

**Aquatic Weed Treatment for Water Hyacinth Removal
& Stormwater Monitoring Results at Weems Pond Stormwater Management Facility
(Upper Lake Lafayette Nutrient Reduction Facility)
June 2008 – October 2010**

July 1, 2011

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INTRODUCTION

The Weems Pond Stormwater Facility, also known as the Upper Lake Lafayette Nutrient Reduction Facility, in Tallahassee, Florida, receives urban runoff from approximately 10,175 acres from the Northeast Drainage Ditch. The surface area at pool elevation is 9.7 acres. In June 2008 a Tri-Party Agreement was executed with the Florida Department of Environmental Protection (DEP), Florida Department of Transportation (DOT) and the City of Tallahassee (COT) for the transfer of the general permit and responsibility of operations and maintenance (O&M) from DOT to COT for the Weems Pond stormwater facility. As part of the Tri-Party Agreement, the City agreed that it would design, permit and construct an “Enhancement Project” to further improve the performance of the facility. The Enhancement Project is described in the last section of this report. The agreement also stipulated that DOT would, among other requirements, remove the invasive aquatic plants, predominantly *Eichhornia crassipes* (water hyacinth) prior to the COT assuming full O&M responsibility. At the time of the transfer, the facility had 100% water hyacinth coverage. The DEP Bureau of Invasive Plant Management, (currently the Fish and Wildlife Conservation Commission (FWC), Invasive Plant Management Section) recommended chemical treatment over mechanical harvesting for plant removal.

AQUATIC WEED TREATMENT AND MONITORING ACTIVITIES

The COT installed two monitoring stations in May 2008 at the Inflow and Outflow of Weems Pond (Figures 1, 2, and 3) to collect storm event data before, during and after chemical treatment of the hyacinth. After an unsuccessful attempt by a DOT contracted vendor to remove or control the water hyacinth in 2008, the transfer process was then delayed for more than a year. It was agreed that COT would assume responsibility and contract with another vendor to remove the aquatic weeds. Beginning July 2010, DGC Environmental entered into a 1 year maintenance contract with COT to eradicate the water hyacinth and any other invasive aquatic plant species on the Weems Pond stormwater facility. The maintenance plan included 3 initial treatments at 2 week intervals, covering 1/3 of the pond each visit, and then monthly treatments through July 2011.

DGC Environmental recommended using the State of Florida approved aquatic herbicide chemical 2,4-Dichlorophenoxyacetic acid (2,4-D). Per the exemptions listed in the Florida Aquatic Plant Control Rule (F.A.C. 68F-20) a permit was not required for this project. The City of Tallahassee planned to minimize the potential for any adverse impacts in the pond or downstream. Fish kills can occur from a dissolved oxygen crash as a result of decaying vegetation and already stressed environmental conditions. Additionally, a sinkhole is located more than 1 mile downstream of the pond, in Upper Lake Lafayette. Although not required for Class III surface water, the COT intended

to limit the potential for concentrations of 2,4-D that would exceed Maximum Contaminant Levels in Drinking Water (70 ug/L) or Class I Surface Waters (100 ug/L) standards, from water discharging through the outfall. Therefore, COT requested a few specific precautionary requirements for the treatment protocol:

- Apply herbicide to 1/3 of the pond for each treatment,
- Divide the initial treatment into 2 week intervals,
- For 2,4-D, use the FWC recommended mixing concentration, 0.5 gal of 2,4-D per 100 gal. water per one acre of plants. This is less than the manufacturer's recommendation for heavy coverage of water hyacinth.

Table 1 shows the results of calculations COT used to demonstrate that the recommended application rate would fall below Florida standards listed above.

Table 1

Rate of 0.5 gal per Acre--FWC recommended application			
<u>No. Applications</u>	<u>Acres Treated</u>	<u>Active Ingredient(lbs)</u>	<u>Concentration ug/L</u>
1	9.6	18.2	70
2	4.8	9.1	35
3	3.2	6.1	23
4	2.4	4.6	17

Note:

1. 2-4D mass active ingredient sprayed at max rate **4 pints (0.5 gallon)** per acre diluted in permanent pool volume 96.4 ac ft.
2. 2-4D = 3.8 lb/gal

RESULTS

DGC began the application treatments June 29, 2010, treating 1/3 of the facility at two week intervals for a total of 3 initial treatments. The monthly maintenance treatment began in August 2010. The City of Tallahassee documented the treatment process with weekly photos and collected two water quality samples from storm events during Week 3 and Week 9 of the treatment period. At the request of DEP, the samples were also analyzed for 2,4-D. There were two herbicide applications prior to the July 16 sample date and 4 applications prior to the August 26 sample date. The concentrations for 2,4-D at the Outfall (Table 2) for the storm samples on 7/16/2010 and 8/26/2010 (0.54 ug/L and 0.44 ug/L) were well below Florida standards, also listed in Table 2. The photo documentation of the aquatic weed treatment from July 2010 through January 2011 is provided in Appendix A. The DGC Weed Control Reports are shown in Appendix B.

