverage to 75 percent in Cell 1 and 55 percent in Cell 2. In September 2013, additional plantings of alligator flag were conducted in Cell 2. By the end of WY2014, the emergents provided almost 95 percent coverage in Cell 1 and about 75 percent in Cell 2 (**Figure 3**). The increase in emergent vegetation coverage should help in establishing a reliable and sustainable treatment system with maximum P uptake capability (Toth, 2012).

Figure 3. Emergent vegetation coverage in Cell 1 (left, facing southeast) and Cell 2 (right, facing southeast) following drawdown (photos by SFWMD).

The elimination of plant species that do not contribute to the primary goal of P uptake and removal and species that can impact cover of desirable species for water quality treatment or STA function was one of the goals of the updated vegetation management plan (Toth, 2012). In WY2014, plant control efforts focused on the treatment of water lettuce (*Pistia stratiotes*). Water lettuce is by far the most difficult species to control because it can rapidly form dense mats during summer months. It has the potential to clog the outflow structure and impact the existing cover of submerged aquatic vegetation. A combination of diquat, a non-selective contact herbicide, and flumioxazin, a new, more selective herbicide, was used to control water lettuce around and within existing stands of emergent vegetation in both cells of the STA. During WY2014, the District treated 42 acres (17 hectares), and sprayed 234 ounces (7.3 quarts) of flumioxazin and 192 ounces (6 quarts) of diquat to treat water lettuce infestations in the STA (**Table 3**). This information is being provided in compliance with Specific Condition 16D of the existing permit.

Table 3. Herbicide usage for routine control and maintenance of undesirable vegetation within the TC-STA during WY2014.

Spray Date	Herbicide Name	Application Rate (ounces per acre)[a]	Area Sprayed (acres)	Total Applied[b] (ounces)	Targeted Vegetation	Cell
24-Jul-13	Flumioxazin	6	6	36	Water lettuce	2
07-Nov-13	Flumioxazin	6	10	60	Water lettuce	1
07-Nov-13	Diquat	64	3	192	Water lettuce	1
08-Nov-13	Flumioxazin	6	3	18	Water lettuce	1
20-Nov-13	Flumioxazin	6	10	60	Water lettuce	1&2
04-Dec-13	Flumioxazin	6	10	60	Water lettuce	2
Total	Flumioxazin	6	39	234	Water lettuce	1&2
Total	Diquat	64	3	192	Water lettuce	1
Total	All	--	42	426	Water lettuce	1&2

[a] Application rate – ounce per acre
[b] Application rate x acres sprayed (ounces)

WILDLIFE SURVEY

The TC-STA was surveyed for wildlife activities within the treatment cells during WY2014. Surveys were conducted to protect migratory birds that can nest in the area from January to July. Six great blue heron (*Ardea herodias*) nests were first observed in the Cell 2 tree island in May 2013 (**Table 4**, **Figure 4**). The same number of nests was spotted again at the same location in March 2014 and April 2014. Active nests of black-necked stilts (*Himantopus mexicanus*) were first observed in TC-STA on June 5, 2013, and the presence of these nests continued through June 22, 2013. The black-necked stilt egg incubation period is approximately 23 days. Therefore, the observed nests must have been present for several days prior to the first observation since they were not observed again 17 days later, and black-necked chicks were observed during the June 22 survey. Since black-necked stilts are protected by the Migratory Bird Treaty Act, the following operational changes were necessary to avoid negative impacts (e.g., flooding) to the ground-nesting black-necked stilts during WY2014. Water depths were maintained below 0.3 ft in Cell 1, and 0.6 ft in Cell 2 of TC-STA between June 5 and June 22. No black-necked stilts were observed nesting during the remainder of WY2014.

Figure 4. Great blue heron nesting in Cell 2 of TC-STA (photo by SFWMD).

Evidence of successful nesting by several other avian species, such as mottled ducks (*Anas fulvigula*), pied-billed grebes (*Podilymbus podiceps*), and common gallinules (*Gallinula chloropus*) was observed within the STA during WY2014. Several Florida sandhill cranes (*Grus caroliniana pratensis*) have nested in TC-STA in past years, but there is no evidence of cranes nesting in the STA during WY2014.

As the TC-STA matures and the emergent vegetation expands, there will be fewer locations available for ground-nesting birds such as black-necked stilts to nest and forage in the STA. The significant increase in emergent vegetation coverage over the last two years may explain why the STA was utilized less by ground-nesting birds in WY2014 than it was historically.

Table 4. Results of migratory bird surveys conducted by District staff at the TC-STA during WY2014.

