Taylor Creek Stormwater Treatment Area

2009 Annual Report

Prepared for:

Florida Department of Environmental Protection

By:

U.S. Army Corps of Engineers Jacksonville District

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1.0 INTRODUCTION

This report provides a summary of flow through (discharge) activities performed during Water Year 2009 (WY09) (May 1, 2008 – April 30, 2009), as part of the Initial Operational Testing and Monitoring Period for the Taylor Creek Pilot Stormwater Treatment Area (TC-STA). Included in the report are a summary of operation and maintenance activities, analysis of TC-STA performance and a preliminary evaluation of compliance with the discharge requirements and conditions of Taylor Creek Permit No. 0194485-006-GL.

TC-STA compliance with pre-discharge requirements for total phosphorus, mercury and pesticides as outlined in Specific Condition 14 of the above referenced permit was achieved on April 30, 2008. However, discharge activities were not initiated until June 26, 2008 due to reduced water availability in the Taylor Creek Basin and protected bird species nesting in both cells of the TC-STA. Pumping operations to maintain water levels were resumed on June 24, 2008. Two days after Cells 1 and 2 reached their target stages of 23.6 and 22.6 ft NGVD, respectively, the slide gate at the outfall structure (S392) was opened on June 26, 2008 to allow initial discharge of water back into Taylor Creek. The TC-STA continued to operate on a discharge mode until February 24, 2009 when pumping and discharge activities were suspended after a failure of the culvert at S392 was detected. Limited pumping occurred following suspension, when creek levels favored the ability to put water into the TC-STA to maintain optimal cell depths. The U.S. Army Corps of Engineers (Corps) and the South Florida Water Management District (DISTRICT) staff determined the main problem to be the separation of various joints along the discharge culvert. Repairs to address the issue were initiated by the Corps in August 2009. The Corps anticipates all repairs to be completed by mid February 2010.

The suspension of TC-STA operation prompted a request from the Corps to temporarily suspend quarterly mercury and pesticide monitoring as required in Taylor Creek Permit No. 0194485-006-GL. Following an on-site meeting between the Corps and the Florida Department of Environmental Protection (FDEP) staff on April 14, 2009, FDEP acknowledged the problem and granted the Corps' request on April 23, 2009. One of the conditions placed on the request approval was the submittal of monitoring data collected while the TC-STA was undergoing repairs, in order for FDEP to have the ability to evaluate the data prior to approving the resumption of flow through operations.

While the new reporting period covers monitoring activities performed following temporary suspension of TC-STA operation, this report is based mainly on flow through data collected between June 26, 2008 and February 24, 2009. A separate report of the data collected during the entire period of suspension will be submitted to FDEP once construction repairs at the S392 structure are complete.

All monitoring activities were performed in accordance with Chapter 62-160, Florida Administrative Code (F.A.C.) and the approved Water Quality Monitoring Plan (DISTRICT, 2005) as per Specific Condition 19A of the permit.

2.0 PROJECT DESCRIPTION

2.1 Background

The construction and operation of Stormwater Treatment Areas (STAs) in the Lake Okeechobee Watershed is a major component of the Lake Okeechobee Protection Plan (LOPP). Required as part of Chapter 373.4595 (F.S.), the plan seeks to restore and protect Lake Okeechobee by achieving and maintaining compliance with water quality standards in the lakes and its tributaries, through an innovative restoration program designed to reduce total phosphorus (TP) loads and implement long-term solutions, in accordance with the lake's Total Maximum Daily Load (TMDL).

The Taylor Creek Pilot STA (TC-STA) is one of the two pilot STAs being implemented north of the lake. Constructed in April 2006, the TC-STA is a long, narrow enclosure located about 2 miles north of the city of Okeechobee in central Okeechobee County. It is bordered on the east by US 441 and by Taylor Creek on the west. The site is approximately 142 acres and the designed STA has an effective treatment area of 118 acres (Figure 1). The Taylor Creek pilot STA is divided into two cells in series and is expected to treat about 10% of the water flow in Taylor Creek.

The Corps is the federal sponsor of the project and is responsible for the activities performed under the original permit issued to them on September 15, 2003, for the construction and preliminary operations of the TC-STA. The DISTRICT is the local project sponsor and is responsible for operation and maintenance of the facility as a contractor to the Corps until the project is transferred over to the DISTRICT as provided in the Project Cooperation Agreement.

2.2 Performance Objectives

The primary goal for water quality improvement is to capture about 10% of Taylor Creek flow and maximize total P load reduction before returning this flow to Taylor Creek and eventually into Lake Okeechobee. Using the Everglades STA design model, the expected annual average TP removal performance of the Taylor Creek Pilot STA was estimated at 2.08 metric tons/yr (Stanley Consultants, 2003). The TC-STA is likely to provide additional water quality benefits to downstream waters through the removal of suspended solids, metals and pesticides that would otherwise flow into the lake (Goforth, 2005).

