Indian River County, Florida
Stormwater Division
Public Works Department
Pilot Algal Turf Scrubber®
For PC South

Monthly Performance Reports
Summary Report #6

Work Order # PCS-1

Project Manager for Indian River County
Keith McCully, P.E.
Director, Stormwater Division

Prepared for:

Indian River County and
Florida Department of Environmental Protection

Prepared by:

HydroMentia
WATER TREATMENT TECHNOLOGIES

HydroMentia, Inc.
3233 SW 33rd Road, Suite 201
Ocala, FL 34474

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Executive Summary

The PC-South Algal Turf Scrubber® (ATS™)[1] Pilot Investigation (Pilot) was implemented by Indian River County, Florida in an effort to assess the technology's applicability in rendering a blended water of Reverse Osmosis Concentrate associated with Indian River County (County) Utilities Water Treatment Facility located on Oslo Road in Vero Beach, Florida and surface water from the nearby South Relief Canal which captures and conveys water from a rural/suburban watershed to the Indian River Lagoon, compliant with applicable conditions associated with:

- The Industrial Wastewater Facility Permit # 31-FL0037940-NPDES (Minor) issued by the Florida Department of Environmental Protection (FDEP) on October 23, 2008
- An attendant Consent Order 08-1661 dated September 19, 2008;
- A letter (OCD-1W-10-145) related to specific requirements of the Pilot dated July 28, 2010 from Christianne Ferraro P.E., Program Administrator for Water Facilities with FDEP to Erik Olson, Director of Utilities, Indian River County.
- Rules of FDEP Ch62-302.530 F.A.C. and 62-302.500 F.A.C.

Based upon the Scope of Work for the Pilot included within the contract between HydroMentia, Inc and the County—Work Order PCS-1-- the influent water to be investigated is to be a blend of approximately 6:1 to 10:1 canal water to Reverse Osmosis (RO) Concentrate[2]. The Pilot has rendered water within these dilution ranges compliant with the applicable limits, except for three pH values[3], and four conductivity levels during the 7Q10 ratio during the last weeks of the monitoring period[4] as noted in Table ES-1 (a) through (o).

[1] The Algal Turf Scrubber® is a proprietary technology (HydroMentia, Inc. of Ocala, Fl) that relies upon chemical changes and direct biological uptake across a sloped floway upon which is grown an attached algal turf to reduce waterborne pollutants and enhance water quality.
[2] Investigations showed the 7Q10 flow in the South Relief Canal to be 4.40 MGD, or a blend ratio of 3.67:1. This ratio was investigated during the final 5 weeks of the monitoring period.
[3] The values shown are daytime pH values, and do not represent 24 hr diurnal values. As noted later in the text pH values drop considerably at night, bringing the average daily pH to well within limits
[4] The effluent conductivity levels during the final period are just above the 50% increase allowable during the lower blending ratio. However, background conductivity during actual 7Q10 conditions would be considerably higher than what was noted during the monitoring period, which would allow the effluent to be compliant during the 7Q10 conditions. The issue of effluent conductivity is discussed in greater detail within the main body of the text.

Table ES-1(a): Summary of Pilot pH Results Compared to Applicable Compliance Conditions

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		Daily Max 8.5 Daily Min 6.0	Per Permit	Per Permit	8.5>pH>6.0 No background change +/- 1 unit	
pH	**pH Units**	**Field**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4	7.86	7.80	7.91	**8.25**	Yes
01/31/11			10.0	7.70	7.77	8.04	**8.46**	Yes
02/07/11			7.1	7.67	7.85	7.90	**8.75**	No
02/14/11			9.5	7.82	7.83	7.83	**8.62**	No
02/21/11			7.8	7.85	7.78	7.89	**8.53**	No
05/16/11			6.3	7.41	7.37	7.67	**8.32**	Yes
05/23/11			12.3	7.68	7.50	7.78	**8.41**	Yes
05/30/11			4.9	7.77	7.51	7.80	**8.35**	Yes
06/06/11			8.3	7.89	7.55	7.83	**8.28**	Yes
07/18/11			4.4	7.77	7.44	7.64	**8.01**	Yes
07/25/11			4.3	7.53	7.24	7.53	**8.00**	Yes
08/01/11			3.7	7.33	7.14	7.34	**8.00**	Yes
08/08/11			3.9	7.29	7.15	7.44	**7.86**	Yes
08/15/11			4.1	7.38	7.05	7.30	**8.01**	Yes
		Average		7.66	7.53	7.74	**8.31**	
		Max Daily		7.89	7.85	8.04	**8.75**	
		30 day Max		7.92	7.83	7.91	**8.59**	

Table ES-1 (b): Summary of Pilot TP Results Compared to Applicable Compliance Conditions

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		Monthly average grab samples 1 mg/L	Per Permit	Per Permit	Not cause ecological disruption	
Total Phosphorus	**mg/L**	**Composite**	**Dilution**	**Results Canal Influent (grab samples)**	**Results RO Concentrate (grab samples)**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4		0.023	0.073	**0.053**	Yes
01/31/11			10.0	0.118	0.038	0.092	**0.061**	Yes
02/07/11			7.1			0.095	**0.059**	Yes
02/14/11			9.5	0.106	0.046	0.084	**0.049**	Yes
02/21/11			7.8			0.073	**0.041**	Yes
05/16/11			6.3			0.118	**0.064**	Yes
05/23/11			12.3	0.139	0.028	0.109	**0.058**	Yes
05/30/11			4.9			0.120	**0.053**	Yes
06/06/11			8.3	0.143	0.031	0.178	**0.059**	Yes
07/18/11			4.4			0.154	**0.100**	Yes
07/25/11			4.3	0.170	0.038	0.150	**0.092**	Yes
08/01/11			3.7			0.154	**0.112**	Yes
08/08/11			3.9	0.179		0.189	**0.053**	Yes
		Average		0.143	0.064	0.122	**0.068**	
		Max Daily		0.179	0.046	0.189	**0.122**	
		30 day Max		0.175	0.042	0.162	**0.099**	

Table ES-1 (c): Summary of Pilot Results Projected TP Load Reduction Compared to Applicable Compliance Conditions

Limitations		Permit 31-FL0037940			Consent Order 08-1661			FDEP Letter OCD-1W-10-145			Class III waters Ch 62-302.530 F.A.C
Parameter		RO Concentrate Load ≤ 291 lb/yr			Per Permit			Per Permit			Not cause ecological disruption
Total Phosphorus	**Dilution**	**Average RO Concentrate Influent**			**Average Blended Influent**			**Average Blended Effluent**			**Average TP Load Removed**
		Flow MGD	mg/L	lb/month	Flow MGD	mg/L	lb/month	Flow MGD	mg/L	lb/month	**lb/month**
January 2011	10.2	1.2	0.031	9.62	13.4	0.083	287.55	13.4	0.057	197.47	**90.08**
February 2011	8.4	1.2	0.046	12.89	11.3	0.084	221.66	11.3	0.055	145.13	**76.53**
May 2011	7.0	1.2	0.030	9.31	9.6	0.131	325.14	9.6	0.059	146.44	**178.70**
July 2011	4.1	1.2	0.038	11.79	6.1	0.162	255.49	6.1	0.089	140.36	**115.13**
		Monthly Average RO Influent lb		**10.90**						**Monthly Average Removed lb**	**115.11**
		Average Annual RO Influent lb		**130.80**						**Average Annual Removed lb**	**1,381.32**
		Annual RO Concentrate TP Load Discharged <0.00 lb/yr. Percent of RO Concentrate TP Load reduced = 1,056% System is in Compliance with Limitations									

Table ES-1 (d): Summary of Pilot TN Results Compared to Applicable Compliance Condition

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		Monthly average grab samples 3 mg/L	Per Permit	Per Permit	Not cause ecological disruption	
Total Nitrogen	**mg/L**	**Composite**	**Dilution**	**Results Canal Influent (grab samples)**	**Results RO Concentrate (grab samples)**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4		1.72	0.67	**0.53**	Yes
01/31/11			10.0	0.53	1.51	0.62	**0.37**	Yes
02/07/11			7.1			0.55	**0.37**	Yes
02/14/11			9.5	0.53	1.48	0.55	**0.30**	Yes
02/21/11			7.8			0.91	**0.57**	Yes
05/16/11			6.3			0.67	**0.53**	Yes
05/23/11			12.3	0.64	1.52	0.57	**0.30**	Yes
05/30/11			4.9			0.66	**0.41**	Yes
06/06/11			8.3			1.05	**0.68**	Yes
07/18/11			4.4			1.03	**0.85**	Yes
07/25/11			4.3	1.03	1.66	0.80	**0.66**	Yes
08/01/11			3.7			0.98	**0.64**	Yes
08/08/11			3.9	0.92	3.82	0.67	**0.53**	Yes
		Average		0.73	1.95	0.71	**0.50**	
		Max Daily		1.03	3.82	1.05	**0.85**	
		30 day Max		0.98	2.74	1.39	**0.71**	

Table ES-1 (e): Summary of Pilot Results Projected TN Load Reduction Compared to Applicable Compliance Conditions

Limitations		Permit 31-FL0037940			Consent Order 08-1661			FDEP Letter OCD-1W-10-145			Class III waters Ch 62-302.530 F.A.C
Parameter		RO Concentrate Load ≤ 4,636 lb/yr			Per Permit			Per Permit			Not cause ecological disruption
Total Nitrogen	**Dilution**	**Average RO Concentrate Influent**			**Average Blended Influent**			**Average Blended Effluent**			**Average TP Load Removed**
		Flow MGD	mg/L	lb/month	Flow MGD	mg/L	lb/month	Flow MGD	mg/L	lb/month	**lb/month**
January 2011	10.2	1.2	1.62	502.60	13.4	0.65	2,251.88	13.4	0.45	1,558.00	**693.88**
February 2011	8.4	1.2	1.48	414.73	11.3	0.67	1,767.98	11.3	0.41	1,081.90	**686.08**
May 2011	7.0	1.2	1.52	471.58	9.6	0.74	1,836.67	9.6	0.48	1,191.35	**645.32**
July 2011	4.1	1.2	2.74	850.08	6.1	0.87	1,372.07	6.1	0.67	1,056.65	**315.42**
		Monthly Average RO Influent lb		**559.75**						**Monthly Average Removal lb**	**585.18**
		Average Annual RO Influent lb		**6,716.97**						**Average Annual Removal lb**	**7,022.10**

Annual RO Concentrate TN discharged Load <0.00 lb/yr.
Percent of RO Concentrate TN Load reduced = 105%
System is in Compliance with Limitations

Table ES-1 (f): Summary of Pilot Dissolved Oxygen Results Compared to Applicable Compliance Condition