Survey Date	Observations
08-May-13	• No ground-nesting birds observed nesting in TC-STA • Approximately six great blue heron nests observed in Cell 2 tree island
08-Jun-13	• One black-necked stilt nesting in Cell 1 and one nesting in Cell 2
22-Jun-13	• No ground-nesting birds observed nesting in TC-STA • No more nesting surveys conducted during calendar year 2013
24-Jan-14	• No ground-nesting birds observed nesting in TC-STA
17-Feb-14	• No ground-nesting birds observed nesting in TC-STA
14-Mar-14	• No ground-nesting birds observed nesting in TC-STA • Approximately six great blue heron nests observed in the Cell 2 tree island
18-Apr-14	• No ground-nesting birds observed nesting in TC-STA • Approximately six great blue heron nests observed in the Cell 2 tree island

PERMIT MONITORING REQUIREMENTS AND COMPLIANCE

This section summarizes results of monitoring activities conducted during WY2014 and provides an evaluation of compliance with discharge requirements outlined in Specific Conditions 8 and 12 of TC-STA permit 0194485-002-GL. All monitoring activities were performed in accordance with Chapter 62-160, F.A.C. and the approved water quality monitoring plan (SFWMD, 2005), per Specific Condition 14 of the permit. Water quality data for WY2014 are included in Attachment B, and flow and rainfall data for WY2014 are summarized in Attachment C.

TOTAL PHOSPHORUS

WY2014 marked the second year of post-stabilization operation for the TC-STA. During the post-stabilization period, the STA was to be operated to maximize P load reductions to the extent practicable, consistent with the design objectives set forth in the *Taylor Creek STA Operation Plan* (Goforth, 2005). During the first quarter of WY2014, the TC-STA was in the midst of a drawdown as part of a continuing effort to enhance the vegetation conditions in the STA. Water levels were lowered to allow for natural recruitment of emergents and to plant wetland vegetation in open water areas of the STA. Hence, the TC-STA operated for nine full months only, and was not able to capture and treat high P waters from May to July 2013. During the nine-month flow-through period, the STA received 1.624 mt of TP from the Taylor Creek drainage basin and retained 0.629 mt, for a treatment efficiency of over 38 percent (**Table 9** in the *STA Performance Evaluation* section). While the TC-STA fell short of the target load reduction of 2.0 mt per year, the design treatment efficiency of 38 percent was met. These numbers are expected to improve as the emergent vegetation coverage in the STA continues to expand and provide P uptake and removal mechanisms. Should the STA not perform in a manner consistent with its design objectives after the first three years of post-stabilization operation, the District and the FDEP shall confer and develop an optimization plan designed to improve its performance.

DISSOLVED OXYGEN

In accordance with Specific Condition 8B of the existing operations permit, dissolved oxygen (DO) was monitored at the inflow (S-390), outflow (S-392), and downstream (TCDO) monitoring locations during WY2014. DO concentrations differed among locations for the smallest observation (sample minimum), median, mean, and largest observation (sample maximum) (**Table 5**). DO concentrations measured at the outflow showed higher variability than those collected at other locations. Range, defined simply as the difference between the minimum and maximum values, was 7.2, 10.4, and 5.8 milligrams per liter (mg/L) at the inflow, outflow, and downstream locations, respectively. The inflow had the highest mean value, 5.14 mg/L, while the downstream location had the highest median value, 4.89 mg/L. The lowest mean and median values were at the outflow station.

Table 5. DO compliance summary for TC-STA for WY2014.
[Note: minimum, median, mean, maximum, and standard deviation values are reported in mg/L; excursions were determined based on % DO saturation calculations provided in Attachment B].

Station	# of Obs.	Min	Median	Mean	Max	Std Dev	Excursions	Excursion Rate*	Compliance Status
S-390	34	2.14	4.76	5.14	9.35	1.69	2	5.9%	Compliance
S-392	34	0.34	2.09	2.83	10.70	2.83	22	66.7%	Non Compliance
TCDO	35	2.98	4.89	5.09	8.78	1.24	0	0%	Compliance

* To be in compliance, a station's excursion rate must not exceed 10 percent.

To determine whether the STA contributed to the degradation of DO in the downstream receiving waters, DO concentrations measured at the designated locations in the STA were evaluated using the new freshwater Class III criterion **(Table 6)**. The new freshwater DO standard states that no more than 10 percent of the daily average DO saturation (percent DO) values shall be below 38 percent in the Everglades bioregion for daily data, or for instantaneous

data (discrete measurements), the percent DO values shall not exceed the limit based on the calculated time-day specific translation (FDEP, 2013).

Table 6. Water quality parameters with Florida Class III surface water criteria specified in Section 62-302.530, F.A.C.

Parameter	Unit*	Class III Criteria
Dissolved Oxygen	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 Conductivity	µS/cm	Not greater than 50% of background or greater than 1,275 µS/cm, whichever is greater
pH	SU	Not less than 6.0 or greater than 8.5
Turbidity	NTU	Less than or equal to 29 NTU above background conditions
Alkalinity	mg/L	Not less than 20 mg/L
Unionized Ammonia	mg/L	Less than or equal to 0.02 mg/L

*mg/L – milligrams per liter
µS/cm – microSiemens per centimeter
SU – standard units
NTU – nephelometric turbidity unit

Dissolved oxygen conditions in the TC-STA were assessed using instantaneous DO data. Because DO data were collected as a concentration in mg/L, the values were first converted to percent DO saturation using the temperature measured at the same location. To assess compliance with the daily criterion, each measured DO level at a given time was compared to the calculated time-of-day–specific translation for that time. If the instantaneous DO is greater than or equal to the calculated value, the daily DO criterion is achieved (FDEP, 2013). For a monitoring location to be in compliance, the excursion rate for that site must not exceed 10 percent. Using this criterion, both the inflow and downstream monitoring locations were in compliance, with excursion rates of 5.9 and 0 percent, respectively (**Table 5**). The outflow failed to comply, with a 66.7 percent excursion rate.