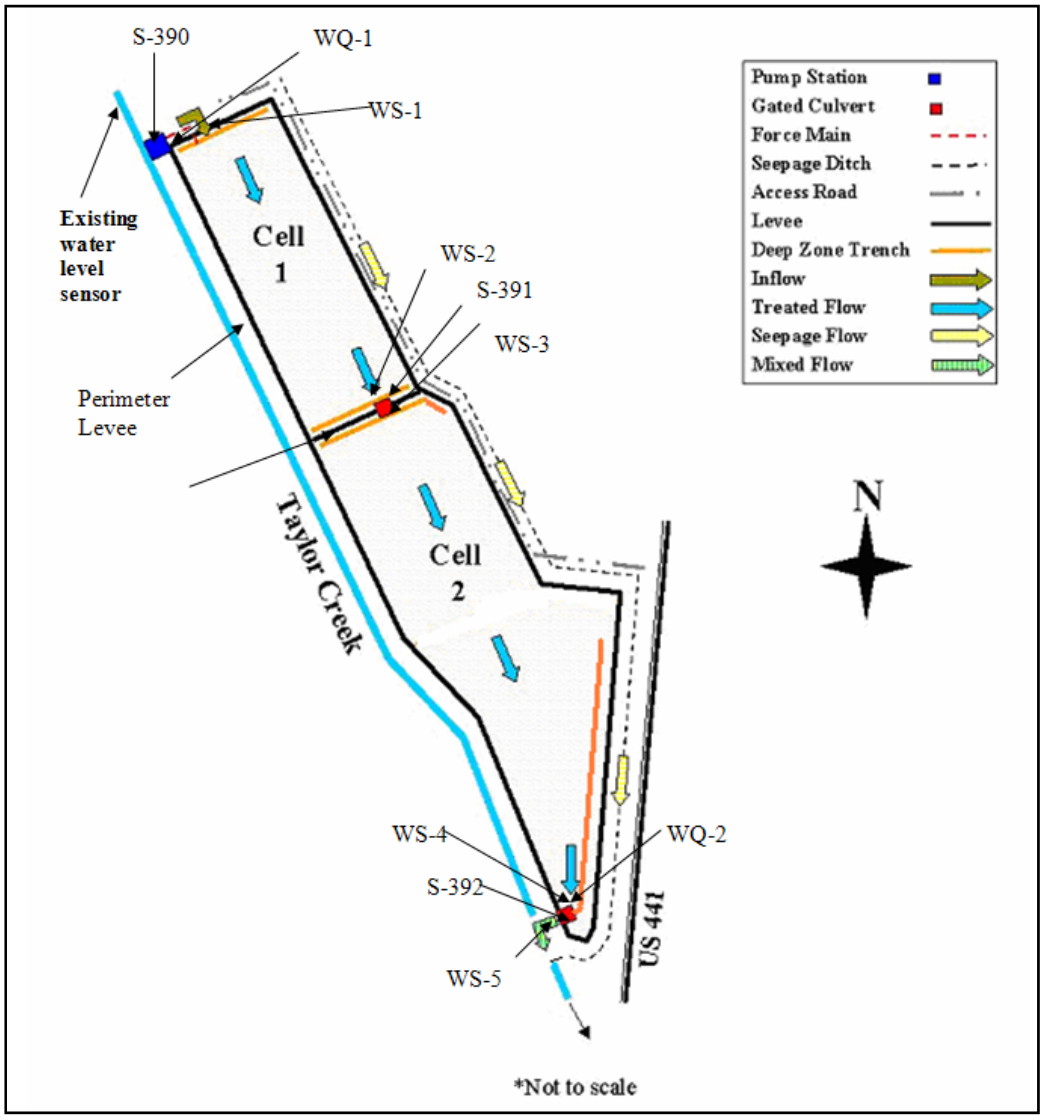

Figure 1. Schematic of TC-STA showing structures, flow and water quality monitoring stations (WS- water stage sensor; WQ- water quality sample station).

2.3 Project Mandate and Permit Status

The original permit for the construction and preliminary operation of the Taylor Creek Pilot STA (Permit No. 0194485-001-GL) was issued to the Corps on September 15, 2003, 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.); and pursuant to Section 373.4595(9) of the LOPA, the FDEP's authority under Chapters 373 and 403, Florida Statutes. To date, the permit has had seven modifications which involved time extensions and minor changes in the water quality monitoring program.

The last modification to the permit was made on June 26, 2009 extending expiration date to September 15, 2010.

A separate permit was issued to the DISTRICT on June 9, 2006 (Permit No. 0194485-002-GL) authorizing activities to be performed during the long-term operation of the project. Operation of the TC-STA by the DISTRICT under the above referenced permit will commence once the Corps has transferred the project over to the DISTRICT in accordance with the Project Cooperation Agreement between the two agencies.