The progression of plant decay over time (Appendix A) appeared normal until late September 2010. Note that during September patches of open water increased, as expected, as the plants began to sink or break apart and move downstream. On September 26 through September 27 the basin received approximately 2.0" of rain. Two days later (See picture dated 9/29/10) it appeared that the facility

was mostly covered with the decaying water hyacinth again. Although the exact cause of this occurrence is not known, DGC Environmental and COT staff suggest that there may have been two processes involved. One is that the plants had begun to sink as they were decaying, but the decomposition process, which produced gases, caused the plants to temporarily re-emerge. And the second circumstance is that the open water allowed the shoreline mats that may not have been visible in the documentation photos, especially on the western side of the facility, to break free and stack up at the Outfall on the eastern side. The plants began sinking and more open water appeared again within 2 weeks following this event.

As the winter weather progressed, the cold weather conditions and the continuation of monthly maintenance treatments have resulted in the eradication of water hyacinth on Weems Pond. The monthly maintenance to control the growth of any invasive aquatic plants will proceed until the capital project for the retrofit of Weems Pond begins.

The two COT maintained monitoring stations at the Inflow and Outflow of Weems Pond were equipped with ISCO 6700 samplers, 750 Area Velocity Flow Modules and Low Profile Sensors. The Outflow was also equipped with an ISCO 674 Rain Gauge. The storm event samples were collected during an ongoing monitoring contract that COT managed with Ecology and Environment, Inc. and analyzed by Test America Laboratory. These data will provide baseline data prior to the capital improvement retrofit project described below. Storm event samples were collected using the automatic samplers on 6/23/2008, 8/7/2008, 7/16/2010, and 8/26/2010. Rainfall for those events was 0.63", 0.64", 2.36", and 0.95" respectively. One ambient grab sample was collected on 10/21/2010.

All of the analytical results from the four storm events and one ambient sample collection are listed in Appendix C. The ISCO sampler data showing stage levels, rainfall and sampling information for each storm event are provided in Appendix D. Figure 4 shows the average storm event nutrient concentration for Total Phosphorus (TP) and Total Nitrogen (TN) at the Inflow and Outflow. Comparing the Inflow to the Outflow, it does appear that, during a storm event, the facility provides some nutrient removal (41% for TP and 10.5% for TN). The average concentrations for TP and TN were also compared to the Numeric Nutrient Criteria (NNC) for flowing waters in the Panhandle East region, which are 1.03 mg/L for TN and 0.18 mg/L for TP. Figure 4 shows that, during storm events, only the Inflow average for TP exceeded the TP criteria and the TN for both the Inflow and Outflow was below the NNC for TN. Figure 5 shows concentrations for TP and TN for one ambient grab sample on 10/21/2010. During this period the TP and TN increased when comparing the Inflow to the Outflow (83% for TP and 57% for TN). This was expected as the full effect of the decaying hyacinth biomass was likely occurring at this time. Except for the TP Ambient Outflow result of 0.22 mg/L, the Ambient Inflow TP (0.12 mg/L) and both TN values (Inflow 0.37 mg/L and Outflow 0.58 mg/L) were below the NNC.

The bacteriological analyses (Appendix C) were conducted with the knowledge that the samples would often not meet holding times due to the nature of automatic sampling methods. The City opted to request these analyses for non-regulatory, informational purposes only. The results during storm conditions indicate that high levels of bacteria may be transported in the runoff and for fecal coliform, can be orders of magnitude greater than the Total Maximum Daily Load (TMDL) target limit of 400 cfu/#100ml. The single ambient sample each for the Inflow (28 cfu/#ml) and Outflow (18 cfu/#100ml) were well below the TMDL target limit.