The reduction in DO levels from inflow to outflow can be attributed to a combination of factors: (1) the highly colored water and heavy shading provided by cypress trees at the southern portion of the STA could be limiting light penetration, which reduces photosynthetic DO production; (2) decomposition of dead biomass from periodic spraying to control water lettuce and other undesirable plant species could result in elevated natural biological oxygen demand that depletes the oxygen in the water [the limited photosynthetic activity and high oxygen demand in many Florida freshwater systems results in naturally low DO levels, with values typically ranging down to 3.0 mg/L or less (FDEP, 2013)]; and (3) exceedances are fairly common in macrophyte-dominated wetlands where photosynthesis and respiration result in wide diel swings in DO levels (Ivanoff et al., 2013).

OTHER WATER QUALITY PARAMETERS

Water quality parameters with Florida Class III standards are identified in **Table 6**. Permit compliance for these parameters was evaluated as follows:

1. If the average outflow concentration does not exceed applicable criteria, then the STA is deemed in compliance.
2. If the average outflow concentration causes or contributes to an exceedance of applicable criteria, but does not exceed, or is equal to, the average inflow concentration, then the STA is deemed in compliance.
3. If the average outflow concentration causes or contributes to an exceedance of applicable criteria, and also exceeds the average inflow concentration, then the STA is deemed out of compliance.

Water year average inflow and outflow concentrations were compared to determine whether the STA contributed to an excursion for a specific parameter (**Table 7**). The median pH values were 7.05 at the inflow and 6.95 at the outflow, which are within the Class III pH limits of 6.0-8.5. Average specific conductivity at the inflow (482 microsiemens per centimeter [µS/cm]), was slightly lower than the average conductivity at the outflow (523 µS/cm) but both are well below the Florida Class III standard of 1,275 µS/cm. Average turbidity values of 6.47 and 3.96 nephelometric turbidity units (NTU) at the inflow and outflow stations, respectively, were much lower than the allowable turbidity value of 29 NTU. Alkalinity values were markedly greater than the Class III minimum standard of 20 mg/L, with an average of 79 mg/L at the inflow and 82 mg/L at the outflow. Unionized ammonia levels averaged 0.62 micrograms per liter (µg/L) at the inflow and 0.82 µg/L at the outflow, which are considerably lower than the Class III standard of 20 µg/L. Sulfate levels at the inflow and outflow stations averaged 57 and 62 mg/L, respectively. There was a substantial reduction in nitrate+nitrite-N (N represents nitrogen) from inflow to outflow, but slight decreases in orthophosphorus (OP) and total ammonia concentrations at the outflow were noted. Total nitrogen (Total Kjeldahl N + nitrate+nitrite-N) averaged 1.660 and 1.619 mg/L at the inflow and outflow, respectively. Average chloride concentrations at the inflow and outflow were 66 and 71 mg/L, respectively. As none of the water quality parameters with Class III standards caused or contributed to an excursion from applicable water quality standards in terms of average outflow concentrations, the TC-STA is deemed in compliance with Specific Condition 8C of the permit.

Table 7. Summary of other water quality parameters measured at the TC-STA during WY2014. [Note: includes number of excursions for parameters with Florida Class III surface water criteria, Section 62-302.530, F.A.C.]

Parameter[a]	# of Obs.	Mean[b]	Std Dev[c]	Min	Percentiles			Max	Excursions[d]
					25th	50th	75th		
Inflow (S-390)									
Water Temperature [degrees Celsius (°C)]	34	25.0	3.3	17.2	22.8	25.9	27.6	29.7	
Water pH	34	--	--	6.40	6.80	7.05	7.30	7.70	0(34)
Specific Conductivity (µS/cm)	34	482	202	147	263	526	644	763	0(34)
Total Suspended Solids (mg/L)	26	8.62	3.78	4.00	6.00	7.50	11.25	16.00	
Turbidity (NTU)	26	6.47	3.27	2.50	4.20	5.40	7.10	14.40	0(26)
Total Dissolved Solids (mg/L)	26	329	116	102	218	375	424	476	
Total Alkalinity (mg/L)	26	79	34	27	27	78	108	139	0(26)
Chloride (mg/L)	26	66	29	16	31	73	94	104	
Total Ammonia-N (mg/L)	25	0.108	0.111	0.005	0.019	0.054	0.161	0.371	
Unionized Ammonia (µg/L)	25	0.616	0.638	0.039	0.265	0.419	0.748	2.857	0(25)
Nitrate+Nitrite (mg/L)	34	0.140	0.156	0.005	0.011	0.088	0.226	0.687	
Total Nitrogen (mg/L)	34	1.660	0.604	0.745	1.105	1.527	2.197	2.735	
Orthophosphorus (mg/L)	34	0.286	0.181	0.026	0.133	0.280	0.408	0.720	
Sulfate (mg/L)	26	57.1	35.6	5.5	16.0	62.8	86.6	108.0	
Outflow (S-392)									
Water Temperature (°C)	34	25.2	4.0	17.5	21.8	26.3	28.6	33.4	
Water pH	34	--	--	6.50	6.68	6.95	7.10	8.70	0(34)
Specific Conductivity (µS/cm)	34	523	162	234	365	550	670	752	0(34)
Total Suspended Solids (mg/L)	25	4.86	4.94	1.50	1.50	1.50	8.50	16.00	
Turbidity (NTU)	25	3.96	3.51	1.20	1.85	2.50	5.10	14.60	0(26)
Total Dissolved Solids (mg/L)	25	336	112	94	238	374	428	474	
Total Alkalinity (mg/L)	25	82	18	51	66	88	100	113	0(25)
Chloride (mg/L)	25	71	24	27	47	84	93	100	
Total Ammonia-N (mg/L)	25	0.145	0.095	0.012	0.062	0.128	0.214	0.346	
Unionized Ammonia (µg/L)	25	0.815	0.965	0.112	0.271	0.665	0.982	4.967	0(25)
Nitrate+Nitrite (mg/L)	35	0.009	0.011	0.005	0.005	0.005	0.009	0.065	
Total Nitrogen (mg/L)	34	1.619	0.448	0.985	1.196	1.651	1.905	2.625	
Orthophosphorus (mg/L)	35	0.187	0.087	0.017	0.121	0.200	0.247	0.373	
Sulfate (mg/L)	25	62.0	28.6	11.0	31.9	69.1	87.9	102.0	
Downstream Monitoring Station (TCDO)									
Water Temperature (°C)	35	25.1	3.4	17.0	22.6	25.9	27.7	30.5	
Water pH	35	6.98	0.33	6.40	6.70	6.90	7.30	7.80	0(35)
Specific Conductivity (µS/cm)	35	498	232	141	258	551	682	851	0(35)