3.0 PERMIT MONITORING REQUIREMENTS AND COMPLIANCE

The original permit issued to the Corps on September 15, 2003 requires a variety of monitoring activities both during construction and normal operations. The Initial Operational and Testing and Monitoring Period of the project consists of pre-discharge and discharge (flow through) activities. As mentioned earlier, compliance by the TC-STA with pre-discharge requirements for total phosphorus, mercury and pesticides as outlined in Specific Condition 14 of Permit No. 0194485-006-GL has already been met. This section of the report summarizes results of monitoring activities performed during the flow through period from June 26, 2008 to February 24, 2009 and provides an evaluation of compliance with discharge requirements specified under Specific Condition 15 of the above referenced permit. Also included in this section are the results of monitoring activities for mercury and pesticides outlined in Specific Condition 14B and C of the permit.

3.1 Phosphorus (Specific Condition 15A)

The moving, three-month, flow weighted mean (FWM) inflow total phosphorus (TP) concentrations ranged from 222 to 627 µg/L (Table 1). FWM outflow TP concentrations followed the same trend as inflow TP concentrations, with values ranging from 210 to 420 µg/L. FWM inflow and outflow TP concentrations during WY09 averaged 392 and 289 µg/L, respectively, which translates into over 26% reduction in TP concentration.

As required in the permit, the weekly flow weighted mean inflow and outflow TP concentrations were compared using the student's t-test with a 95% confidence interval on log transformed data. (The t-test assumes that the observations within each group are normally distributed and the variances are equal in the two groups). The results for a one-tailed t-test summarized in Table 2 indicate that there is a statistically significant difference between TP concentrations at the inflow and outflow points of the TC-STA (t=2.677, p=0.0046). This statistical difference verifies that the mean outflow TP concentration was significantly lower than the mean inflow TP concentration. According to the permit, a statistically significant reduction in TP concentration between the inflow and outflow indicates that the TC-STA is in compliance with Specific Condition 15A.

Table 1. Rolling three-month flow weighted mean surface water total phosphorus concentrations at the inflow (S390) and outflow (S392) stations of the TC-STA for WY09.

Rolling 3-month Period	TP Concentration (µg/L)	
	S390	S392
May-08 – Jul-08	539	281
Jun-08 – Aug-08	551	321
Jul-08 – Sep-08	627	365
Aug-08 – Oct-08	624	420
Sep-08 – Nov-08	511	395
Oct-08 – Dec-08	341	284
Nov-08 – Jan-09	280	251
Dec-08 – Feb-09	250	228
Jan-09 – Mar-09	247	217
Feb-09 – Apr-09	222	210
WY09 Average	**392**	**289**

Table 2. Student's t test results for weekly flow weighted mean TP concentrations at the inflow and outflow points of the TC-STA, WY09. Values are log transformed.

	S390	S392
Mean	2.618	2.478
Variance	0.051	0.048
Observations	36	36
Pooled Variance	0.049	
Hypothesized Mean Difference	0	
df	70	
t Stat	2.677	
P(T<=t) one-tail	0.0046	
t Critical one-tail	1.667	

3.2 Dissolved Oxygen (Specific Condition 15B)

Dissolved oxygen (DO) concentrations measured at the permitted inflow and outflow stations of the TC-STA during WY09 are summarized in Figure 2. Dissolved oxygen levels were higher at the inflow point (S390) compared to levels measured at the outflow point (S392) with average DO levels of 4.89 and 3.02 mg/L, respectively. These DO levels are below the lower limit of the Class III criteria for predominantly fresh, surface

water of 5.0 mg/L specified in Section 62-302.530, F.A.C. The TC-STA was chemically treated in August 2007 to reduce the standing biomass of cattail, fireflag and torpedograss, as part of the pre-discharge vegetation management plan (USACE, 2009a). Low DO levels, especially at the outflow can be attributed to die-off and decomposition of this vegetation, a process that consumes dissolved oxygen. Similarly low DO levels have been reported for macrophytic dominated STAs south of the lake (Pietro et al., 2010).