Figure 1
Weems Pond Stormwater Facility Monitoring Station Locations

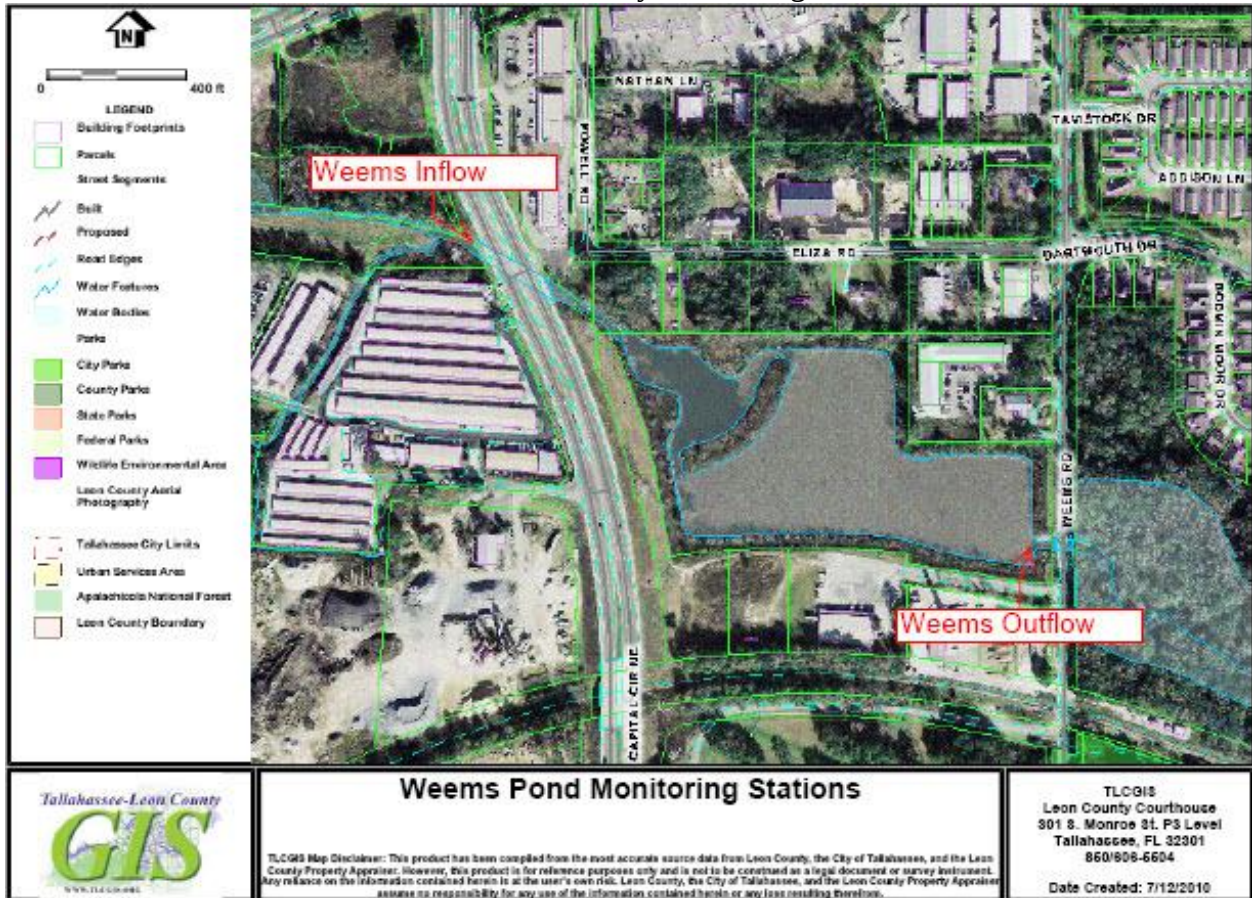


Figure 2
Inflow Station



Figure 3
Outflow Station



Table 2
Stormwater Sampling Analytical Results
2,4-Dichlorophenoxyacetic acid

Sample Location	Date	2,4-D
MCL (µg/L) ¹		70
SWQS (µg/L) ²		< 100
SWCTL (µg/L) ¹		80
NADC (µg/L) ³		800
Inflow	7/16/10	0.037 U
	8/26/10	0.15 I
Outflow	7/16/10	0.54
	8/26/10	0.44 I

Notes:

1. Maximum Contaminant Levels (MCLs) and Surface Water Cleanup Target Levels (SWCTLs) as set forth in the Florida Administrative Code (FAC) Chapter 62-550
2. Surface Water Quality Standard (SWQS) calculated as set forth in the FAC Chapter 62-302
3. Natural Attenuation Default Concentrations (NADCs) as set forth in the FAC Chapter 62-777

Key:

- I = The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
- ug/L = Micrograms per liter
- U = Compound analyzed for but not detected
- < = Less than or equal to