[a]Measured on either weekly or biweekly grab sample; Total nitrogen is Total Kjeldahl N + Nitrate+Nitrite-N
[b]Arithmetic mean
[c]Standard deviation
[d]Excursions from Florida Class III surface water standard, Section 62-302-530, F.A.C.; those parameters with Florida Class III criteria contain number of excursions (total number of samples)

MERCURY

FDEP-approved modifications to mercury monitoring at the TC-STA were implemented beginning in WY2014. The project-specific monitoring for surface water total mercury and methyl mercury was terminated; mosquitofish (*Gambusia* spp.) collection was reduced from quarterly to semiannually; and the frequency of bluegill sunfish (*Lepomis macrochirus*) and largemouth bass (*Micropterus salmoides*) collection was changed from annual to triennial (Gu, 2013).

Mercury monitoring at the TC-STA was conducted in accordance with Specific Condition 12 of the permit (0194485-002-GL) and followed *A Protocol for Monitoring Mercury and Other Toxicants* (FDEP and SFWMD, 2011). Mosquitofish composites were collected at the interior (TCSTAC) and downstream (TCDS) sites on October 17, 2013, and April 17, 2014. Large-bodied fish collection is on a triennial basis, and was not conducted in WY2014.

THg levels in mosquitofish samples collected on October 17, 2013, were 18 nanograms per gram (ng/g) at the interior (TCSTAC) and 48 ng/g at the downstream site (TCDS). Mosquitofish samples collected on April 17, 2014, had lower THg concentrations—13 ng/g at the interior site and 23 ng/g at the downstream location (**Table 8**). These values are considerably below the United States Environmental Protection Agency trophic level 3 criterion for fish (77 ng/g[1]) and do not exceed the 75th percentile concentration of 100 ng/g for the period of record for the Everglades Protection Area.

Table 8. Total mercury concentrations in mosquitofish monitored at the TC-STA during WY2014. Values are on a wet weight basis.

Station*	Description	Collection Date	THg (ng/g)
TCSTAC	Interior	17-Oct-2013	18
TCDS	Downstream	17-Oct-2013	48
TCSTAC	Interior	17-Apr-2014	13
TCDS	Downstream	17-Apr-2014	23

*TCDS- Taylor Creek downstream;
TCSTAC- Composited mosquitofish sample from Cells 1 and 2

[1] Note that the trophic level 3 criterion is used as a surrogate for mosquitofish, which is considered representative of fish species between trophic levels 2 and 3.

STA PERFORMANCE EVALUATION

This section summarizes TC-STA performance for the current reporting year and provides a comparison with the performance of previous years, as required in Specific Condition 16B of the permit. Flow-through operations at the TC-STA commenced on June 26, 2008. By the end of WY2014, the TC-STA had almost 46 months of flow-through:

- WY2009: 8 months of flow-through (June 26, 2008–February 24, 2009)
- WY2010: No flow-through. The TC-STA was offline the entire water year (May 1, 2009–April 20, 2010) while construction repairs to the failed culvert at the outflow structure were being completed.
- WY2011: Almost 8 months of flow-through (September 8, 2010–April 30, 2011)
- WY2012: 12 months of flow-through (May 1, 2011–April 30, 2012)
- WY2013: 9 months of flow-through (May 1, 2012–January 31, 2013). Operational interruptions resulted from implementation of drawdown activities.
- WY2014: 9 months of flow-through (July 30, 2013–April 30, 2014). The TC-STA was offline during the first quarter of WY2014 due to a drawdown to enhance vegetation conditions in the STA.