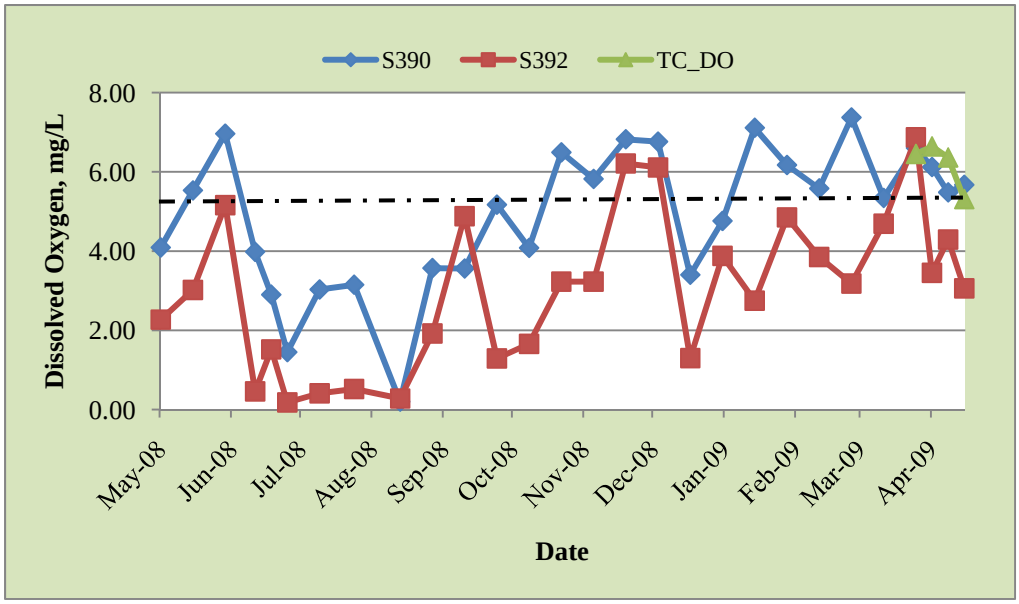

Figure 2. Dissolved oxygen concentrations measured at the inflow (S390) and outflow (S392) locations of the TC-STA. The dashed line represents the lower limit of Class III water quality criteria of 5.0 mg/L.

Just recently, a representative downstream location half a mile south of the S392 outfall structure in Taylor Creek (TC_DO) was included for additional DO monitoring. Dissolved oxygen levels shown in Figure 2 for this station were above the applicable criteria of 5.0 mg/L. Average DO level for the entire month of April at the downstream location was 6.2 mg/L. This upwarding trend in DO concentrations has been reported in other STAs as these systems become more established and stable with maturity.

While the inflow and outflow DO levels were not greater than the applicable criteria, the DO levels at the downstream monitoring location (TC_DO) and the resulting reductions in TP concentrations put the TC-STA in compliance with Specific Condition 15B.

3.3 Other Water Quality Parameters (Specific Condition 15C)

Water quality parameters other than total phosphorus and dissolved oxygen were monitored at the inflow and outflow stations of the TC-STA during WY09 in accordance with Table 2 of Taylor Creek Permit No. 0194485-006-GL. The monitoring results for all water quality parameters with and without Florida Class III standards are summarized in Table 3.

Compliance with the above-referenced permit for water quality parameters other than TP and DO was evaluated as follows:

1. If the annual average outflow concentration does not cause or contribute to violations of applicable Class III water quality standards, then the STA shall be deemed in compliance.

2. If the annual average concentration at the outflow causes or contributes to violations of applicable Class III water quality standards, but does not exceed or is equal to the annual average concentration at the inflow station, then the STA shall be deemed in compliance.

3. If the annual average concentration at the outflow causes or contributes to violations of applicable Class III water quality standards and also exceeds the annual average concentration at the inflow station, then the STA shall be deemed out of compliance.

All water quality parameters with Florida Class III standards meet the applicable criteria provided in Table 4. Specific conductivity values at the outflow (687 µS/cm) were slightly higher than conductivity values at the inflow (631 µS/cm) (Table 3) but both are well below the Class III standard of 1,275 µS/cm (Table 4). Average turbidity values of 5.4 and 6.0 NTUs at the inflow and outflow stations, respectively, were several-fold lower than the threshold value of 29 NTUs. Water pH averaged 7.2 at the inflow and 7.1 at the outflow, which are well within the pH limits of 6.0 and 8.5. Alkalinity values were markedly greater than Class III minimum standard of 20 mg/L with a mean of 114 mg/L at the inflow and 125 mg/L at the outflow. Sulfate levels monitored quarterly at the inflow and outflow stations from February to May 2009 averaged 55 and 52 mg/L, respectively. Small reductions in total nitrogen and soluble reactive phosphorus (SRP) concentrations from the inflow to outflow were also obtained (Table 4).

Since none of the water quality parameters with Florida Class III standards caused or contributed to an exceedance of applicable water quality standards in terms of average outflow concentrations, the TC-STA is deemed in compliance with Specific Condition 15C.

Table 3. Summary of other water quality parameters monitored at the inflow (S390) and outflow (S392) stations of the TC-STA during WY09. Included is the number of excursions for parameters with Class III surface water criteria (Section 62-302.530, F.A.C.)