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		≥ 5 mg/L	Per Permit	Per Permit	≥ 5 mg/L	
Dissolved Oxygen	**mg/L**	**Field**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4	5.73	5.98	5.94	**13.87**	Yes
01/31/11			10.0	8.18	8.58	8.98	**22.54**	Yes
02/07/11			7.1	5.29	5.84	5.54	**14.68**	Yes
02/14/11			9.5	5.56	6.05	5.78	**18.91**	Yes
02/21/11			7.8	6.03	6.51	6.39	**14.30**	Yes
05/16/11			6.3	5.56	7.03	6.34	**11.15**	Yes
05/23/11			12.3	5.94	7.00	6.68	**9.42**	Yes
05/30/11			4.9	5.75	7.79	5.32	**13.48**	Yes
06/06/11			8.3	7.36	7.32	8.33	**13.20**	Yes
07/25/11			4.3	5.13	5.95	5.21	**13.49**	Yes
08/01/11			3.7	5.02	6.81	4.85	**8.45**	Yes
08/08/11			3.9	5.25	6.88	5.22	**7.56**	Yes
08/11/11			4.1	3.83	4.51	3.65	**7.58**	Yes
		Average		5.74	6.63	6.02	**12.97**	
		Min Daily		3.83	4.51	3.65	**7.56**	
		30 day Min		4.81	5.29	4.73	**9.27**	

Table ES-1 (g): Summary of Pilot Conductivity Results Compared to Applicable Compliance Condition

				Limitations					
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C		
Parameter	**Units**	**Sample Type**		≤ 50% above Background	≤ 6,500	Per Permit	≤ 50% above Background		
Specific Conductivity	**micros/cm**	**Field**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**% Increase Above Background**	**Compliance**
01/24/11			10.4	1,773	6,287	2,188	**2,273**	**28.2%**	Yes
01/31/11			10.0	1,495	6,522	2,060	**2,050**	**37.1%**	Yes
02/07/11			7.1	1,809	6,434	2,318	**2,533**	**40.0%**	Yes
02/14/11			9.5	1,629	6,303	2,053	**2,325**	**42.7%**	Yes
02/21/11			7.8	6.03	6.51	6.39	**14.30**	**44.5%**	Yes
05/16/11			6.3	2,300	5,923	2,725	**2,797**	**21.6%**	Yes
05/23/11			12.3	2,547	6,118	2,777	**2,940**	**15.4%**	Yes
05/30/11			4.9	2,660	5,891	2,972	**3,082**	**15.9%**	Yes
06/06/11			8.3	2,082	6,028	2,361	**2,461**	**18.2%**	Yes
07/18/11			4.4	1,956	6,778	2,820	**2,832**	**44.8%**	Yes
07/25/11			4.3	1,920	6,696	2,908	**2,999**	**56.2%**	No
08/01/11			3.7	2,004	7,027	3,158	**3,318**	**65.6%**	No
08/08/11			3.9	1,957	6,705	2,832	**2,962**	**51.4%**	No
08/11/11			4.1	1,524	6,070	2,453	**2,598**	**70.5%**	No
		Average		1,961	6,358	2,582	**2,697**	**37.5%**	
		Max Daily		2,660	7,027	3,158	**3,318**	**24.7%**	
		30 day Max		2,309	6,625	2,838	**2,969**	**28.6%**	

Table ES-1 (h): Summary of Water Temperature Results Compared to Applicable Compliance Condition

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		Not Stated	Per Permit	Per Permit	≤ 92° F	
Water Temperature	**° F**	**Field**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4	66.88	75.27	67.68	**72.18**	Yes
01/31/11			10.0	75.40	66.51	66.51	**68.16**	Yes
02/07/11			7.1	77.61	74.30	74.30	**81.39**	Yes
02/14/11			9.5	75.22	68.68	68.68	**73.99**	Yes
02/21/11			7.8	77.50	74.23	74.23	**79.03**	Yes
05/16/11			6.3	80.96	78.73	81.01	**84.02**	Yes
05/23/11			12.3	83.93	80.51	83.62	**91.09**	Yes
05/30/11			4.9	85.62	79.21	85.19	**89.60**	Yes
06/06/11			8.3	84.09	79.66	83.26	**88.43**	Yes
07/18/11			4.4	86.95	80.06	85.78	**87.15**	Yes
07/25/11			4.3	88.41	80.22	86.74	**86.09**	Yes
08/01/11			3.7	88.52	81.19	86.52	**92.89**	No
08/08/11			3.9	86.70	79.97	85.01	**89.13**	Yes
08/11/11			4.1	85.37	81.28	84.11	**91.22**	Yes
		Average		79.81	78.70	79.48	**83.89**	
		Max Daily		88.52	81.28	86.74	**92.89**	
		30 day Max		87.25	80.67	85.60	**89.83**	

Table ES-1 (i): Summary of Total Fluoride Results Compared to Applicable Compliance Condition

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		≤ 5 mg/L	NA	Per Permit	≤ 10 mg/L	
Total Fluoride	**mg/L**	**Grab**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4		9.30	1.20	**1.20**	Yes
01/31/11			10.0	0.76	8.00	1.10	**1.10**	Yes
02/07/11			7.1		8.30	1.20	**1.20**	Yes
02/14/11			9.5	0.80	12.70	1.10	**1.20**	Yes
02/21/11			7.8		15.00	2.00	**2.00**	Yes
05/16/11			6.3		6.10	1.20	**1.20**	Yes
05/23/11			12.3	0.97	4.80	1.10	**1.10**	Yes
05/30/11			4.9		5.60	1.10	**1.20**	Yes
06/06/11			8.3	0.78	5.70	1.00	**0.97**	Yes
07/18/11			4.4			0.75	**0.75**	Yes
07/25/11			4.3	0.19	3.20	0.73	**0.85**	Yes
08/01/11			3.7		6.00	1.40	**1.50**	Yes
08/08/11			3.9	0.87	8.80	1.30	**0.98**	Yes
		Average		0.73	7.79	1.17	**1.17**	
		Max Daily		0.97	15.00	2.00	**2.00**	
		30 day Max		0.88	11.00	1.35	**1.38**	

Table ES-1 (j): Summary of Unionized Ammonia Results Compared to Applicable Compliance Condition

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		Not Stated	Per Permit	Per Permit	≤ 0.02	
Unionized Ammonia-N	**mg/L**	**Calculated from Composite Total Ammonia-N**	**Dilution**	**Results Canal Influent (grab samples)**	**Results RO Concentrate (grab samples)**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4		0.03	U	**U**	Yes
01/31/11			10.0		0.04	U	**U**	Yes
02/07/11			7.1		0.04	U	**U**	Yes
02/14/11			9.5	U		U	**U**	Yes
02/21/11			7.8		0.03	U	**U**	Yes
05/16/11			6.3		U	U	**U**	Yes
05/23/11			12.3	U	0.02	U	**U**	Yes
05/30/11			4.9		0.04	U	**U**	Yes
06/06/11			8.3	U	0.02	U	**U**	Yes
07/18/11			4.4			U	**U**	Yes
07/25/11			4.3			U	**U**	Yes
08/01/11			3.7	U	U	U	**U**	Yes
08/08/11			3.9		U	U	**U**	Yes
		Average		U	0.02	U	**U**	
		Max Daily		U	0.04	U	**U**	
		30 day Max		U	0.03	U	**U**	

U = below detectable limits

Table ES-1 (k): Summary of Unionized Hydrogen Sulfide Results Compared to Applicable Compliance Condition

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		Not Stated	Per Permit	Per Permit	Odor Free 62-302.500	
Unionized Hydrogen Sulfide	**mg/L**	**Calculated from grab Total Sulfide**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4		U	U	**U**	Yes
01/31/11			10.0		U	U	**U**	Yes
02/07/11			7.1		U	U	**U**	Yes
02/14/11			9.5	U	U	U	**U**	Yes
02/21/11			7.8		U	U	**U**	Yes
05/16/11			6.3			U	**U**	Yes
05/23/11			12.3	U	U	U	**U**	Yes
05/30/11			4.9		U	U	**U**	Yes
06/06/11			8.3		U	U	**U**	Yes
07/18/11			4.4			U	**U**	Yes
07/25/11			4.3			U	**U**	Yes
08/01/11			3.7	U	U	U	**U**	Yes
08/08/11			3.9		U	U	**U**	Yes
		Average		U	U	U	**U**	
		Max Daily		U	U	U	**U**	
		30 day Max		U	U	U	**U**	

Table ES-1 (l): Summary of Gross Alpha Particles Results Compared to Applicable Compliance Condition

				Limitations			
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C
Parameter	**Units**	**Sample Type**		≤ 15 Pci/L	Max 32 Pci/L	Per Permit	≤ 15 Pci/L
Gross Alpha Particles	**Pci/L**	**Grab**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Effluent**	**Compliance**
01/31/11			10.0	<2.90+/- 1/43	6.19+/- 2.28	**<2.74 +/- 1.56**	Yes
02/14/11			9.5	<2.26 +/- 1.39	6.01+/-1.79	**<1.86 +/- 1.04**	Yes
05/16/11			6.3	2.07 +/- 1.21	8.13 +/- 2.32	**2.93 +/- 1.65**	Yes
05/23/11			12.3	4.71+/- 2.22	19.70+/- 4.36	**3.69 +/- 2.15**	Yes
06/06/11			8.3	2.92U+/- 1.48	8.56+/-3.17	**3.66U+/-1.94**	Yes
07/25/11			4.3	3.97+/- 1.81	9.56+/-3.25	**4.29U+/-2.03**	Yes
08/08/11			3.9	2.24 +/- 1.49	52.00 +/- 11.40	**4.03+/- 1.67**	Yes
		Average		3.01	15.74	**3.31**	
		Max Daily		4.71	52.00	**4.29**	
		30 day Max		3.23	30.78	**4.16**	

Table ES-1 (m): Summary of Total Radium Results Compared to Applicable Compliance Condition

				Limitations			
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C
Parameter	**Units**	**Sample Type**		≤ 5 Pci/L	Max 32 Pc1/L	Per Permit	≤ 5 Pci/L
(Total) Radium 226+ Radium 228	**Pci/L**	**Grab**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Effluent**	**Compliance**
01/31/11			10.0	2.21 +/- 1.40	4.33 +/- 1.91	**1.25 +/- 1.23**	Yes
02/14/11			9.5	1.76 +/- 1.11	4.94 +/- 1.92	**2.04 +/- 1.28**	Yes
05/16/11			6.3	3.50 +/- 1.31	6.34 +/- 2.05	**2.54+/- 1.12**	Yes
05/23/11			12.3	5.62+/- 2.09	2.66+/- 1.38	**0.10+/- 0.62**	Yes
06/06/11			8.3	2.93+/- 1.53	5.52+/- 2.15	**2.50+/- 1.39**	Yes
07/25/11			4.3	2.81+/- 1.34	4.10+/- 1.65	**2.67+/- 1.24**	Yes
08/08/11			3.9	1.98 +/- 1.20	3.67 +/-1.78	**2.79 +/- 1.45**	Yes
		Average		2.97	4.51	**1.98**	
		Max Daily		5.62	6.34	**2.79**	
		30 day Max		4.56	4.63	**2.73**	