WY2014 marked the second year of post-stabilization operation for the TC-STA. During this period, the STA captured and treated 4,863 acre-feet (ac-ft) of runoff water from the Taylor Creek drainage basin (**Table 9**). The volume of treated water discharged back into Taylor Creek was 3,697 ac-ft HRT, the average length of time the runoff remained within the STA was 14 days, which is longer than any previous HRT. The longer HRT was the result of operational changes made in response to the reversals in weekly TP concentrations and to accommodate new plantings in the STA. Only one pump at 6-cfs was operated starting in early October 2013, and through the remainder of WY2014. Flow-weighted mean (FWM) TP concentrations measured at the inflow and outflow points of the STA averaged 271 and 218 µg/L, respectively. Although these values indicate a net reduction, the difference between inflow and outflow FWM TP concentrations was not statistically significant using a Mann-Whitney U test with a 95 percent confidence interval (U=35.0, P=0.273). The TP concentration reduction for WY2014 was almost 20 percent (**Table 9**). TP loading over the effective treatment area of the TC-STA averaged 0.013 grams per square meter per day ($g/m^2/d$), which is the lowest of all water years—a direct result of reduced hydraulic loading. A total of 1.62 mt of TP were loaded into the STA in WY2014, removing 0.63 mt, for a TP removal efficiency of 38.7 percent. Although the STA did not meet the annual target load reduction of 2.0 mt, it achieved the design treatment efficiency of 38 percent. The below-projected performance of the TC-STA during WY2014 can be attributed to two main factors: (1) the STA was offline during the first quarter of WY2014 due to drawdown, which meant the STA did not have an opportunity to capture and treat high P flows from May through July 2013, and (2) reduced hydraulic and TP mass loadings in response to reversals in weekly TP concentrations.

Performance data from TC-STA over the last three water years have shown net reductions in TP concentrations and loads during periods of high flows. However, during periods of decreasing stream flow and TP concentrations that usually commence in mid-October and last through the end of the dry season, the TC-STA demonstrated inconsistent performance. During WY2012, the TC-STA had fifteen reversals, nine of which were recorded from November 2011 to February 2012 (Villapando, 2013). In WY2013, fourteen reversals were recorded from October 2012 through January 2013, prompting the District to temporarily suspend flow-through operation in February 2013 (Villapando, 2014). In WY2014, mild reversals in FWM TP concentration were observed for fourteen weeks between October 2013 and April 2014 (**Figure 5**).

Table 9. Summary of calculated operational parameters and performance metrics for the TC-STA by water year. [Note: TC-STA was offline during all of WY2010.]

Parameter	WY2009	WY2011	WY2012	WY2013	WY2014
Period of operation, days	244	235	366	276	275
Total inflow volume, ac-ft	9,218	6,988	13,118	5,810	4,863
Hydraulic loading rate, centimeter per day	10.04	7.70	9.26	5.44	4.41
Inflow FWM TP concentration, µg/L	408	167	341	368	271
Total inflow load, mt	4.64	1.44	5.51	2.63	1.62
TP mass loading rate, $g/m^2/d$	0.038	0.014	0.031	0.020	0.013
Total outflow volume, ac-ft	8,768	6,257	12,208	5,762	3,697
Outflow FWM TP conc., µg/L	296	68	292	289	218
Total outflow load, mt	3.20	0.52	4.40	2.05	0.99
Hydraulic residence time, days	6.34	7.76	6.52	9.72	14.03
TP mass removed, mt	1.44	0.91	1.11	0.58	0.63
TP concentration reduction, %	27.5	59.3	14.4	21.4	19.5
TP load reduction, %	31.1	63.6	20.2	22.0	38.8

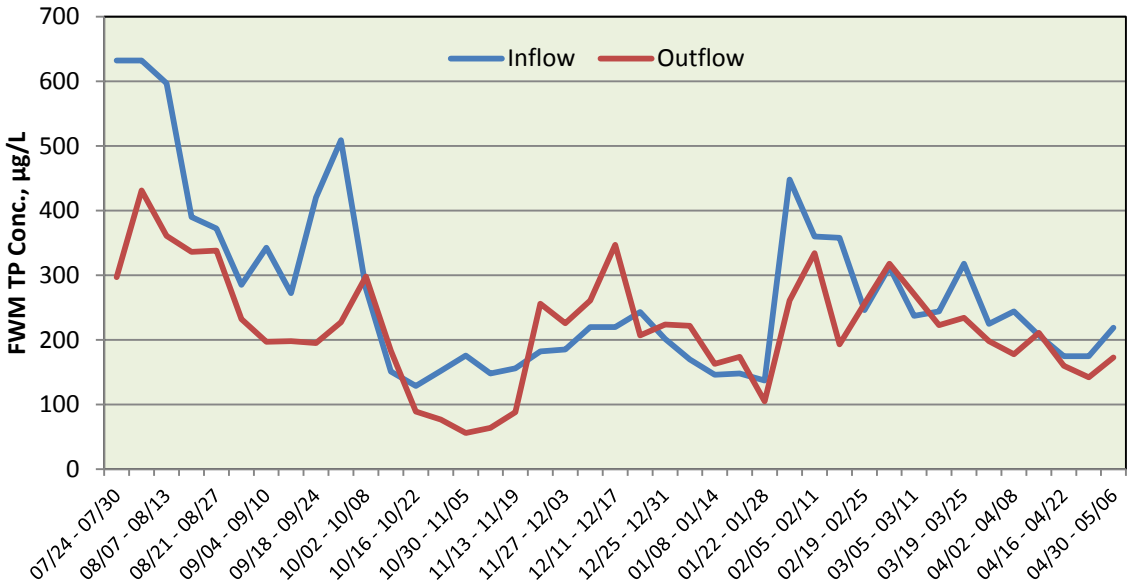

Figure 5. Weekly FWM TP concentrations at the inflow (S-390) and outflow (S-392) points of the TC-STA for WY2014. The STA was offline from May through July 2013.