Parameter Name[a]	No. of Obs	Mean[b]	Standard Deviation	Minimum	Percentiles			Maximum	Excursions[c]
					25th	50th	75th		
Inflow (S390)									
Water Temperature (°C)	28	23.8	4.5	15.4	19.6	24.1	28.1	30.4	---
Conductivity (µS/cm)	28	631	215	133	448	653	756	1076	0 (28)
Water pH	28	7.2	0.4	5.9	7.0	7.2	7.5	7.8	1 (28)
Total Suspended Solids (mg/L)	26	7.0	5.7	<3	4	5	8	22	---
Turbidity (NTU)	26	5.4	3.3	1.2	3.8	4.5	6.3	13.3	0 (26)
Total Dissolved Solids (mg/L)	26	404	126	133	314	404	476	674	---
Total Alkalinity (mg/L)	26	114.4	35.3	36	82	127.5	141	161	---
Chloride (mg/L)	26	91.4	43.6	12.1	61.4	81.7	114.0	195	---
Ammonium as N (mg/L)	27	0.093	0.105	0.007	0.020	0.054	0.151	0.486	---
Nitrate+Nitrite as N (mg/L)	27	0.222	0.327	<0.005	0.005	0.086	0.282	1.133	---
Total Kjeldahl Nitrogen (mg/L)	27	1.56	0.43	0.97	1.26	1.39	1.79	2.67	---
Total Nitrogen (mg/L)	27	1.79	0.58	0.97	1.34	1.55	2.26	2.94	---
SRP (mg/L)	26	0.337	0.193	0.077	0.199	0.298	0.409	0.942	---
TP (mg/L)	52	0.421	0.215	0.152	0.272	0.368	0.502	1.119	
Sulfate (mg/L)	2	54.9	-	46.0	-	-	-	63.8	-
Outflow (S392)									
Water Temperature (°C)	28	23.9	4.4	16.0	20.0	24.5	28.3	30.1	---
Conductivity (µS/cm)	28	687	258	245	446	687	936	1021	0 (28)
Water pH	28	7.1	0.4	6.2	6.8	7.1	7.4	7.9	0 (28)
Total Suspended Solids (mg/L)	27	6.8	9.4	<3	<3	<3	6	35	---
Turbidity (NTU)	27	6.0	7.6	0.7	1.3	3.2	5.1	28.0	0 (27)
Total Dissolved Solids (mg/L)	27	435	144	182	297	443	571	661	---
Total Alkalinity (mg/L)	27	125.3	38.3	53	93	135	154	178	---
Chloride (mg/L)	27	109.5	54.2	29.4	61.9	103.0	153.5	198	---
Ammonium as N (mg/L)	28	0.049	0.034	0.011	0.028	0.042	0.060	0.177	---
Nitrate+Nitrite as N (mg/L)	28	0.008	0.008	<0.005	<0.005	0.004	0.011	0.026	---
Total Kjeldahl Nitrogen (mg/L)	28	1.69	0.50	1.12	1.28	1.58	2.05	2.89	---
Total Nitrogen (mg/L)	28	1.70	0.50	1.13	1.29	1.58	2.06	2.90	---
SRP (mg/L)	27	0.229	0.165	0.010	0.136	0.214	0.320	0.686	---
TP (mg/L)	53	0.318	0.172	0.083	0.198	0.270	0.389	0.877	
Sulfate (mg/L)	2	52.4	-	47.6	-	-	-	57.3	-

[a] SRP - Soluble reactive phosphorus is predominantly composed of orthophosphate; TP – Total phosphorus

[b] Arithmetic mean.

[c] Excursions from Class III Surface Water Standard, Section 62-302-530, FAC. Those parameters with Class III criteria contain number of excursions (total number of samples).

Table 4. Water quality parameters with Florida Class III criteria specified in Section 62-302.530, Florida Administrative Code.

Parameter	Units*	Class III Criteria
Dissolved Oxygen	mg/L	Greater than or equal to 5.0 mg/L
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
Unionized Ammonia	mg/L	Less than or equal to 0.02 mg/L
Alkalinity	mg/L	Not less than 20 mg/L

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

3.4 Mercury

In accordance with Specific Condition 14C of Taylor Creek Permit No. 0194485-006-GL, total mercury (THg) and methyl mercury (MeHg) were monitored at the inflow and outflow points of the TC-STA on a quarterly basis during WY09. Surface water concentrations at the inflow and outflow sites were generally very low. Averaged over three sampling events, THg concentrations at the inflow and outflow stations were 2.7 and 1.6 nanograms per liter (ng/L), respectively (Table 5a). Methyl mercury levels

Table 5a. Surface water mercury concentrations at the inflow (S390) and outflow (S392) stations of the TC-STA during WY09.

Station ID	Collection Date	Test Name	Value	Unit	Remark Code[a]
S390	12-Aug-08	Mercury, Total, Ultratrace	4.3	ng/L	A
	04-Nov-08	Mercury, Total, Ultratrace	2.6	ng/L	
	10-Feb-09	Mercury, Total, Ultratrace	1.1	ng/L	
	12-Aug-08	Methyl Mercury, Total, Ultratrace	1.3	ng/L	
	04-Nov-08	Methyl Mercury, Total, Ultratrace	0.36	ng/L	
S392	12-Aug-08	Mercury, Total, Ultratrace	1.9	ng/L	
	04-Nov-08	Mercury, Total, Ultratrace	2.1	ng/L	
	10-Feb-09	Mercury, Total, Ultratrace	0.76	ng/L	
	12-Aug-08	Methyl Mercury, Total, Ultratrace	0.31	ng/L	
	04-Nov-08	Methyl Mercury, Total, Ultratrace	0.56	ng/L	
	10-Feb-09	Methyl Mercury, Total, Ultratrace	0.15	ng/L	

[a] A- Value recorded as arithmetic mean of two or more results.

were even lower with an average concentration of 0.83 ng/L at the inflow and 0.43 ng/L at the outflow. THg and MeHg levels are well below the Florida Class III numerical water quality standard (WQS) of 12 ng/L in surface water.