Figure 4

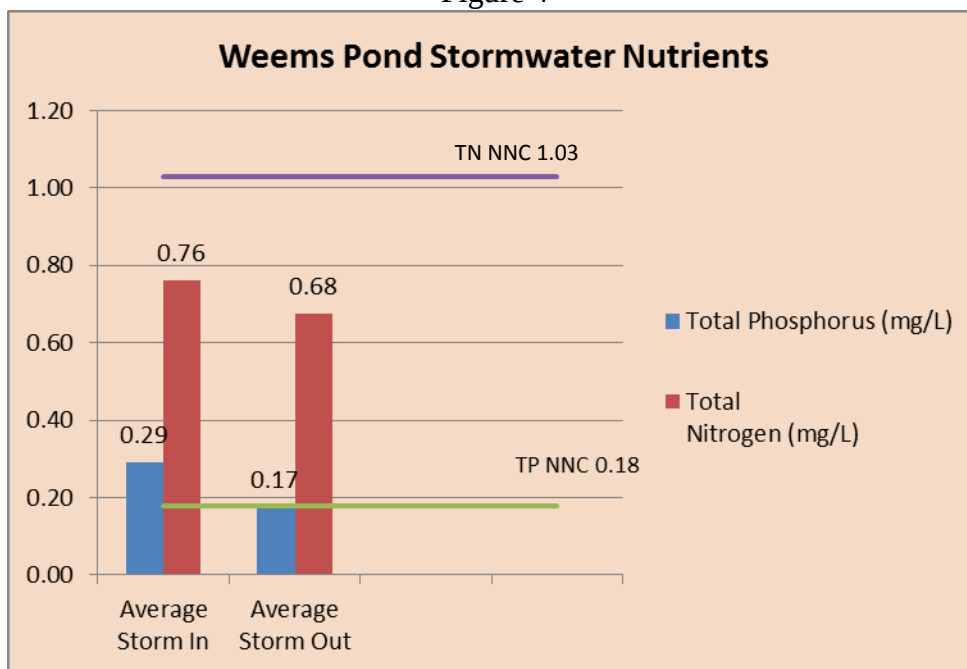
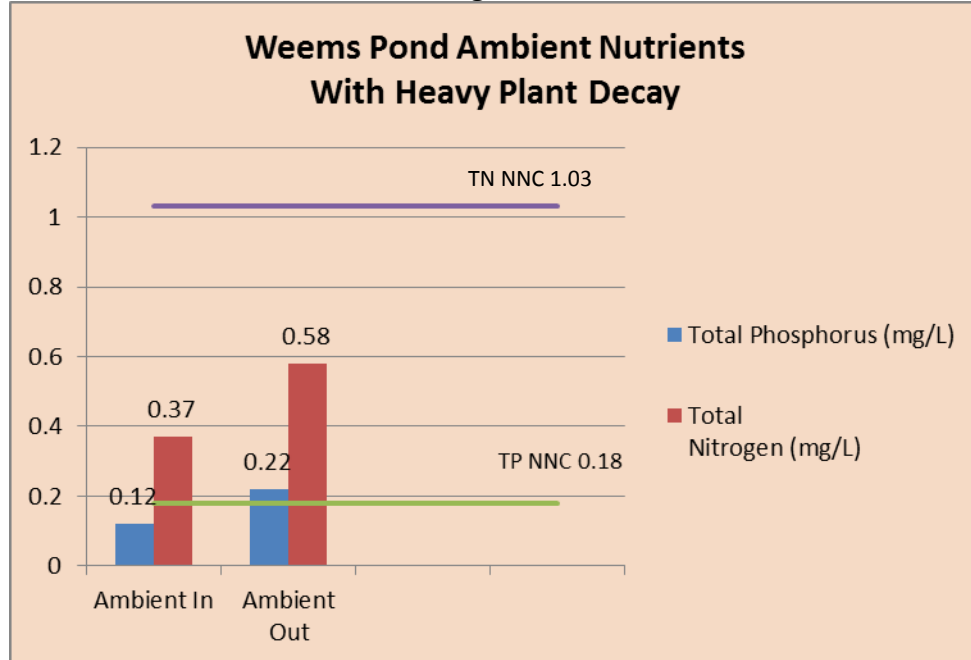


Figure 5



SUMMARY OF THE CAPITAL IMPROVEMENT PROJECT (ENHANCEMENT PROJECT)

The capital improvement project (CIP) plans for the Weems Pond Stormwater Treatment Facility are to convert the existing facility to a chemically enhanced stormwater treatment system to improve the pollutant removal efficiencies of the system and to reduce pollutant loads that ultimately discharge in Upper Lake Lafayette. The current NNC water quality standards for streams, especially the TP value of 0.18 mg/L and the Northeast Drainage Ditch TMDL for fecal coliform (63% reduction) necessitate the design and implementation of more advanced treatment technologies for retrofit projects, such as alum treatment. Jar tests conducted on stormwater samples from 40 Florida projects have demonstrated pollutant removal efficiencies using aluminum sulfate (alum) for TP and fecal coliform up to 90% and 99% respectively.

More than 30 alum stormwater treatment systems have been designed, permitted and constructed in Florida. The systems are designed with in-line or off-line floc settling ponds in accordance with DEP requirements. Accumulated wet floc is commonly pumped to public wastewater treatment facilities; a process planned for this project. The functional alum stormwater treatment facility at Weems Ponds will be in-line, and will include a floc settling pond, water flow measuring equipment, a structure housed with chemical storage tanks and pump equipment. The design plan is intended to dose the flow into the facility with alum (5 mg Al/L) up to a peak flow rate of 200 cubic feet per second (cfs), which comprises 82% of the total annual water volume to the facility. There will be a bypass for flow greater than 200 cfs.