An investigation into the lack of system performance led to two internal transect water quality monitoring studies in December 2012. Results showed that water column TP concentrations were increasing in both cells of the STA at an inflow TP concentration of about 100 µg/L, indicating that P was being released from the sediments and/or porewater to the water column (**Figure 6**, left panel). However, when inflow TP concentration was around 250–300 µg/L, there was no discernible pattern in water column TP concentrations across the STA, which is an indication that the STA was in a state of "equilibrium", with respect to P conditions, at which there was no measurable flux of P from the sediment to the water column and vice versa (**Figure 6**, right panel). These observations suggest that there exists an Equilibrium P Concentration in the water column (EPC_w) or in the soil solution (EPC_o) that would indicate whether adsorption or desorption occurs in the sediments/soils when added P alters the concentration in the porewater. EPC_w is the concentration of P in the water column at which no net flux, i.e. release or retention, occurs from the sediments to the water, and the P in solution is considered in equilibrium with the P in the solid phase (EPC_o) (Reddy et al, 1995, 1999). It was hypothesized that when the overlying water column P concentration is above EPC_w or EPC_o, the underlying sediment/soil will remove P. Conversely, P will flux out of the sediment/soil if P concentration in the water column is below EPC_w or EPC_o.

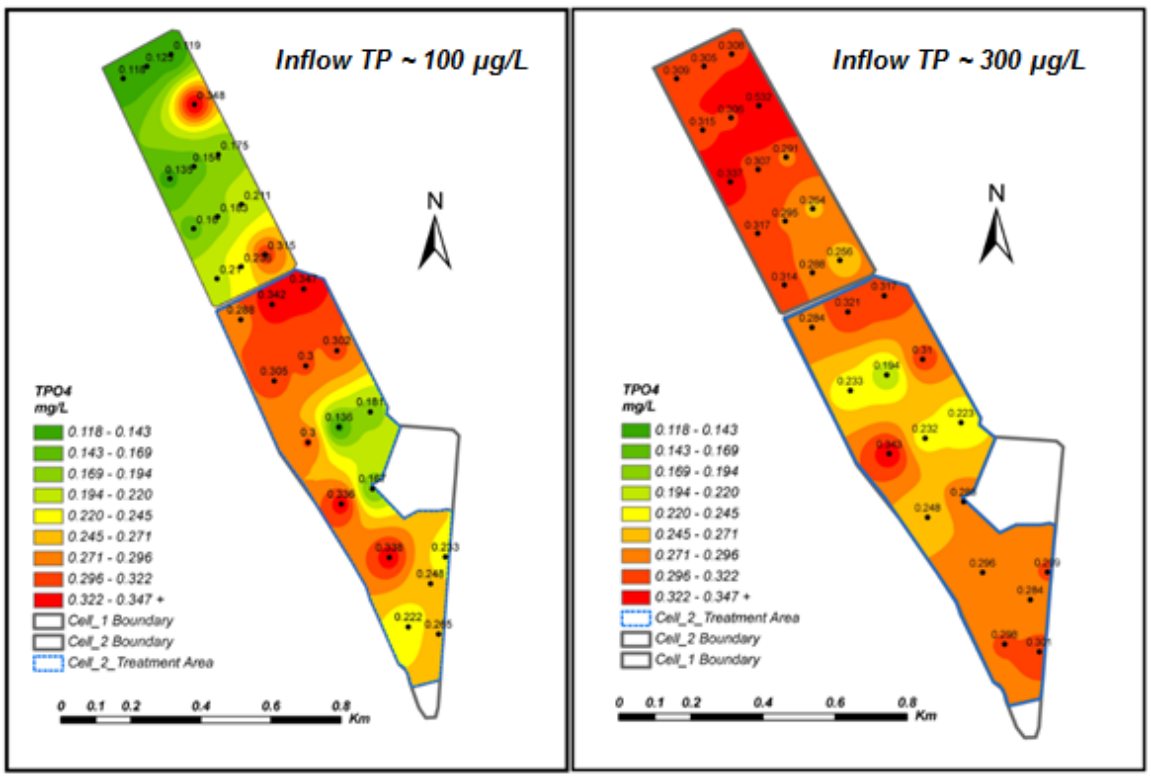

Figure 6. Spatial distribution of TP concentrations in the TC-STA on December 6, 2012 (left panel) and December 20, 2012 (right panel).