Table ES-1 (n): Summary of Acute Bioassay Pilot Results Compared to Applicable Compliance Conditions

Parameter	Units	Sample Type		Limitations				Results ATS™ Blended Effluent	Compliance
96 hr Acute Bioassay *Ceriodaphnia dubia*	LC_{50}	Grab	Dilution	Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C		
01/24/11			10.4	Not Stated	Per Permit	≥ 100%	Concentration at 1/3 of LC_{50} concentration	≥ 100%	Yes
01/31/11			10.0					≥ 100%	Yes
02/14/11			9.5					≥ 100%	Yes
07/18/11			4.4					≥ 100%	Yes
07/25/11			4.3					≥ 100%	Yes
08/01/11			3.7					≥ 100%	Yes
96 hr Acute Bioassay *Pimephales promelas*	LC_{50}	Grab	Dilution	Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C		
01/24/11			10.4	Not Stated	Per Permit	≥ 100%	Concentration at 1/3 of LC_{50} concentration	≥ 100%	Yes
01/31/11			10.0					≥ 100%	Yes
02/14/11			9.5					≥ 100%	Yes
07/18/11			4.4					≥ 100%	Yes
07/25/11			4.3					≥ 100%	Yes
08/01/11			3.7					≥ 100%	Yes

Table ES-1 (o) Summary of Chronic Bioassay Pilot Results Compared to Applicable Compliance Conditions

Parameter	**Units**	**Sample Type**		**Limitations**				**Results ATS™ Blended Effluent**	**Compliance**
Chronic Bioassay *Ceriodaphnia dubia*	IC_{25}/LC_{50}	24hr Composite x 3	Dilution	Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C		
08/16/11			~3.67	Not Stated	Per Permit	≥ 100%	≥ 100%	≥ 100%	Yes
08/30/11			~3.67					≥ 100%	Yes
09/06/11			~3.67					≥ 100%	Yes
Chronic Bioassay *Pimephales promelas*	IC_{25}/LC_{50}	24 hr Composite x 3	Dilution	Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C		
08/16/11			~3.67	Not Stated	Per Permit	≥ 100%	≥ 100%	≥ 100%	Yes
08/30/11			~3.67					≥ 100%	Yes
09/06/11			~3.67					≥ 100%	Yes

I. Introduction and Consent Order/Permit Compliance

The Algal Turf Scrubber® (ATS™) is a proprietary water treatment technology developed specifically to enhance water quality of polluted waters through the active cultivation of attached algae upon an engineered floway surface. By cultivation is meant the production and periodic harvesting of the community of organisms established around the primary production of attached algae (epiphytic and periphytic). This community as associated with the ATS™ is known as algal turf, and includes not only the algal biomass, but also associated invertebrates, vertebrates, bacteria, fungi, organic residues, and inorganic precipitants. Through the biological and chemical dynamics of this community, nutrient pollutants are removed from the water column, dissolved oxygen is increased, and oxidation of reduced substances is facilitated. The result is a treated effluent reduced in nutrients, high in dissolved oxygen, and relieved of many potentially biologically deleterious and toxic substances.

The PC-South ATS™ Pilot Investigation was implemented with the intent of determining the efficacy of the technology to 1) render a Reverse Osmosis Concentrate associated with Indian River County (County) Utilities Water Treatment Facility located on Oslo Road in Vero Beach, Florida, nontoxic to targeted bioassay organisms in accordance with Florida Department of Environmental Protection (FDEP) protocol as delineated within the letter of July 28, 2010 from Christianne Ferraro P.E., Program Administrator for Water Facilities with FDEP to Erik Olson Director Utilities, Indian River County; 2) establish an effluent suitable for discharge into the South Canal in accordance with limits noted within the Industrial Wastewater Facility Permit 31-FL0037940-NPDES (minor) of October 23, 2008 and associated Consent Order 08-1661 dated September 19,2008 between FDEP, and The Indian River County Utilities Department; and 3) reduce nutrient loads associated with the South Relief Canal as managed by the Indian River Farms Water Control District (IRFWCD) prior to release of the canal waters into the Indian River Lagoon (IRL) in accordance with the County's program for overall reduction of nutrient discharge into the Indian River Lagoon.

The pilot system is a standard 500 foot long, 1 foot wide Mobile Pilot Unit (MPU) as developed by HydroMentia, Inc., as shown in Appendix A. Water to the system is delivered from two sources—the canal water from the South Relief Canal and the RO Concentrate. Both are pumped and metered, and blended within a receiving box, prior to release to the floway. Water is allocated to the floway in surges provided by an automatic siphon device. The design flow rate of the blended flows is circa 20 gpm, although some adjustments to flow were made during the course of the monitoring period as needed to facilitate process optimization. The targeted blend per the contract between HydroMentia and the County—work order PCS-1—was 6:1 to 10:1 Canal Water to RO Concentrate.

The blended water, after treatment along the 500 foot floway, is graded through a 500 micron wedge wire screen. This ATS™ effluent flow is measured through a flow meter identical to that at the canal influent, and then released downstream into the South Relief Canal.

Composite sampling (timed sequencing) is applied to both the blended ATS™ influent and the ATS™ effluent, using refrigerated Sigma 900Max samplers. All other samples are collected as grab samples. Sampling is done on Monday mornings on a weekly basis. The composite samples are used for the weekly nutrient parameters—TKN, ammonia-N, nitrate and nitrite (NOx)-N and total phosphorus, and biweekly TOC, Ca, Fe, and Mg. Field parameters of pH, water T, DO and Conductivity are taken at the time of sampling at both influent and effluent as well as the RO Concentrate and the Canal water. The Monitoring Plan has been developed and implemented by HydroMentia, Inc., of Ocala, Florida under Agreement (Agreement PCS-1 dated 9/7/2010) with Indian River County Public Works Department. Sampling and sample handling procedures are conducted in compliance with applicable FDEP standards and guidelines.

The monitoring period extended from the date of initiation on January 17, 2011 to August 15, 2011. During the period from project initiation of January 17, 2011 until February 21, 2011, the blend ratio was maintained between the contracted range of 6:1 to 10:1. Testing during this period showed compliance with the limitations set within the permit and the consent order, including 96 hr acute bioassays for the two selected species *Pimephales promelas* (fathead minnow) and *Ceriodaphnia dubia* (water flea), as seen in the multi-page Table 1 [(a) through (o)], with the exception of three daytime pH values, which do not represent average diurnal values. Across the ATS™ pH drops notably during the nighttime, bringing the daily average within allowable limits (see Section VI-E).

Following this period of compliance, after a series of discussions with the County, it was decided to adjust the blend ratio to about 50% RO Concentrate and 50% Canal Water (1:1) to reflect worst case conditions which might occur during extreme low flow conditions within the South Relief Canal. The intent was to see how the ATS™ would react to the changes in conductivity and higher concentrations of various components associated with the RO Concentrate. This blend was continued through the fourth month (May 9, 2011). The rationale for evaluating this ratio was based upon review of long term USGS flow data from the station just east of the pilot project intake (station 02253500). As noted in Figure 1, over a sixty year period, the lowest minimum for daily mean flows was 1.14 MGD for the month of May. The monthly average for daily mean flows for the sixty year period was well above 10 MGD at 26.34 MGD. (This low daily mean should not be confused with the more official designation of the 7 day 10 year minimum flow, which has been calculated as 4.40 MGD from USGS station 02253500 data—see Appendix B). The dilution ratio was increased to the 6:1 to10:1 range from 5/9/2011 to 6/6/11. For a period from 6/6/11 to 7/11/11 the system was shut down because of the low water levels in the South Relief Canal which made it impossible for the self priming pump to deliver water. With increased flows on 7/11/11 the pump was restarted, and the monitoring continued through the remainder of the monitoring period, ending August 15, 2011. The blend ratio from 7/11/11 to 8/15/11 was targeted at 3.67:1 to emulate 7Q10 conditions.

Two laboratories were used for the mandatory analyses—Pace Laboratories of Ormond Beach, Florida and for Bioassay Testing, Marinco Laboratories of Sarasota, Florida. Both had previously been approved by FDEP and are NELAC certified. Analysis of plant tissue was by Midwest Laboratories in Omaha, Nebraska. Sampling and sample handling for HydroMentia was directed by Robinson Bazurto, Operations Manager, who is a graduate biologist with extensive experience in field sampling procedures as delineated by both FDEP and the various water management district's in Florida.

Initiation of the Pilot Study was on 1/17/2011. The first monthly period ended 2/14/2011. The second monthly period ended 3/14/2011. The third monthly period ended 4/11/2011, the fourth monthly period ended 5/9/2011, the fifth monthly period ended 6/6/11, and the final period was from 7/11/11 to 8/15/11.

During the second month the Indian River Farms Water Control District initiated construction within the South Relief Canal in the vicinity of the pilot study intake. Construction included widening the canal flow area, clearing aquatic vegetation, and placement of a large CMP culvert just upstream of the intake. This activity took place approximately over the first three weeks in March. During this period there was noted considerable change in water quality, both in terms of an increase in suspended solids, color, and nutrients. These changes continued into Month 3, with water quality returning eventually to conditions that appear similar to pre-construction conditions. However, silty deposits appeared to be more prevalent within the canal even after a month following construction, with silt accumulations observed within the vicinity of the intake manifold, and to some extent within the influent itself even during the fourth month of operation. During the first few weeks of this disruptive period, the facility provided very high levels of nutrient reduction, as it appeared much of the removal was associated with solids capture as well as direct algal uptake.

The algal turf was impacted by the deposited silts, but continued to display satisfactory levels of net community productivity. During Month 3, one 96 hr acute toxicity test conducted on Mysid shrimp failed to meet the standard of $LC_{50} \geq 100\%$, while two met this standard, as did three 96 hr acute toxicity tests conducted on the silverside minnow. During Month 4, one 96 hr acute toxicity test conducted on Mysid shrimp failed to meet the standard of $LC_{50} \geq 100\%$, while one met this standard, as did two 96 hr acute toxicity tests conducted on the silverside minnow. It is possible that the disruption to water quality conditions may have been partly responsible for the failures.