The project is scheduled to begin construction in the summer of 2011. Any inquiries regarding the Capital Project at Weems Pond Stormwater Facility can be directed to the City of Tallahassee, Stormwater Management, 850-891-6860.

CONCLUSIONS

The City and DGC Environmental Inc. carefully planned the herbicide treatment application for a pond that was 100% inundated with water hyacinth using conservative calculations and procedures to assure that water quality standards would be met and to minimize any adverse affects to fish and wildlife. The removal of the water hyacinth was successful and without apparent adverse impacts such as fish kills from dramatic changes dissolved oxygen levels due to excessive plant decay. The 2,4-D sample results showed that during the treatment period the concentrations were well below Maximum Contaminant Levels or Surface Water Target Cleanup Levels.

The baseline stormwater data that were gathered and one ambient sample collected may be used in the future to evaluate or improve the treatment and performance capacity of the facility when the capital improvement project is completed. The ambient sample was collected during a dry period in the Fall of 2010 soon after most of the plant biomass was eliminated from the surface. As expected, there was a mass export of nutrients from the pond where concentrations at the Outflow station did increase somewhat as they were released in the water column from the decaying plants. The TP increased by 83% and the TN 57%. The stormwater data showed that TP at the Inflow and fecal coliform at both the Inflow and Outflow exceeded NNC and TMDL water quality standards respectively. The average total nitrogen concentrations for both the Inflow and Outflow were below the NNC. Once the facility has been retrofitted with the enhanced treatment using alum, the expected pollutant removal efficiency for phosphorus and fecal coliform should achieve desired reductions in those pollutants for approximately 82% of the total annual water volume.

Appendix A
Photo Documentation
June 29, 2010 Week 1



July 7, 2010 Week 2



July 13, 2010 Week 3



July 21, 2010 Week 4



July 27, 2010 Week 5



August 5, 2010 Week 6



August 10, 2010 Week 7



August 17, 2010 Week 8



August 26, 2010 Week 9



September 1, 2010 Week 10



September 8, 2010 Week 11



September 14, 2010 Week 12



September 29, 2010 Week 13



October 5, 2010 Week 14



October 13, 2010 Week 15



October 20, 2010 Week 16



January 28, 2011, Week 31



DGC ENVIRONMENTAL SERVICES, INC.

Name of Nearest Water Body: Little Lake Lafayette
County of Water Body: Leon
Applicator's Company Name: DGC Environmental Services, Inc.
Address: 853 South Kings Highway, Fort Pierce, Florida 34945
Telephone: Phone: (772) 467-9224 Fax: (772) 467-9226

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Weed Control Report

City of Tallahassee

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Weed Control Report

City of Tallahassee

Weed Control Report

City of Tallahassee

Weed Control Report

City of Tallahassee

Appendix C

Analytical Results for Storm Event Monitoring Weem Pond Stormwater Facility

Sample Location	Date	Ammonia	Nitrogen, Kjeldahl	Nitrate - Nitrite	Dissolved Phosphorus	Total Phosphorus	B.O.D	C.O.D	TDS	Total Residue	TSS	TVS (%)	TVSS (%)	Turbidity (NTU)	Total Nitrogen
Inflow	6/23/2008	0.02	0.48	0.09	0.081	0.094	2.2	19 I	60	68	2.5 I	0.002	0.0001 U	11	0.57
	8/7/2008	0.067	0.78	0.3	0.15	0.51	9.6	21	68	120	53	0.0043	0.0015	46	1.1
	7/16/2010	0.017 I	0.46	0.15	0.18	0.34	3.2	32	46	40 Q	59	0.0080 UQ	0.00064	22	0.61
	8/26/2010	0.022 U	0.59	0.18 V	0.24	0.22	6.3	30	52	56	76	0.0010 U	0.0022	40	0.77
	10/21/2010	0.05	0.36	0.012	0.085	0.12	1.5 U	8.5 I	96	83	4.0 I	0.0024	0.0010 U	6.4	0.37
Outflow	6/23/2008	0.014 I	0.51	0.11	0.068	0.078	2.5	25	52	70	9.5	0.0027	0.0001 U	17	0.62
	8/8/2008	0.039	0.47	0.012	0.053	0.09	3	17 I	61	76	4.5 I	0.0036	0.0010 U	2.8	0.48
	7/16/2010	0.081	0.46	0.14	0.16	0.30	3	26	59	40 UQ	42	0.0079 UQ	0.0004 U	16	0.60
	8/26/2010	0.0043 U	0.86	0.15 V	0.22	0.23	6	30	52	40 U	19	0.0010 U	0.00056 U	24	1
	10/21/2010	0.16	0.56	0.019	0.22	0.22	1.8 I	20	80	68	3.0 I	0.0045	0.0010 U	2.0	0.58