A P flux study was conducted in May 2013 to determine the effect of increasing floodwater TP concentrations on P retention/release by soils and to estimate the equilibrium P concentrations in the water column (EPC_w) at which no net flux occurs from the soil to the water column. Ten intact soil cores, in triplicate, were taken along a transect from inflow to outflow points of the TC-STA (**Figure 7**).

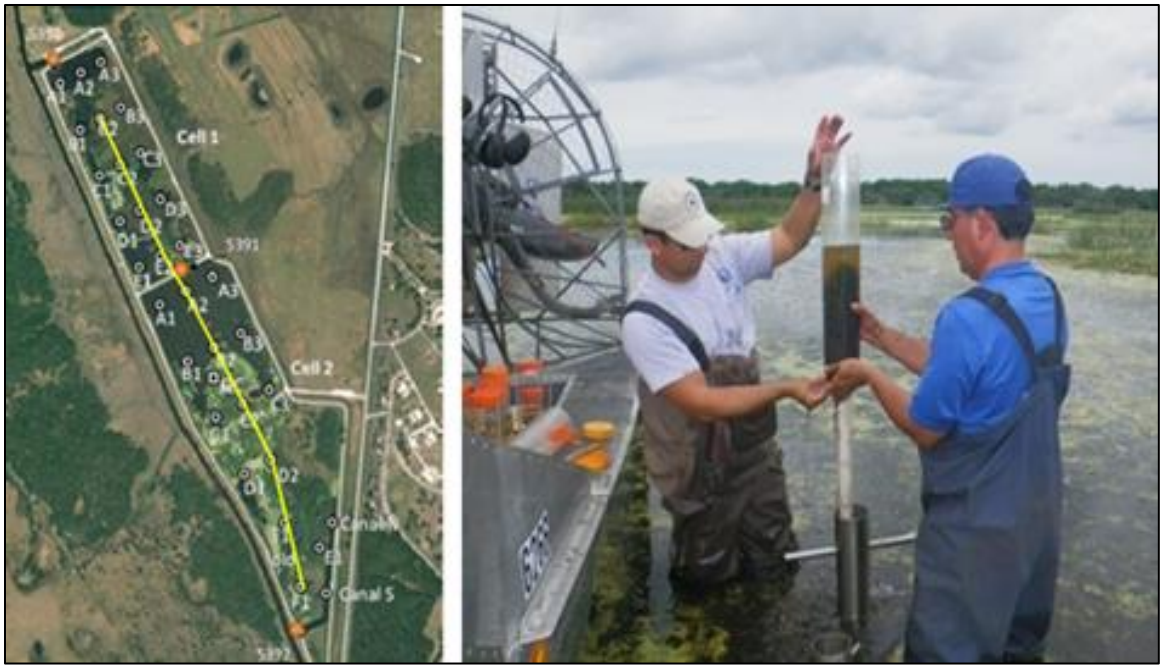

Figure 7. Map showing the transect along the STA's flow path where cores were taken (left panel) and photo of actual sediment collection (right panel) (photo by SFWMD).

Floodwater exchanges consisting of six water column P concentrations that ranged from 10 to 1,000 micrograms phosphorus per liter (µg P L^{-1}) were performed over six ten-day hydraulic retention cycles. The rates at which P was retained by the soils or released to the water column varied widely between cells, locations within each cell, and floodwater TP concentrations (**Table 10**). Overall, soils from Cell 1 locations released less P and/or retained more P at a given floodwater TP concentration. In contrast, soils from Cell 2 locations showed greater potential to release P and lower affinity for added P in the water column. The difference in mean P flux rates between Cells 1 and 2 was attributed to differential concentrations of total P and labile P, which were both higher in Cell 2 soils. Consistent with the P flux results, the estimated equilibrium P concentration in the water column (EPC_w) varied considerably between cells. Estimated mean EPC_w value for Cell 1 soils was 0.165 mg P L^{-1} compared to 0.595 mg P L^{-1} for Cell 2 soils. This indicates that soils in Cell 1 are likely to act as a sink for P while soils in Cell 2 could be a source of internal P load to the STA, depending on TP concentration of the runoff water entering the STA. EPC_w values were positively correlated with labile P and moderately labile organic P, indicating that these P forms are likely to exert significant influence on P release and equilibrium dynamics of soils/sediments within the STA. In an effort to enhance biological uptake of P and control upward flux of P, particularly in Cell 2, additional plantings of cattail and alligator flag were carried out during the drawdown periods to achieve maximum plant cover of desirable wetland species and help improve and sustain STA performance in the long-run.

Table 10. Estimated P release (+) / retention (-) rates and EPC_w of soils from the TC-STA. Each value is the arithmetic average of three replications; "ND" means undefined.