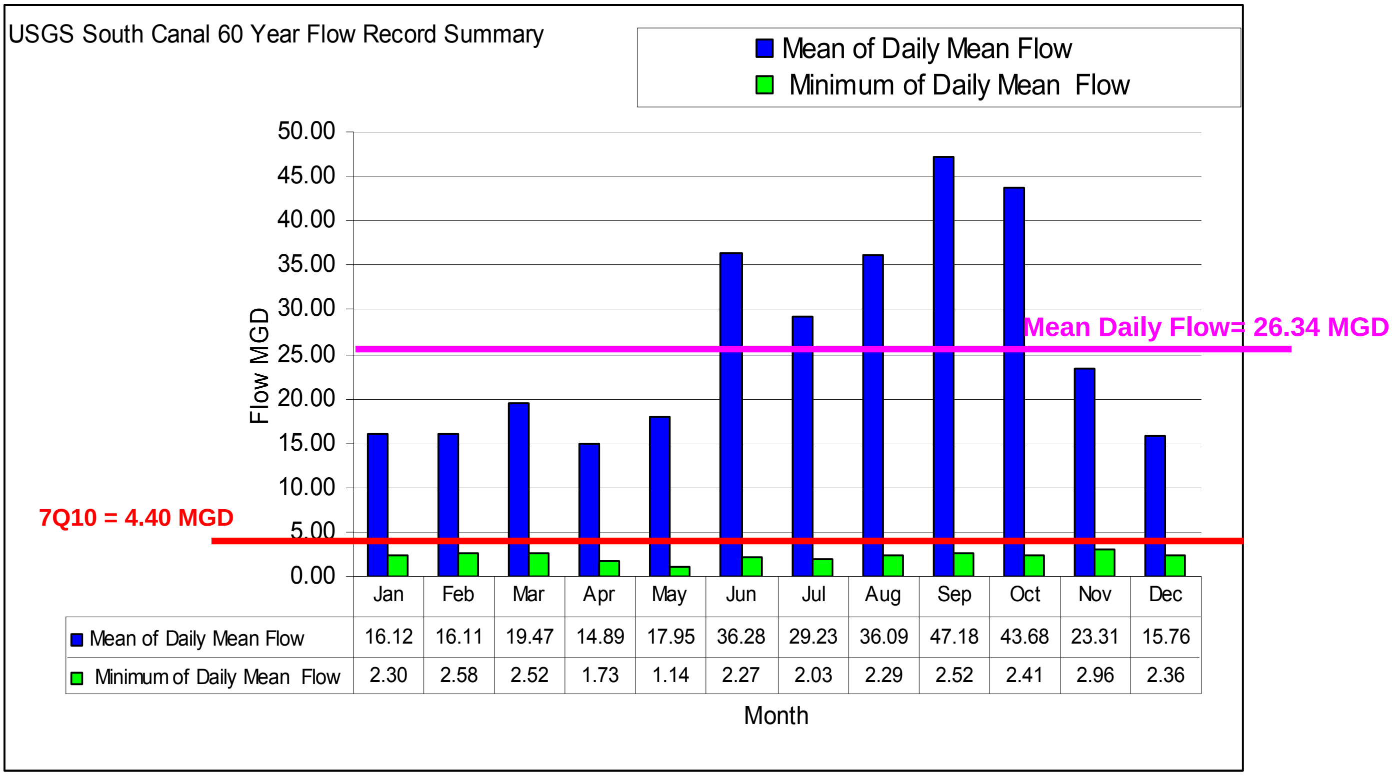


Figure 1: Sixty year flow summary USGS station 02253500 South Canal

Table 1(a): Summary of Pilot pH Results Compared to Applicable Compliance Conditions

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		Daily Max 8.5 Daily Min 6.0	Per Permit	Per Permit	8.5>pH>6.0 No background change +/- 1 unit	
pH	**pH Units**	**Field**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4	7.86	7.80	7.91	**8.25**	Yes
01/31/11			10.0	7.70	7.77	8.04	**8.46**	Yes
02/07/11			7.1	7.67	7.85	7.90	**8.75**	No
02/14/11			9.5	7.82	7.83	7.83	**8.62**	No
02/21/11			7.8	7.85	7.78	7.89	**8.53**	No
05/16/11			6.3	7.41	7.37	7.67	**8.32**	Yes
05/23/11			12.3	7.68	7.50	7.78	**8.41**	Yes
05/30/11			4.9	7.77	7.51	7.80	**8.35**	Yes
06/06/11			8.3	7.89	7.55	7.83	**8.28**	Yes
07/18/11			4.4	7.77	7.44	7.64	**8.01**	Yes
07/25/11			4.3	7.53	7.24	7.53	**8.00**	Yes
08/01/11			3.7	7.33	7.14	7.34	**8.00**	Yes
08/08/11			3.9	7.29	7.15	7.44	**7.86**	Yes
08/15/11			4.1	7.38	7.05	7.30	**8.01**	Yes
		Average		7.66	7.53	7.74	**8.31**	
		Max Daily		7.89	7.85	8.04	**8.75**	
		30 day Max		7.92	7.83	7.91	**8.59**	

Table 1 (b): Summary of Pilot TP Results Compared to Applicable Compliance Conditions

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		Monthly average grab samples 1 mg/L	Per Permit	Per Permit	Not cause ecological disruption	
Total Phosphorus	**mg/L**	**Composite**	**Dilution**	**Results Canal Influent (grab samples)**	**Results RO Concentrate (grab samples)**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4		0.023	0.073	**0.053**	Yes
01/31/11			10.0	0.118	0.038	0.092	**0.061**	Yes
02/07/11			7.1			0.095	**0.059**	Yes
02/14/11			9.5	0.106	0.046	0.084	**0.049**	Yes
02/21/11			7.8			0.073	**0.041**	Yes
05/16/11			6.3			0.118	**0.064**	Yes
05/23/11			12.3	0.139	0.028	0.109	**0.058**	Yes
05/30/11			4.9			0.120	**0.053**	Yes
06/06/11			8.3	0.143	0.031	0.178	**0.059**	Yes
07/18/11			4.4			0.154	**0.100**	Yes
07/25/11			4.3	0.170	0.038	0.150	**0.092**	Yes
08/01/11			3.7			0.154	**0.112**	Yes
08/08/11			3.9	0.179		0.189	**0.053**	Yes
		Average		0.143	0.064	0.122	**0.068**	
		Max Daily		0.179	0.046	0.189	**0.122**	
		30 day Max		0.175	0.042	0.162	**0.099**	

Table 1 (c): Summary of Pilot Results Projected TP Load Reduction Compared to Applicable Compliance Conditions

Limitations		Permit 31-FL0037940			Consent Order 08-1661			FDEP Letter OCD-1W-10-145			Class III waters Ch 62-302.530 F.A.C
Parameter		RO Concentrate Load ≤ 291 lb/yr			Per Permit			Per Permit			Not cause ecological disruption
Total Phosphorus	**Dilution**	**Average RO Concentrate Influent**			**Average Blended Influent**			**Average Blended Effluent**			**Average TP Load Removed**
		Flow MGD	mg/L	lb/month	Flow MGD	mg/L	lb/month	Flow MGD	mg/L	lb/month	**lb/month**
January 2011	10.2	1.2	0.031	9.62	13.4	0.083	287.55	13.4	0.057	197.47	**90.08**
February 2011	8.4	1.2	0.046	12.89	11.3	0.084	221.66	11.3	0.055	145.13	**76.53**
May 2011	7.0	1.2	0.030	9.31	9.6	0.131	325.14	9.6	0.059	146.44	**178.70**
July 2011	4.1	1.2	0.038	11.79	6.1	0.162	255.49	6.1	0.089	140.36	**115.13**
		Monthly Average RO Influent lb		**10.90**						**Monthly Average Removed lb**	**115.11**
		Average Annual RO Influent lb		**130.80**						**Average Annual Removed lb**	**1,381.32**

Annual RO Concentrate TP Load Discharged <0.00 lb/yr.
Percent of RO Concentrate TP Load reduced = 1,056%
System is in Compliance with Limitations

Table 1 (d): Summary of Pilot TN Results Compared to Applicable Compliance Condition

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		Monthly average grab samples 3 mg/L	Per Permit	Per Permit	Not cause ecological disruption	
Total Nitrogen	**mg/L**	**Composite**	**Dilution**	**Results Canal Influent (grab samples)**	**Results RO Concentrate (grab samples)**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4		1.72	0.67	**0.53**	Yes
01/31/11			10.0	0.53	1.51	0.62	**0.37**	Yes
02/07/11			7.1			0.55	**0.37**	Yes
02/14/11			9.5	0.53	1.48	0.55	**0.30**	Yes
02/21/11			7.8			0.91	**0.57**	Yes
05/16/11			6.3			0.67	**0.53**	Yes
05/23/11			12.3	0.64	1.52	0.57	**0.30**	Yes
05/30/11			4.9			0.66	**0.41**	Yes
06/06/11			8.3			1.05	**0.68**	Yes
07/18/11			4.4			1.03	**0.85**	Yes
07/25/11			4.3	1.03	1.66	0.80	**0.66**	Yes
08/01/11			3.7			0.98	**0.64**	Yes
08/08/11			3.9	0.92	3.82	0.67	**0.53**	Yes
		Average		0.73	1.95	0.71	**0.50**	
		Max Daily		1.03	3.82	1.05	**0.85**	
		30 day Max		0.98	2.74	1.39	**0.71**	

Table 1 (e): Summary of Pilot Results Projected TN Load Reduction Compared to Applicable Compliance Conditions

Limitations		Permit 31-FL0037940			Consent Order 08-1661			FDEP Letter OCD-1W-10-145			Class III waters Ch 62-302.530 F.A.C
Parameter		RO Concentrate Load ≤ 4,636 lb/yr			Per Permit			Per Permit			Not cause ecological disruption
Total Nitrogen	**Dilution**	**Average RO Concentrate Influent**			**Average Blended Influent**			**Average Blended Effluent**			**Average TP Load Removed**
		Flow MGD	mg/L	lb/month	Flow MGD	mg/L	lb/month	Flow MGD	mg/L	lb/month	**lb/month**
January 2011	10.2	1.2	1.62	502.60	13.4	0.65	2,251.88	13.4	0.45	1,558.00	**693.88**
February 2011	8.4	1.2	1.48	414.73	11.3	0.67	1,767.98	11.3	0.41	1,081.90	**686.08**
May 2011	7.0	1.2	1.52	471.58	9.6	0.74	1,836.67	9.6	0.48	1,191.35	**645.32**
July 2011	4.1	1.2	2.74	850.08	6.1	0.87	1,372.07	6.1	0.67	1,056.65	**315.42**
		Monthly Average RO Influent lb		**559.75**						**Monthly Average Removal lb**	**585.18**
		Average Annual RO Influent lb		**6,716.97**						**Average Annual Removal lb**	**7,022.10**
		Annual RO Concentrate TN discharged Load <0.00 lb/yr. Percent of RO Concentrate TN Load reduced = 105% System is in Compliance with Limitations									