Key:

Analytical Results = mg/L

B.O.D = Biochemical Oxygen Demand

C.O.D = Chemical Oxygen Demand

DO = Dissolved Oxygen

I = The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit

mg/L = milligrams per liter (units of analytical results, unless otherwise stated)

NTU = Nephelometric turbidity units

Q = Sample held beyond the acceptable hold time

TDS = Total dissolved solids

TSS = Total Suspended Solids

TVS = Total volatile solids

TVSS = Total volatile suspended solids

U = Indicates that the compound was analyzed for but not detected

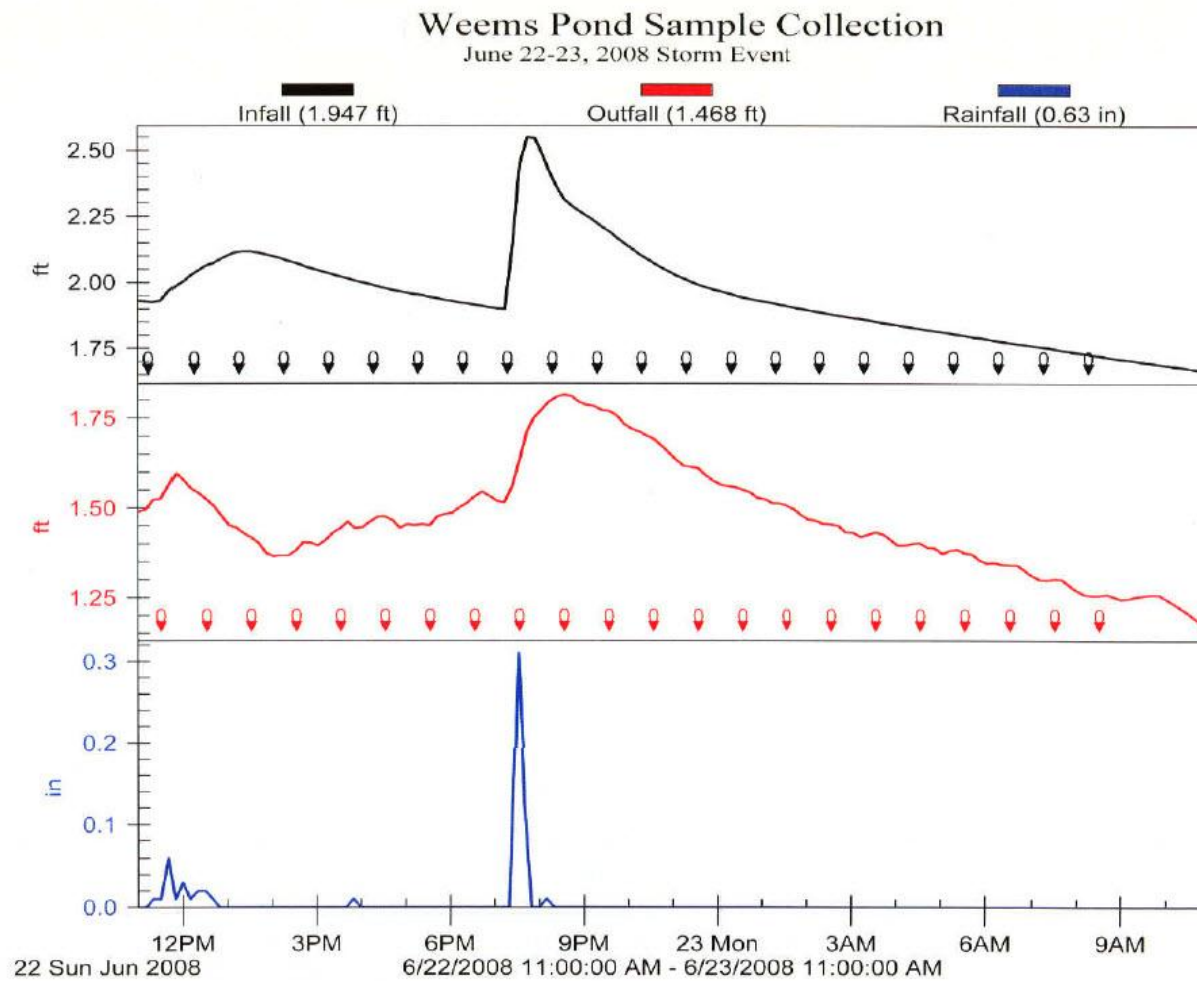
V = Indicates that the analyte was detected in both the sample and the associated method blank