Station	P Release/Retention Rate, milligrams P per square meter per day						EPC_w
	C_0=0.010 mg P L^{-1}	C_0=0.047 mg P L^{-1}	C_0=0.093 mg P L^{-1}	C_0=0.245 mg P L^{-1}	C_0=0.454 mg P L^{-1}	C_0=1.018 mg P L^{-1}	mg L^{-1}
Cell 1, B2	5.19	6.05	1.06	-2.98	-5.71	-7.75	0.251
Cell 1, C2	0.60	1.03	0.30	-2.04	-5.70	-12.61	0.069
Cell 1, D2	3.52	5.42	-0.14	-2.74	-5.37	-8.60	0.145
Cell 1, E2	4.06	0.28	1.49	-1.25	-2.73	-6.83	0.197
Cell 2, A2	6.09	4.00	0.91	0.29	-5.50	-11.38	0.245
Cell 2, B2	2.29	3.29	3.33	5.97	4.44	0.09	ND
Cell 2, C2	1.52	3.23	5.42	2.62	1.57	-0.02	0.788
Cell 2, D2	17.93	6.02	4.62	2.35	2.04	-2.27	0.924
Cell 2, E1 Old	3.76	6.76	1.12	3.03	-1.25	-7.26	0.417
Cell 2, F1	4.22	6.14	5.18	7.04	6.05	-5.39	0.599
Mean, Cell 1	3.34	3.19	0.68	-2.25	-4.88	-8.95	0.165
Mean, Cell 2	5.97	4.91	3.43	3.55	1.22	-4.37	0.595
Overall Mean	4.92	4.22	2.33	1.23	-1.22	-6.20	0.404

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Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions, actions taken, and cross-references presented in this report for the Taylor Creek STA project (NEEPP Permit 0194485-002-GL).

Specific Condition	Description	Applicable Phase	Action Taken	Reported in 2015 SFER Vol. III, App. 4-2 in:			
				Narrative (page #s)	Figure	Table	Attachment
8	Stabilization/Post Stabilization	Post Stabilization	No action needed	1, 9, 14		1	
8A2	Phosphorus/Post Stabilization	Post Stabilization	Demonstrated net reduction in TP loads from inflow to outflow	9		9	B
8B	Dissolved Oxygen	Post Stabilization	Percent DO saturation at the inflow and downstream locations met applicable criteria	9–10		5, 6	B
8C	Other Water Quality Parameters	Post Stabilization	No water quality parameters with Class III standards contributed to exceedances in terms of average outflow concentrations	10–12		7	B
9	Vegetation Conditions	Post Stabilization	Conducted drawdown activities to rejuvenate existing vegetation and expanded vegetation coverage through planting of emergents	6–7	3	3	
10	Factors Outside the Permittee's Control	Post Stabilization	No action needed				
11	Monitoring Requirements	Post Stabilization	Monitoring program conducted in accordance with Specific Condition 16 and Table 1 of the permit	8			
12	Mercury Monitoring	Post Stabilization	Monitoring for mercury conducted in accordance with FDEP/SFWMD's protocol for monitoring mercury and other toxicants.	13		8	B
13	Turbidity Monitoring	Post Stabilization	Not applicable				
14	Quality Assurance and Quality Control	Post Stabilization	Sampling and analysis performed per Chapter 62-160, F.A.C., and SFWMD's water quality monitoring plan	8			

Table A-1. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in 2015 SFER Vol. III, App. 4-2 in:			
				Narrative (page #s)	Figure	Table	Attachment
15	Method Detection Limits	Post Stabilization	No action needed				
16	Annual Monitoring Reports	Post Stabilization	Annual report (this document) was prepared and submitted as required.	All	All	All	All
16A	Water Quality Data	Post Stabilization	Water quality data collected in accordance with Chapter 62-160, F.A.C., and SFWMD's water quality monitoring plan.	8–13		5–9	B, C
16B	Performance Evaluation	Post Stabilization	STA performance during WY2014 was evaluated and compared with performance of previous water years.	14–18	5–7	9, 10	B
16C	Hydraulic Retention Time	Post Stabilization	No action needed				
16D	Herbicide and Pesticide Tracking	Post Stabilization	WY2014 usage was tracked, as required, and is summarized in the report.	6–7		3	
16E	Implementation Schedules	Post Stabilization	No action needed				
17	Removal of Parameters	Post Stabilization	No action needed				
18	Addition of Parameters	Post Stabilization	No action needed				
20	Permit Modifications for Design Changes	Post Stabilization	No action needed				
21	Permit Renewal	Post Stabilization	No action needed				
22	Department Review and Approval	Post Stabilization	Mutual agreement was reached on remedial actions and plan modifications.				

Attachment B: Water Quality Data

This project information is required by Specific Condition 16A of the Taylor Creek STA permit (0194485-002-GL), and is available upon request.

Attachment C: Hydrologic Data

This project information is required by Specific Condition 16A of the Taylor Creek STA permit (0194485-002-GL), and is available upon request.

Table C-1. Total monthly flow at the inflow and outflow points of the TC-STA for WY2014.

Month/Year	Inflow (acre-ft)	Outflow (acre-ft)
May 2013	0	94
June 2013	32	31
July 2013	22	43
August 2013	604	395
September 2013	722	623
October 2013	755	611
November 2013	535	424
December 2013	457	340
January 2014	457	330
February 2014	414	332
March 2014	457	296
April 2014	439	305
Total	4,894	3,824

Table C-2. Total monthly rainfall (in inches) recorded at station Mobley_R near TC-STA for WY2014.

Month/Year	Rainfall (inches)
May 2013	5.31
June 2013	11.30
July 2013	9.64
August 2013	6.73
September 2013	4.79
October 2013	1.31
November 2013	0.88
December 2013	0.93
January 2014	3.31
February 2014	3.60
March 2014	1.48
April 2014	2.31
Total	51.59