Table 1 (f): Summary of Pilot Dissolved Oxygen Results Compared to Applicable Compliance Condition

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		≥ 5 mg/L	Per Permit	Per Permit	≥ 5 mg/L	
Dissolved Oxygen	**mg/L**	**Field**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4	5.73	5.98	5.94	**13.87**	Yes
01/31/11			10.0	8.18	8.58	8.98	**22.54**	Yes
02/07/11			7.1	5.29	5.84	5.54	**14.68**	Yes
02/14/11			9.5	5.56	6.05	5.78	**18.91**	Yes
02/21/11			7.8	6.03	6.51	6.39	**14.30**	Yes
05/16/11			6.3	5.56	7.03	6.34	**11.15**	Yes
05/23/11			12.3	5.94	7.00	6.68	**9.42**	Yes
05/30/11			4.9	5.75	7.79	5.32	**13.48**	Yes
06/06/11			8.3	7.36	7.32	8.33	**13.20**	Yes
07/25/11			4.3	5.13	5.95	5.21	**13.49**	Yes
08/01/11			3.7	5.02	6.81	4.85	**8.45**	Yes
08/08/11			3.9	5.25	6.88	5.22	**7.56**	Yes
08/11/11			4.1	3.83	4.51	3.65	**7.58**	Yes
		Average		5.74	6.63	6.02	**12.97**	
		Min Daily		3.83	4.51	3.65	**7.56**	
		30 day Min		4.81	5.29	4.73	**9.27**	

Table 1 (g): Summary of Pilot Conductivity Results Compared to Applicable Compliance Condition

				Limitations					
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C		
Parameter	**Units**	**Sample Type**		≤ 50% above Background	≤ 6,500	Per Permit	≤ 50% above Background		
Specific Conductivity	**micros/cm**	**Field**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**% Increase Above Background**	**Compliance**
01/24/11			10.4	1,773	6,287	2,188	**2,273**	**28.2%**	Yes
01/31/11			10.0	1,495	6,522	2,060	**2,050**	**37.1%**	Yes
02/07/11			7.1	1,809	6,434	2,318	**2,533**	**40.0%**	Yes
02/14/11			9.5	1,629	6,303	2,053	**2,325**	**42.7%**	Yes
02/21/11			7.8	6.03	6.51	6.39	**14.30**	**44.5%**	Yes
05/16/11			6.3	2,300	5,923	2,725	**2,797**	**21.6%**	Yes
05/23/11			12.3	2,547	6,118	2,777	**2,940**	**15.4%**	Yes
05/30/11			4.9	2,660	5,891	2,972	**3,082**	**15.9%**	Yes
06/06/11			8.3	2,082	6,028	2,361	**2,461**	**18.2%**	Yes
07/18/11			4.4	1,956	6,778	2,820	**2,832**	**44.8%**	Yes
07/25/11			4.3	1,920	6,696	2,908	**2,999**	**56.2%**	No
08/01/11			3.7	2,004	7,027	3,158	**3,318**	**65.6%**	No
08/08/11			3.9	1,957	6,705	2,832	**2,962**	**51.4%**	No
08/11/11			4.1	1,524	6,070	2,453	**2,598**	**70.5%**	No
		Average		1,961	6,358	2,582	**2,697**	**37.5%**	
		Max Daily		2,660	7,027	3,158	**3,318**	**24.7%**	
		30 day Max		2,309	6,625	2,838	**2,969**	**28.6%**	

Table 1 (h): Summary of Water Temperature Results Compared to Applicable Compliance Condition

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		Not Stated	Per Permit	Per Permit	≤ 92° F	
Water Temperature	**° F**	**Field**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4	66.88	75.27	67.68	**72.18**	Yes
01/31/11			10.0	75.40	66.51	66.51	**68.16**	Yes
02/07/11			7.1	77.61	74.30	74.30	**81.39**	Yes
02/14/11			9.5	75.22	68.68	68.68	**73.99**	Yes
02/21/11			7.8	77.50	74.23	74.23	**79.03**	Yes
05/16/11			6.3	80.96	78.73	81.01	**84.02**	Yes
05/23/11			12.3	83.93	80.51	83.62	**91.09**	Yes
05/30/11			4.9	85.62	79.21	85.19	**89.60**	Yes
06/06/11			8.3	84.09	79.66	83.26	**88.43**	Yes
07/18/11			4.4	86.95	80.06	85.78	**87.15**	Yes
07/25/11			4.3	88.41	80.22	86.74	**86.09**	Yes
08/01/11			3.7	88.52	81.19	86.52	**92.89**	No
08/08/11			3.9	86.70	79.97	85.01	**89.13**	Yes
08/11/11			4.1	85.37	81.28	84.11	**91.22**	Yes
		Average		79.81	78.70	79.48	**83.89**	
		Max Daily		88.52	81.28	86.74	**92.89**	
		30 day Max		87.25	80.67	85.60	**89.83**	

Table 1 (i): Summary of Total Fluoride Results Compared to Applicable Compliance Condition

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		≤ 5 mg/L	NA	Per Permit	≤ 10 mg/L	
Total Fluoride	**mg/L**	**Grab**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4		9.30	1.20	**1.20**	Yes
01/31/11			10.0	0.76	8.00	1.10	**1.10**	Yes
02/07/11			7.1		8.30	1.20	**1.20**	Yes
02/14/11			9.5	0.80	12.70	1.10	**1.20**	Yes
02/21/11			7.8		15.00	2.00	**2.00**	Yes
05/16/11			6.3		6.10	1.20	**1.20**	Yes
05/23/11			12.3	0.97	4.80	1.10	**1.10**	Yes
05/30/11			4.9		5.60	1.10	**1.20**	Yes
06/06/11			8.3	0.78	5.70	1.00	**0.97**	Yes
07/18/11			4.4			0.75	**0.75**	Yes
07/25/11			4.3	0.19	3.20	0.73	**0.85**	Yes
08/01/11			3.7		6.00	1.40	**1.50**	Yes
08/08/11			3.9	0.87	8.80	1.30	**0.98**	Yes
		Average		0.73	7.79	1.17	**1.17**	
		Max Daily		0.97	15.00	2.00	**2.00**	
		30 day Max		0.88	11.00	1.35	**1.38**	

Table 1 (j): Summary of Unionized Ammonia Results Compared to Applicable Compliance Condition

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		Not Stated	Per Permit	Per Permit	≤ 0.02	
Unionized Ammonia-N	**mg/L**	**Calculated from Composite Total Ammonia-N**	**Dilution**	**Results Canal Influent (grab samples)**	**Results RO Concentrate (grab samples)**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4		0.03	U	**U**	Yes
01/31/11			10.0		0.04	U	**U**	Yes
02/07/11			7.1		0.04	U	**U**	Yes
02/14/11			9.5	U		U	**U**	Yes
02/21/11			7.8		0.03	U	**U**	Yes
05/16/11			6.3		U	U	**U**	Yes
05/23/11			12.3	U	0.02	U	**U**	Yes
05/30/11			4.9		0.04	U	**U**	Yes
06/06/11			8.3	U	0.02	U	**U**	Yes
07/18/11			4.4			U	**U**	Yes
07/25/11			4.3			U	**U**	Yes
08/01/11			3.7	U	U	U	**U**	Yes
08/08/11			3.9		U	U	**U**	Yes
		Average		U	0.02	U	**U**	
		Max Daily		U	0.04	U	**U**	
		30 day Max		U	0.03	U	**U**	

U = Below Detectable Limits

Table 1 (k): Summary of Unionized Hydrogen Sulfide Results Compared to Applicable Compliance Condition

				Limitations				
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C	
Parameter	**Units**	**Sample Type**		Not Stated	Per Permit	Per Permit	Odor Free 62-302.500	
Unionized Hydrogen Sulfide	**mg/L**	**Calculated from grab Total Sulfide**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Influent**	**Results ATS™ Blended Effluent**	**Compliance**
01/24/11			10.4		U	U	**U**	Yes
01/31/11			10.0		U	U	**U**	Yes
02/07/11			7.1		U	U	**U**	Yes
02/14/11			9.5	U	U	U	**U**	Yes
02/21/11			7.8		U	U	**U**	Yes
05/16/11			6.3			U	**U**	Yes
05/23/11			12.3	U	U	U	**U**	Yes
05/30/11			4.9		U	U	**U**	Yes
06/06/11			8.3		U	U	**U**	Yes
07/18/11			4.4			U	**U**	Yes
07/25/11			4.3			U	**U**	Yes
08/01/11			3.7	U	U	U	**U**	Yes
08/08/11			3.9		U	U	**U**	Yes
		Average		U	U	U	**U**	
		Max Daily		U	U	U	**U**	
		30 day Max		U	U	U	**U**	

Table 1 (l): Summary of Gross Alpha Particles Results Compared to Applicable Compliance Condition

				Limitations			
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C
Parameter	**Units**	**Sample Type**		≤ 15 Pci/L	Max 32 Pci/L	Per Permit	≤ 15 Pci/L
Gross Alpha Particles	**Pci/L**	**Grab**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Effluent**	**Compliance**
01/31/11			10.0	<2.90+/- 1/43	6.19+/- 2.28	**<2.74 +/- 1.56**	Yes
02/14/11			9.5	<2.26 +/- 1.39	6.01+/-1.79	**<1.86 +/- 1.04**	Yes
05/16/11			6.3	2.07 +/- 1.21	8.13 +/- 2.32	**2.93 +/- 1.65**	Yes
05/23/11			12.3	4.71+/- 2.22	19.70+/- 4.36	**3.69 +/- 2.15**	Yes
06/06/11			8.3	2.92U+/- 1.48	8.56+/-3.17	**3.66U+/-1.94**	Yes
07/25/11			4.3	3.97+/- 1.81	9.56+/-3.25	**4.29U+/-2.03**	Yes
08/08/11			3.9	2.24 +/- 1.49	52.00 +/- 11.40	**4.03+/- 1.67**	Yes
		Average		3.01	15.74	**3.31**	
		Max Daily		4.71	52.00	**4.29**	
		30 day Max		3.23	30.78	**4.16**	

Table 1 (m): Summary of Total Radium Results Compared to Applicable Compliance Condition