Total mercury levels for the different fish species collected at designated locations of the TC-STA were generally very low (Table 5b). Mosquitofish tissue total mercury levels ranged from 0.010 to 0.042 mg/Kg, which are well below the 75th percentile concentration of 0.972 mg/Kg for the period of record for downstream monitoring basins. Similarly, none of the mercury levels detected in bluegill and large-mouth bass exceeded the 75th percentile concentrations of 0.230 and 0.670 mg/Kg, respectively.

Table 5b. Total mercury concentrations in tissue of different fish species monitored at the TC-STA during WY09. Values are on a wet weight basis.

Station ID[a]	Collection Date	Fish Type	Test Name	Value	Unit	Remark Code[c]
TC2	19-Nov-08	Blue Gill	Mercury, Total	0.011[b]	mg/Kg	I
TCDS	05-May-08	Mosquito Fish	Mercury, Total	0.029	mg/Kg	
	11-Aug-08	Mosquito Fish	Mercury, Total	0.040	mg/Kg	
	03-Nov-08	Mosquito Fish	Mercury, Total	0.042	mg/Kg	A
	19-Nov-08	Blue Gill	Mercury, Total	0.036[b]	mg/Kg	
	19-Nov-08	Large-mouth Bass	Mercury, Total	0.252[b]	mg/Kg	
	09-Feb-09	Mosquito Fish	Mercury, Total	0.030	mg/Kg	
TCSTAC	05-May-08	Mosquito Fish	Mercury, Total	0.010	mg/Kg	
	11-Aug-08	Mosquito Fish	Mercury, Total	0.022	mg/Kg	
	03-Nov-08	Mosquito Fish	Mercury, Total	0.014	mg/Kg	

[a] TC2 – TC-STA Cell 2; TCDS- Taylor Creek Downstream; TCSTAC- Composite sample of Cells 1 and 2.
[b] Values recorded are arithmetic average of five observations.
[c] A- Arithmetic average of two or more results. I – Detected below the quantitation limits.

3.5 Pesticides

In accordance with Specific Condition 14C, toxicants other than mercury listed in Attachment 1 of the permit were monitored in surface water and different fish species. Pesticide levels in both surface water and fish were all below detection limits, with the exception of bromacil and hexazinone that were detected in surface water on two sampling events (Table 6). The detected concentrations are very low and cause no concern for potential toxicity.

Table 6. Pesticide concentrations detected at the inflow (S390) and outflow (S392) stations of the TC-STA during WY09.

Station ID	Collection Date	Sample Type*	Test Name	Value	Unit
S390	04-Nov-08	SW	Bromacil	0.320	µg/L
	04-Nov-08	SW	Hexazinone	0.170	µg/L
	10-Feb-09	SW	Hexazinone	0.036	µg/L
S392	04-Nov-08	SW	Hexazinone	0.420	µg/L
	10-Feb-09	SW	Hexazinone	0.037	µg/L

*Sample Type: SW – surface water.

4.0 TC-STA OPERATIONAL SUMMARY AND PERFORMANCE

4.1 Operations

As mentioned earlier, initial discharge of treated water back into Taylor Creek through S392 occurred on June 26, 2008. Discharge activities continued until February 24, 2009 when flow through operation had to be suspended due to culvert failure at the outfall structure. Water depths across the TC-STA during WY09 were kept within limits of normal operations described in the water control plan (USACE, 2009b). Water depth was maintained between 1.5 and 2.0 ft based on water availability and general hydrologic conditions in the Taylor Creek Basin (Figure 3). Mean water depths in Cells 1 and 2 for the entire period of flow through operation were 1.76 and 1.70 ft, respectively.