**Biological Analytical Results for Storm Event & Ambient Monitoring
Weems Pond Stormwater Facility**

Sample	Date	Escherichia	Fecal	Enterococcus ²
Location	Date	Coli ¹	Coliform ²	
Inlet	6/23/2008	770 Q	29,100 B Q	5,700 B
	8/8/2008	16000 Q	24,000 B	8,500 B Q
	7/16/2010	>2420 Q	29,000	2.0 U
	8/26/2010	5500 Q	19,000 Q	14,200 B Q
(Ambient)	8/26/2010	11 Q	28	150
Outfall	6/23/2008	870 Q	24,400 B	7,000 B
	8/8/2008	46 Q	25,500 B	2,400
	7/16/2010	2900 Q	33,000	2.0 U
	8/26/2010	2,900 Q	23,000 Q	4,200 Q
(Ambient)	8/26/2010	24 Q	18	710 B
Notes:				
1. Escherichia Coli Analytical Results = Most Probable Number per 100 milliliters				
2. Fecal Coliform and Enterococcus Analytical Results = # / 100 milliliters				
Key:				
B = Results based upon colony counts outside the ideal range of 20 - 60 colonies per plate				
Q = Sample held beyond the accepted holding time				
U = Indicates that the compound was analyzed for but not detected				
> = Greater than				