				Limitations			
				Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C
Parameter	**Units**	**Sample Type**		≤ 5 Pci/L	Max 32 Pc1/L	Per Permit	≤ 5 Pci/L
(Total) Radium 226+ Radium 228	**Pci/L**	**Grab**	**Dilution**	**Results Canal Influent**	**Results RO Concentrate**	**Results ATS™ Blended Effluent**	**Compliance**
01/31/11			10.0	2.21 +/- 1.40	4.33 +/- 1.91	**1.25 +/- 1.23**	Yes
02/14/11			9.5	1.76 +/- 1.11	4.94 +/- 1.92	**2.04 +/- 1.28**	Yes
05/16/11			6.3	3.50 +/- 1.31	6.34 +/- 2.05	**2.54+/- 1.12**	Yes
05/23/11			12.3	5.62+/- 2.09	2.66+/- 1.38	**0.10+/- 0.62**	Yes
06/06/11			8.3	2.93+/- 1.53	5.52+/- 2.15	**2.50+/- 1.39**	Yes
07/25/11			4.3	2.81+/- 1.34	4.10+/- 1.65	**2.67+/- 1.24**	Yes
08/08/11			3.9	1.98 +/- 1.20	3.67 +/-1.78	**2.79 +/- 1.45**	Yes
		Average		2.97	4.51	**1.98**	
		Max Daily		5.62	6.34	**2.79**	
		30 day Max		4.56	4.63	**2.73**	

Table 1 (n): Summary of Acute Bioassay Pilot Results Compared to Applicable Compliance Conditions

Parameter	Units	Sample Type		Limitations				Results ATS™ Blended Effluent	Compliance
96 hr Acute Bioassay *Ceriodaphnia dubia*	LC_{50}	Grab	Dilution	Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C		
01/24/11			10.4	Not Stated	Per Permit	≥ 100%	Concentration at 1/3 of LC_{50} concentration	≥ 100%	Yes
01/31/11			10.0					≥ 100%	Yes
02/14/11			9.5					≥ 100%	Yes
07/18/11			4.4					≥ 100%	Yes
07/25/11			4.3					≥ 100%	Yes
08/01/11			3.7					≥ 100%	Yes
96 hr Acute Bioassay *Pimephales promelas*	LC_{50}	Grab	Dilution	Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C		
01/24/11			10.4	Not Stated	Per Permit	≥ 100%	Concentration at 1/3 of LC_{50} concentration	≥ 100%	Yes
01/31/11			10.0					≥ 100%	Yes
02/14/11			9.5					≥ 100%	Yes
07/18/11			4.4					≥ 100%	Yes
07/25/11			4.3					≥ 100%	Yes
08/01/11			3.7					≥ 100%	Yes

Note: The Permit references the two marine species *Mysidopsis bahia* (Mysid shrimp)and *Menidia Berrylina* (silverside minnow) for bioassay testing of the RO Concentrate. Because the Pilot effluent is a freshwater, two freshwater species *Pimephales promelas* (fathead minnow) and *Ceriodaphnia dubia* (water flea) are used for bioassay testing.

Table 1 (o) Summary of Chronic Bioassay Pilot Results Compared to Applicable Compliance Conditions

Parameter	Units	Sample Type		Limitations				Results ATS™ Blended Effluent	Compliance
Chronic Bioassay *Ceriodaphnia dubia*	IC_{25}/LC_{50}	24hr Composite x 3	Dilution	Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C		
08/16/11			~3.67	Not Stated	Per Permit	≥ 100%	≥ 100%	≥ 100%	Yes
08/30/11			~3.67					≥ 100%	Yes
09/06/11			~3.67					≥ 100%	Yes
Chronic Bioassay *Pimephales promelas*	IC_{25}/LC_{50}	24 hr Composite x 3	Dilution	Permit 31-FL0037940	Consent Order 08-1661	FDEP Letter OCD-1W-10-145	Class III waters Ch 62-302.530 F.A.C		
08/16/11			~3.67	Not Stated	Per Permit	≥ 100%	≥ 100%	≥ 100%	Yes
08/30/11			~3.67					≥ 100%	Yes
09/06/11			~3.67					≥ 100%	Yes

II. Summary of Flows

As noted previously, two separate flows were delivered to the ATS™ surger box. The RO Concentrate was delivered via a small self priming centrifugal pump associated with a bladder tank, and measured through a propeller meter with a totalizer. The Canal water was delivered through a Pacer self priming centrifugal pump, and measured through a 2” Octave ultrasonic, unimpeded flow meter (an identical meter is located at the effluent end). Once the two flows were measured and mixed within the surge box, a sample line drew off flow at a set flow rate, and was calibrated once weekly by hand measurement. The flow delivered to the ATS™ Floway (exclusive of rainfall) is the sum of the two measured flows, minus the sample return.

Effluent flow is measured using an identical 2” Octave flow meter. Prior to metering, the effluent is strained through an inclined 500 micron wedge wire screen. A small amount of flow escapes the screen, and collects with residual sloughed solids in a solids collection chamber. This escaped flow combined with a small amount of leakage and overflow is considered incidental flow losses. During the end of the third month this incidental flow was diverted such that it passes through the flow meter, thereby eliminating the need to estimate incidental effluent flow loss. The effluent flow then is the sum of the measured effluent flow plus the estimated incidental loss flow, with the measured flow including rainfall. The water balance then can be expressed in equation form:

$$F_I = F_c + F_{RO} - F_S$$

$$F_O = F_E + F_{IL}$$

$$F_O = F_I + F_R - F_{ET}$$

Where:

F_I = Influent Flow
F_c = Metered Flow from Canal
F_{RO} = Metered RO Concentrate Flow
F_S = Measured Flow for Sampling Influent
F_O = Outflow from ATS™ Floway
F_E = Metered Effluent Flow
F_{IL} = Estimated Incidental Flow Losses
F_R = Contributed Flow from Rainfall
F_{ET} = Evapotranspirational Losses

Therefore solving for F_{ET},

$$F_{ET} = F_I - F_O + F_R$$

or

$$F_{ET} = (F_c + F_{RO} - F_S) - (F_E + F_{IL}) + F_R$$

As noted in Table 2, for the monitoring period the influent flow, including rainfall was 4,679,483 gallons, ranging in weekly average flow rates of 7.6 gpm to 20.7 gpm, with an overall average of 13.7gpm. The average ratio of canal water to RO concentrate was 4.38:1, which include the period in March through May when the ratio was lowered to about 1:1. Effluent flow for the monitoring period was estimated at 4,583,920 gallons (average 13.4 gpm). Rainfall was 6.9 inches for the period, contributing 3,125 gallons to the floway.

During the second month, the wedge wire screen began to blind to the extent that significant flow was being diverted away from the flow meter. Therefore the flows noted for Month 2 are based upon estimates of this diverted flow. In addition the effluent flow meter malfunctioned during the first week, and it was determined that purged air from the sampler was impacting the meter's electrodes.

By the end of Month 3, the effluent meter was repositioned to avoid the air purging and to capture the diverted flow. However, during Month 3, the influent flow meter began giving inconsistent readings, either because of blinding of the electrodes from the silts within the influent flow during the mentioned construction activity, or because of air bubbles within the flows, which appeared to have developed because of the increased suction head on the pump, as related to falling canal levels. By the beginning of the fourth month, the influent flow meter was removed for repairs, and the effluent meter used to record flows. During Month 4 and 5 it was assumed influent flow equaled effluent flow. By the sixth month water levels in the canal returned to workable levels, and the performance of the influent flow meter returned.

Evapotranspiration over the monitoring period was estimated at an average of 1.59 inches/day. However, the accuracy of the ET estimates was negatively impacted by occasional effluent flow meter stoppages and requirements to estimate incidental losses such as flow over the 500 micron wedge wire screen, as mentioned previously. Design refinements were made by the end of Month 3 in order to reduce these impacts, but the loss of the Influent meter performance during months 4 and 5, made reasonable ET estimates from totalized flows unreliable. ET losses as estimated amounted to about 2% of the influent flow.

Table 2: Flow Dynamics Months 1 through 6 South Canal ATS™ Pilot Study

Week Ending	South Canal Volume (Gallons)	RO Concentrate Volume (Gallons)	Sample Line Return Volume (Gallons)	Rainfall (inches)	Rainfall Volume (Gallons)	Total Influent Flow (Gallons)
1/24/2011	208,841	20,170	15,120	0.3	95	213,986
1/31/2011	190,135	19,126	15,120	0.25	396	194,537
2/07/2011	150,661	19,515	15,120	0	0	155,056
2/14/2011	175,793	18,457	3,024	0.75	238	191,464
2/21/2011	191,532	24,554	20,160	0	0	195,926
2/28/2011	149,136	96,087	22,176	0	0	223,047
3/07/2011	113,544	93,913	16,128	0.75	238	191,567
3/14/2011	93,663	90,787	16,128	0.5	158	168,480
3/21/2011	102,563	102,344	16,128	0	0	188,779
3/28/2011	133,342	98,310	16,128	0.59	158	215,682
4/04/2011	73,407	99,635	16,128	1	317	157,231
4/11/2011	99,561	102,159	16,128	0	0	185,592
4/18/2011	106,200	99,838	12,096	0	0	193,942
4/25/2011	77,500	101,983	12,096	0	0	167,387
5/02/2011	82,100	103,394	12,096	0.25	79	173,477
5/09/2011	161,500	104,260	12,096	0	0	253,664
5/16/2011	107,932	17,097	12,096	0.5	158	113,091
5/23/2011	115,066	9,377	12,096	0	0	112,347
5/30/2011	153,911	31,718	12,096	0	0	173,533
6/06/2011	184,535	22,268	10,100	0	0	196,703
7/18/2011	182,745	42,039	11,850	0.25	79	213,013
7/25/2011	182,438	42,720	12,060	0.25	79	213,177
8/01/2011	160,648	43,882	22,227	0	0	182,303
8/08/2011	167,894	43,206	12,026	0.6	190	199,264
8/15/2011	175,119	42,334	12,168	3	950	206,235
INFLUENT TOTAL	**3,539,767**	**1,489,173**	**352,591**	**6.9**	**3,135**	**4,679,483**

Table 2 (continued): Flow Dynamics Months 1 through 6 South Canal ATS™ Pilot Study