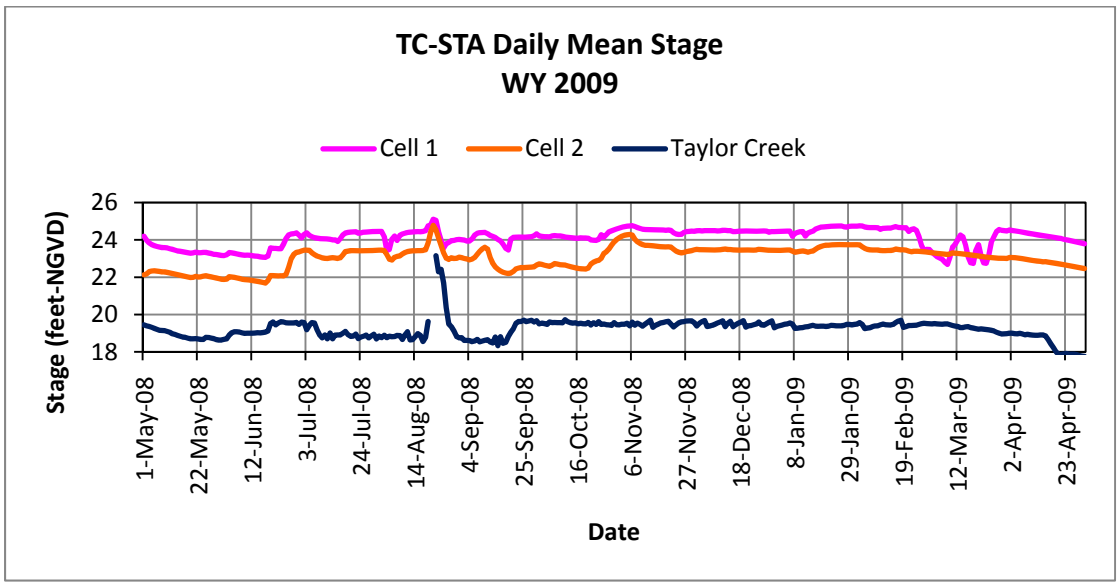

Figure 3. Daily mean stages in Cells 1 and 2 of the TC-STA in relation to Taylor Creek.

4.2 Vegetation Management

Vegetation management activities for the TC-STA in WY09 focused on the creation of a healthy mixed marsh with predominately desirable wetland plants. The establishment of a mixed marsh will increase sunlight penetration, encourage growth of emergent and subemergent vegetation, improve water quality and increase overall biodiversity. In September 2008, several open areas in Cell 2 were planted with desirable wetland species that included bulrush (*Scirpus californicus*), spikerush (*Eleocharis interstincta*) and pickerelweed (*Pontederia cordata*) (Figure 4). As of March 2009, it was estimated that between 50-60% of Cell 2 has been converted into a mixed marsh. Plans are underway to continue the expansion of desirable vegetation in three additional open areas in Cell 2. It is anticipated that the established planting areas within Cell 2 will be used as plant donor sites for new planting locations.

Figure 4. Planting of desirable wetland species in one of the open water areas in Cell 2 of the TC-STA, September 2008.

Although Cell 1 was not planted with any additional desirable plant material, it has been managed to control/eradicate undesirable vegetation such as torpedograss and water lettuce. Table 7 provides a summary of maintenance spraying activities within Cells 1 and 2 including targeted species, type and amount of herbicides used, acreage of treated area and date of treatment as required in Specific Condition 19D.

Table 7. A summary list of herbicides used for routine maintenance of undesirable vegetation within the TC-STA during WY09.

Spraying Date	Herbicide		Acres Sprayed	Targeted Species	Cell No.
	Name	Application Rate*			
22-Apr-08	Diquat	1	1	Water lettuce	2
17-Jul-08	Diquat	1	10	Water lettuce	2
18-Jul-08	Diquat	1	11	Water lettuce	2
25-Jul-08	Diquat	1	5	Water lettuce	2
01-Aug-08	Diquat	1	6	Water lettuce	2
14-Aug-08	Glyphosate	3.75	7	Cattail	2
11-Sep-08	Glyphosate	3.75	3	Cattail	2
11-Sep-08	Glyphosate	3.75	1.5	Cattail	2
11-Sep-08	Diquat	1	8	Water lettuce	2
11-Sep-08	Diquat	1	4	Water lettuce	2
12-Sep-08	Diquat	1	6	Water lettuce	2
12-Sep-08	Diquat	1	6	Water lettuce	2
05-Nov-08	Diquat	1	19	Water lettuce	2
06-Nov-08	Diquat	1	16	Water lettuce	2
07-Nov-08	Diquat	1	8	Water lettuce	2
07-Nov-08	Glyphosate	3.75	6	Torpedograss	1
12-Nov-08	Glyphosate	3.75	4	Torpedograss	1
12-Nov-08	Diquat	1	5.5	Water lettuce	1
21-Nov-08	Diquat	1	8	Water lettuce	1,2
21-Nov-08	Diquat	1	8	Water lettuce	1,2
19-Feb-09	Glyphosate	3.75	1	Torpedograss	1
25-Feb-09	Glyphosate	3.75	17	Torpedograss	1
26-Feb-09	Glyphosate	3.75	9	Torpedograss	1
27-Feb-09	Glyphosate	3.75	4	Torpedograss	1

*Recommended Application Rate- Quarts/Acre

4.3 TC-STA Performance

The performance of the TC-STA for WY09 was evaluated using the Nutrient Load Program, a flow and nutrient load analytical tool developed by the DISTRICT's Environmental Resource Assessment Department (DISTRICT, 2005). The program retrieves water quality and flow data from the DISTRICT database and generates loads and flow weighted means for the inflow and outflow stations. A summary of the program run performed on flow through data collected from June 26, 2008 to February 24, 2009 (Table 8) formed the basis for the P load removal calculations and performance analyses discussed later in this section.

Table 8. Monthly flows and total phosphorus load data for the TC-STA in WY09.