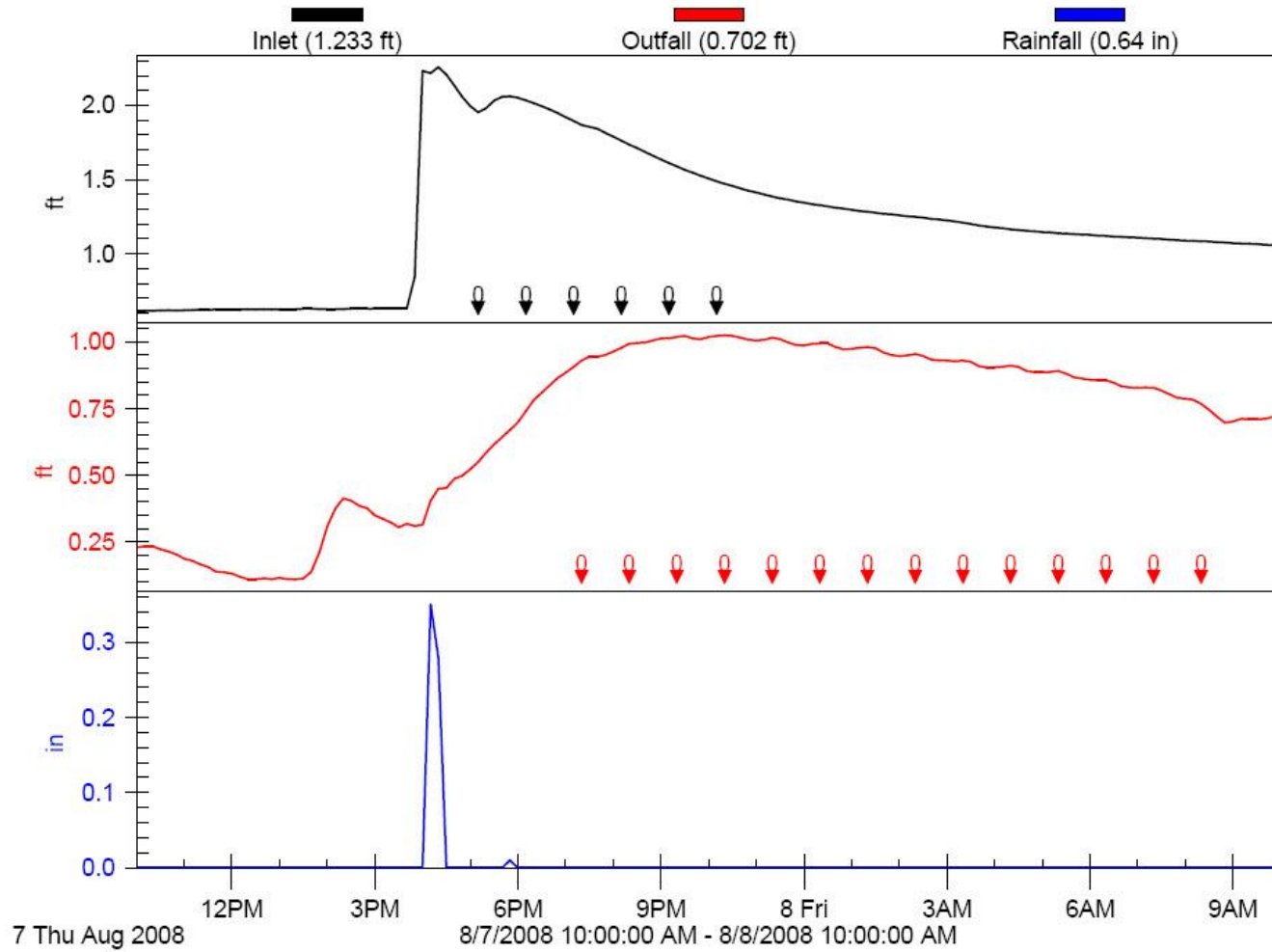
Appendix D

ISCO Flow and Sampler Reports



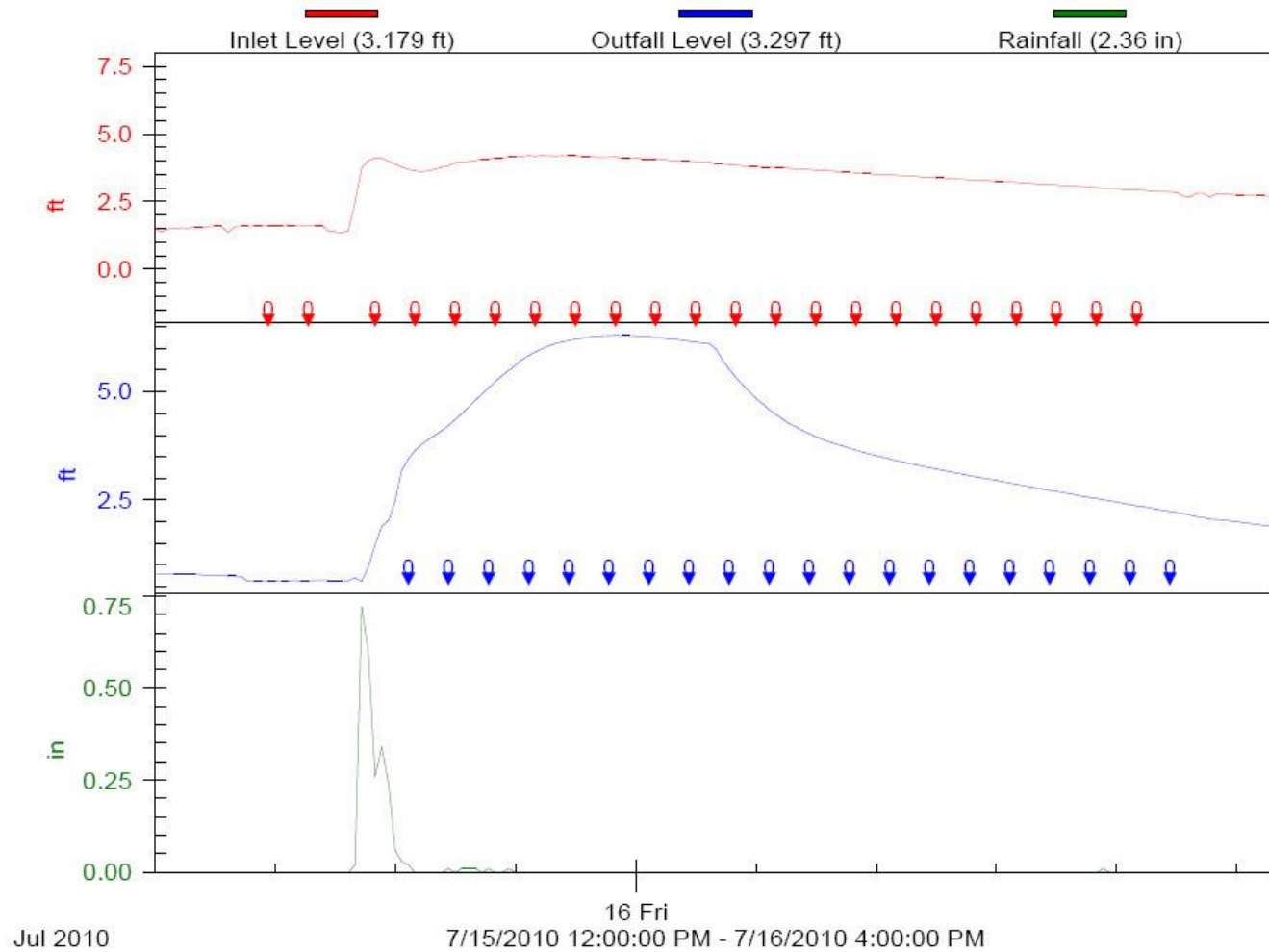
Weems Pond Sample Collection

August 7-8, 2008 Storm Event



Weems Pond Storm Sampling Event

July 15-16, 2010



Weems Pond Storm Sampling Event

August 25-26, 2010