Week Ending	Measured Effluent Flow Volume (Gallons)	Estimated Incidental Loss Volume (Gallons)	Evapotranspiration (ET) Losses (Gallons)	ET Losses (inches/day)[1]	Total Effluent Flow (Gallons)	Ratio Canal:RO
1/24/11	208,717	5,040	229	0.10	213,757	10.35:1
1/31/11	184,209	6,048	4,280	1.93	190,257	9.94:1
2/07/11	148,465	6,048	543	0.25	154,513	7.72:1
2/14/11	191,453	0	11	0.00	191,453	9.52:1
2/21/11	192,823	0	3,103	1.40	192,823	7.80:1
2/28/11[2]	223,000	0	47	0.02	223,000	1.55:1
3/07/11	183,317	4,032	4,218	1.90	187,349	1.21:1
3/14/11	141,360	20,160	6,960	3.14	161,520	1.03:1
3/21/11	127,275	55,440	6,064	2.74	182,715	1.00:1
3/28/11	145,597	55,440	14,645	6.61	201,037	1.36:1
4/04/11	126,058	20,160	11,013	4.97	146,218	0.74:1
4/11/11	185,075	20,160	-19,643	-8.86	205,235	0.97:1
4/18/11[2]	193,972	NA	-30	-0.01	193,972	1.06:1
4/25/11	167,349	NA	38	0.02	167,349	0.76:1
5/02/11	173,506	NA	-29	-0.01	173,506	0.79:1
5/09/11	253,685	NA	-21	-0.01	253,685	1.55:1
5/16/11	113,141	NA	-50	-0.02	113,141	6.31:1
5/23/11	112,304	NA	43	0.02	112,304	12.27:1
5/30/11	164,465	NA	9,068	4.09	164,465	4.85:1
6/06/11	210,821	NA	-14,118	-6.36	210,821	8.29:1
7/18/11	197,636	NA	15,377	6.83	197,636	4.35:1
7/25/11	193,844	NA	19,333	8.70	193,844	4.27:1
8/01/11	160,819	NA	21,484	9.71	160,819	3.66:1
8/08/11	198,434	NA	830	0.34	198,434	3.89:1
8/15/11	194,067	NA	12,168	5.52	194,067	4.14:1
EFFLUENT TOTAL	**4,391,392**	**192,528**	**95,563**	**Ave 1.59**	**4,583,920**	**Ave. 4.38:1**

[1] ET Loss calculation affected by accuracy of Estimated Incidental Loss Volume
[2] Effluent Flow Meter Malfunctioned. Assume input=output, applies from 4/18/11 to 6/6/11

III. Bioassay Testing

ATS™ Effluent was collected as grab samples during the first month when the blend ratio was about 10:1 and during the six month when the blend ratio was close to 3.67:1—the 7Q10 condition--for 96 hr acute bioassay testing to determine the extent of toxicity to applicable test organisms. Also during the sixth month a series of composite samples were collected on three occasions for chronic toxicity testing—the lower ratio considered the worst case condition. These tests were completed in conformance with FDEP guidelines and protocols as identified within the aforementioned letter of July 28, 2010 from Christianne Ferraro P.E. , Program Administrator for Water Facilities with FDEP to Erik Olson Director Utilities, Indian River County. Test results for six 96 hour acute tests and the three chronic tests at the dilution rates as specified, for the designated organisms—*Pimephales promelas* (fathead minnow) and *Ceriodaphnia dubia* (water flea)—show an absence of toxicity, as noted in Table 1(n)and (o), and again summarized in Table 3.

The term LC_{50} is read as the Lethal Concentration soliciting 50% mortality. The right side of the results equation refers to the percentage of the targeted water within a diluted mix which results in the 50% mortality. When LC_{50} is shown as ≥ 100%, this means there was less than 50% mortality even when the target water was not diluted. The term IC_{25} is read as the concentration at which inhibition to growth or fecundity (depending upon the selected organism) is no more that 25%.

Table 3: Compliance Bioassay Testing Results South Canal ATS™ Pilot Study

	Dilution Canal:RO Concentrate	**96 hr Acute *Pimephales promelas***	**96 hr Acute *Ceriodaphnia dubia***	**Chronic *Pimephales promelas***	**Chronic *Ceriodaphnia dubai***
Week Ending		ATS™ Effluent	ATS™ Effluent	ATS™ Effluent	ATS™ Effluent
01/24/11	10.4	LC_{50} ≥ 100%	LC_{50} ≥ 100%		
01/31/11	10.0	LC_{50} ≥ 100%	LC_{50} ≥ 100%		
02/14/11	9.5	LC_{50} ≥ 100%	LC_{50} ≥ 100%		
07/18/11	4.4	LC_{50} ≥ 100%	LC_{50} ≥ 100%		
07/25/11	4.3	LC_{50} ≥ 100%	LC_{50} ≥ 100%		
08/01/11	3.7	LC_{50} ≥ 100%	LC_{50} ≥ 100%		
08/16/11	~3.7			IC_{25}≥100% LC_{50} ≥ 100%	IC_{25}≥100% LC_{50} ≥ 100%
08/30/11	~3.7			IC_{25}≥100% LC_{50} ≥ 100%	IC_{25}≥100% LC_{50} ≥ 100%
09/06/11	~3.7			IC_{25}≥100% LC_{50} ≥ 100%	IC_{25}≥100% LC_{50} ≥ 100%

When the blend was shifted to about 1:1 Canal Water to RO Concentrate during months 2 and 3, it was necessary, because of the higher conductivity, to change bioassay organisms to the marine species *Mysidopsis bahia* (Mysid shrimp) and *Menidia berrylina.* (silverside minnow). Bioassay sampling of the ATS™ effluent using these organisms commenced on 4/4/11, after impact of the construction upon water quality appeared to have subsided. As shown in Table 4, the five 96 hour acute bioassays showed no toxicity for the silverside minnow, and for three of the five tests on Mysid shrimp. It is not known whether the two samples showing toxicity to the Mysid shrimp were a result of inadequate dilution; higher concentrations of toxic factors within the RO concentrate; some toxic influences within the canal water induced by the construction activities; or a combination of these. Bioassay laboratory reports including Standard Reference Toxicant analyses are included as Appendices C, D, E,F and G.

No bioassay samples were taken during the fifth month because of scheduling issues with the laboratory and the inconsistent performance of the pumping system. By the end of Month 5, the canal level had fallen to an elevation that prevented the pump to provide sufficient lift. Consequently the system was shut down until the rainy season generated enough flow to raise the canal level. By July 10, 2011 heavy rains finally resulted in increase levels, and allowed the pumping system to be reactivated.

Table 4: Bioassay Testing Results 1:1 Blend Canal Water to RO Concentrate South Canal ATS™ Pilot Study

	Dilution Canal:RO Concentrate	**96 hr Acute *Menidia Berrylina***	**96 hr Acute *Mysidopsis Bahia***
Week Ending		ATS™ Effluent	ATS™ Effluent
02/28/11	1.55	$LC_{50} \geq 100\%$	$LC_{50} \geq 100\%$
04/04/11	0.74	$LC_{50} \geq 100\%$	$LC_{50} \geq 100\%$
04/11/11	0.97	$LC_{50} \geq 100\%$	$LC_{50} \geq 12.6\%$
04/18/11	1.06	$LC_{50} \geq 100\%$	$LC_{50} \geq 100\%$
05/02/11	0.79	$LC_{50} \geq 100\%$	$LC_{50} \geq 34.6\%$

As previously noted (see Figure 1), towards the end of Month 5, an analysis of canal flows from the nearby USGS gauging station was conducted to determine the 7Q10 flow, which was calculated at 4.40 MGD, or a design dilution ratio of 3.67:1. The 7Q10 calculations are included as Appendix B. During Month 6, upon establishing a consistent pumped flow from the canal, acute testing was evaluated for a circa 3.67:1 dilution, followed by chronic testing for the 7Q10 value of 3.67:1 for the freshwater species, as noted in Table 3. The results all showed compliance with stated effluent limitations in terms of both LC_{50} and IC_{25}.

IV. Gross Alpha Particle Activity and Total Radium

The RO Concentrate, South Canal Water and the ATS™ effluent were sampled as grab samples during the monitoring period for gross alpha particle activity and total radium (radium 226 + radium 228). These tests were completed in conformance with FDEP guidelines and protocols as identified within the aforementioned Consent Order of September 19, 2008. Test results for the first five months are summarized within Table 5. As noted previously [Table 1(l) and (o)], the ATS™ effluent was in conformance with set limitations within the Permit and the Consent Order for the higher dilution rates associated with samples from 1/17/11 to 2/21/11 and during Months 5 and 6. All but one of the samples at the 1:1 dilution ratio were also in conformance with the Permit and Consent Order limits. Of the Canal and RO Concentrate, results all were in conformance with the Permit (<15 PCi/L) and Consent Order limitations (<32 PCi/L) except for the gross alpha particle for the RO Concentrate sample taken 2/28/11, 3/28/11, 5/23/11 and 8/8/11. For Total Radium, the Canal water was above the effluent limit on 5/23/11. The one ATS™ blend effluent sample on 3/28/11, when the dilution ratio was 1.36:1, the Gross Alpha Particle was at about 28 PCi/L, which is above the Permit limit of ≤ 15 PCi/L. This result may be an outlier, as it is higher than even the RO Concentrate, and is considerably higher than any other ATS™ blend effluent samples.

Table 5: Month 1 through 6 Gross Alpha Particles and Total Radium Results South Canal ATS™ Pilot Study

MONTH 1	Gross Alpha Particle (PCI/L)		Radium 226 (PCI/L)		Radium 228 (PCI/L)		Total Radium (PCI/L)	
	1/31/11	2/14/11	1/31/11	2/14/11	1/31/11	2/14/11	1/31/11	2/14/11
Canal	<2.90 +/-1.43	<2.26 +/-1.35	1.06 +/-0.652	<0.806 +/-0.603	<1.38 +/-0.743	<0.944 +/-0.512	2.21 +/-1.40	1.76 +/-1.11
RO Concentrate	6.19 +/-2.28	6.01 +/-1.79	3.69 +/-1.42	4.26 +/-1.44	<0.971 +/-0.489	<0.944 +/-0.482	4.33 +/-1.91	4.94 +/-1.92
ATS™ Effluent	<2.74 +/-1.56	<1.86 +/-1.04	1.19 +/-0.813	1.34 +/-0.787	<0.988 +/-0.419	<0.944 +/-0.482	1.25 +/-1.23	2.04 +/-1.28

MONTH 2	Gross Alpha Particle (PCI/L)		Radium 226 (PCI/L)		Radium 228 (PCI/L)		Total Radium (PCI/L)	
	2/28/11	3/14/11	2/28/11	3/14/11	2/28/11	3/14/11	2/28/11	3/14/11
Canal	<2.99 +/- 1.78	3.14+/- 1.81	1.37 +/- 0.781	2.83 +/- 1.16	1.37 +/- 0.781	<0.92 +/- 0.510	2.27 +/- 1.29	3.88 +/-1.72
RO Concentrate	80.4 +/- 15.4	7.18+/- 2.47	3.61 +/- 1.26	4.06 +/- 1.43	3.61 +/- 1.26	<0.96 +/- 0.416	3.72 +/- 1.68	5.30 +/- 1.98
ATS™ Effluent	<3.96 +/- 2.19	5.24 +/- 2.21	1.36 +/- 0.719	2.82 +/- 1.16	1.36 +/- 0.719	<0.915 +/- 0.498	2.21 +/- 1.22	3.99 +/- 1.68