Month	S390			S392		
	Flow (ac-ft)	Load (mt)*	FWMC (µg/L)	Flow (ac-ft)	Load (mt)*	FWMC (µg/L)
Jun	233	0.062	215	177	0.030	136
Jul	1278	0.942	598	1366	0.505	299
Aug	1043	0.732	569	1343	0.609	367
Sep	475	0.487	832	342	0.259	615
Oct	592	0.404	554	307	0.164	432
Nov	1052	0.444	342	949	0.356	305
Dec	1667	0.543	264	1648	0.497	244
Jan	1631	0.515	256	1406	0.387	223
Feb	1247	0.341	222	1229	0.318	210
Total	9,218	4.470	392	8,767	3.125	289

*mt – metric tons.

During WY09, the TC-STA received and treated 9,218 ac-ft of runoff water from the Taylor Creek Basin through the S390 structure (Table 8). The volume of treated water discharged back into Taylor Creek during this period was 8,767 ac-ft. The difference in total inflow and outflow volumes reflects the net contributions of direct rainfall, seepage and evapotranspiration (ET).

The inflow FWM TP concentrations for the period ranged from 215 to 832 µg/L while the outflow FWM TP concentrations ranged from 136 to 615 µg/L (Table 8). The highest FWM inflow and outflow TP concentrations were recorded in the month of September due to the aftermath of tropical storm Fay. Flow weighted mean inflow and outflow TP concentrations for WY09 were 393 and 289 µg/L, respectively. This translates into a TP concentration reduction of over 26%.

Total P loading to the system during the flow through period was 4.47 metric tons (mt) (Table 8). Total P mass in the outflow was 3.12 mt, giving a net TP load removal of 1.35 mt. Phosphorus treatment efficiency for WY09 was slightly over 30%. The anticipated long-term average phosphorus reduction within the TC-STA was estimated at approximately 38% or 2.02 mt of TP per year.

Using the flow volumes, TP loads and FWM TP concentrations recorded during the reporting period, key performance parameters for the TC-STA were calculated to evaluate system performance.

Total inflow volume captured by the TC-STA through the S390 structure resulted in an average hydraulic loading rate (HLR) of 9.7 cm/d (Table 9). Hydraulic loading rate is inflow volume per unit time divided by the effective treatment area of the TC-STA.

Table 9. A summary of TC-STA operational parameters calculated based on a 244-d of flow through operation.

PARAMETER	Calculated Value
Period of Operation, d	244
Total Inflow Volume, ac-ft	9,218
Hydraulic Loading Rate, cm/d	9.7
FWM Inflow TP Conc, µg/L	393
Total Inflow TP Load, mt	4.470
TP Mass Loading Rate, g/m^2/d	0.038
Total Outflow Volume, ac-ft	8,768
FWM Outflow TP Conc, µg/L	289
Total Outflow TP Load, mt	3.125
Hydraulic Residence Time, d	5.5
TP Load Removed, mt	1.345
TP Mass Removal Rate, g/m^2/d	0.012
TP Load Reduction, %	30.1
TP Conc. Reduction, %	26.5

The calculated HLR resulted in a mean hydraulic retention time (HRT) of 5.5 days (Table 9). HRT is the average length of time the runoff remained in the STA. Longer HRTs generally result in higher treatment efficiency but this would mean having less water in the STA available for treatment (reduced hydraulic loading rate).

Phosphorus loading rate over the effective treatment area of the TC-STA averaged 0.038 g/m^2/d over the 244-d period (Table 9). TP load reduction during WY09 based on a 244-d of operation was 1.35 mt, for a treatment efficiency of 30.1%. Although slightly lower than the projected long-term average treatment efficiency of 38% or 2.0 mt of TP/yr, the TC-STA is still on track of meeting the designed goal for water quality improvement. The successful implementation of the vegetation management plan to establish a healthy mixed marsh in Cell 2 is anticipated to help the overall function of the TC-STA in removing excess phosphorus from the Taylor Creek Drainage Basin.

5.0 PUBLIC USE

The Taylor Creek Pilot Stormwater Treatment Area was opened for public use on November 7, 2007. The facility has an approximately 3-mile levee trail that is ideal for walking, jogging, cycling and bird watching. The trail also provides two chickees constructed by the Seminole Tribe, and picnic tables generously donated by the Okeechobee High School Future Farmers of America (FFA). Other features include an informational kiosk, composting toilet, and parking area. The facility is open 7 days a week from sunrise to sunset, except during periods of required project maintenance and management. Future plans for the facility, if funding becomes available, include a boardwalk and a pavilion.

The facility is frequently utilized and has become a popular and appreciated local feature. Public access and recreation at this facility is made possible through a partnership between the South Florida Water Management District and Okeechobee County.

6.0 FUTURE REPORTING

Once the transfer of the project from the Corps to the DISTRICT is complete as provided by the Project Consent Agreement, the DISTRICT will operate the facility under a FDEP Operations Permit No. 0194485-002-GL. Annual reporting of TC-STA treatment performance to FDEP will be made by the DISTRICT via the Annual South Florida Environmental Report.

7.0 REFERENCES

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