MONTH 3	Gross Alpha Particle (PCI/L)		Radium 226 (PCI/L)		Radium 228 (PCI/L)		Total Radium (PCI/L)	
	3/28/11	4/11/11	3/28/11	4/11/11	3/28/11	4/11/11	3/28/11	4/11/11
Canal	3.87 +/- 2.04	<2.98 +/- 1.87	1.08 +/-0.636	1.58 +/-0.837	1.32 +/- 0.608	1.17 +/- 0.581	2.40 +/- 1.24	2.75 +/-1.42
RO Concentrate	20.4 +/- 4.36	6.11 +/- 2.35	<0.620 +/-0.410	5.21 +/-1.69	<0.967 +/- 0.527	1.21 +/- 0.593	1.25 +/-0.957	6.42 +/- 2.28
ATS™ Effluent	28.2 +/- 5.87	5.12 +/- 2.09	4.14 +/-1.40	3.02 +/- 1.20	<0.978 +/- 0.451	0.972 +/- 0.539	4.40 +/- 1.85	3.99 +/- 1.74

Table 5 (continued): Month 1 through 5 Gross Alpha Particles and Total Radium Results South Canal ATS™ Pilot Study

MONTH 4	Gross Alpha Particle (PCi/L)		Radium 226 (PCi/L)		Radium 228 (PCi/L)		Total Radium (PCi/L)	
	4/25/11	5/16/11	4/25/11	5/16/11	4/25/11	5/16/11	4/25/11	5/16/11
Canal	<2.97 +/- 1.47	<2.07 +/- 1.21	1.88 +/-0.925	2.54 +/-0.99	<0.753 +/- 0.408	<0.967 +/- 0.421	2.53 +/- 1.30	3.50 +/-1.31
RO Concentrate	8.50 +/- 2.62	8.13 +/- 2.32	3.01 +/-1.16	5.36 +/-1.52	1.10 +/- 0.450	<0.98 +/- 0.48	4.11 +/-1.61	6.34 +/- 2.05
ATS™ Effluent	2.58 +/- 2.19	2.93 +/- 1.65	2.87 +/-1.21	1.57 +/- 0.75	<0.982 +/- 0.464	<0.97 +/- 0.474	3.85 +/- 1.67	2.54 +/- 1.12

MONTH 5	Gross Alpha Particle (PCi/L)		Radium 226 (PCi/L)		Radium 228 (PCi/L)		Total Radium (PCi/L)	
	5/23/11	6/6/11	5/23/11	6/6/11	5/23/11	6/6/11	5/23/11	6/6/11
Canal	4.71 +/- 2.22	2.92 +/- 1.48	4.93 +/- 1.58	2.11 +/- 1.00	0.967 +/- 513	0.99 +/- 0.526	5.62 +/- 2.09	2.93 +/- 1.53
RO Concentrate	19.7 +/- 4.36	8.56 +/- 3.17	1.89 +/- 0.863	4.79 +/- 1.64	0.913 +/- 0.513	0.99 +/- 0.505	2.66 +/- 1.38	5.52 +/- 2.15
ATS™ Effluent	3.69 +/- 1.94	3.66 +/- 1.94	0.536 +/- 0.202	1.01 +/- 0.727	0.979 +/- 0.418	1.66 +/- 0.657	0.98 +/- 0.620	2.50 +/- 1.39

MONTH 6	Gross Alpha Particle (PCi/L)		Radium 226 (PCi/L)		Radium 228 (PCi/L)		Total Radium (PCi/L)	
	7/25/11	8/8/11	7/25/11	8/8/11	7/25/11	8/8/11	7/25/11	8/8/11
Canal	3.97 +/- 1.81	2.24 +/- 1.81	1.88 +/- 0.88	1.52 +/- 0.78	0.93 +/- 0.456	0.86 +/- 0.418	2.81 +/- 1.34	1.98 +/- 1.20
RO Concentrate	9.56 +/- 3.25	52.0 +/- 11.40	3.14 +/- 1.12	3.18 +/- 1.32	0.96 +/- 0.448	0.93 +/- 0.456	4.10 +/- 1.65	3.67 +/- 1.78
ATS™ Effluent	4.28 +/- 2.03	4.03 +/- 1.67	1.20 +/- 0.257	2.48 +/- 1.05	0.98 +/- 0.448	0.86 +/- 0.404	2.67 +/- 1.24	2.79 +/- 1.45

V. Total Phosphorus and Total Nitrogen Removal Performance

For the combined six month monitoring period, total phosphorus and total nitrogen influent concentrations for the blended water averaged 0.139 mg/L and 0.89 mg/L respectively. The corresponding effluent concentrations averaged 0.054 mg/L and 0.54 mg/L respectively. The percent removals were 59.40% for total phosphorus and 37.61% for total nitrogen for the six month period. Areal removal rates were 64.38 g/m^2-yr for total phosphorus and 264.76 g/m^2-yr for total nitrogen for the six month period. A summary of the system performance in terms of total phosphorus and total nitrogen are shown in Table 6 and Figures 2 through 7. There is a substantial increase in nutrient reduction rates during the last week of the second month, which is largely attributable to the high influx of nutrients associated with the construction activity within the South Canal. These high nutrient levels are attendant with the elevated levels of suspended solids. During Months 4 through 6, as the water quality returned to pre-construction conditions, nutrient levels and removal rates adjusted accordingly to pre-construction rates. Even during Month 1, the removal rates are quite high considering the cooler temperatures and comparatively low nutrient levels associated with the influent blend. The RO Concentrate contributes significant alkalinity and available nitrogen to the influent, which likely helps maintain this high level of performance.

Of the mean ATS™ influent total phosphorus, 50% (0.054 mg/L) was inorganic (PO_4^{-3}), typically referenced as ortho-phosphorus. This is the form which is available for direct biological uptake. The remaining 50% was either in the organic form, or as polyphosphate, both which are generally considered unavailable for biological uptake unless first acted upon by specialized enzymes such as phospho-diesterase, or certain environmental changes, which disassociates the ortho-phosphorus from the organic component.

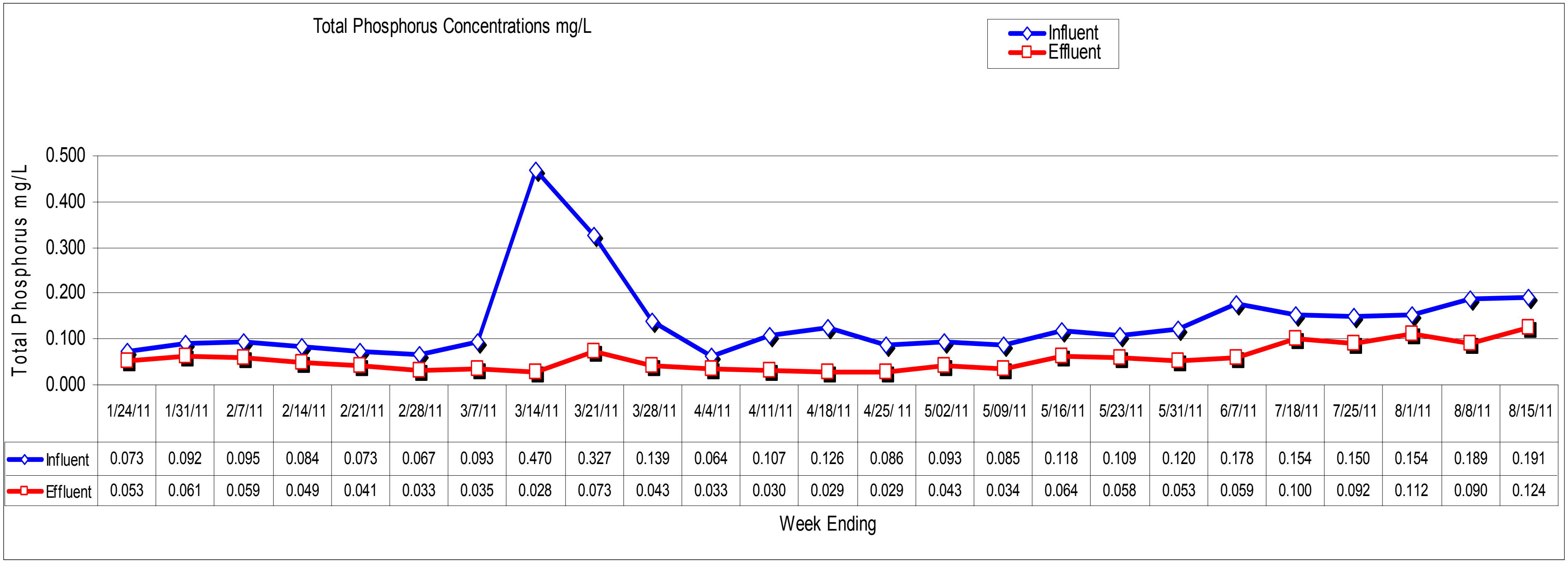
The percentage of total phosphorus as ortho-phosphorus within the ATS™ effluent was 59% (0.032 mg/L), with the organic/polyphosphate as the remaining 41% (0.022 mg/L). The ortho-phosphorus was reduced by 53% across the ATS™, while the organic/polyphosphate was reduced by 67%. This is suggestive that the either the organic/polyphosphate was largely vulnerable to enzymatic hydrolysis, or that much of it was particulate in nature and was captured through settling and adsorption by the ATS™, or both. The argument that much of the organic/polyphosphate phosphorus was particulate appears consistent with the 64% reduction in total suspended solids across the ATS™ from 8.5 to 3.0 mg/L. However, much of the total suspended solids loading occurred during the construction activity. If the data from this period are excluded, the influent and effluent total suspended solids are very low at 3.0 mg/L. However, for the same data set organic/polyphosphate phosphorus reduction is still rather high at 50%, supporting the premise that there is considerable vulnerability of the organic/polyphosphate fraction to enzymatic hydrolysis.

Total nitrogen is the sum of Total Kjeldahl Nitrogen (TKN) and nitrate+ nitrite nitrogen or NOx-N. The TKN is the sum of organically bound nitrogen (such as amino acids, or complex organic molecules containing nitrogen) and ammonia nitrogen. Ammonia and NOx-N are considered the forms available for direct biological uptake, while organic nitrogen must be acted upon by enzymes such as deaminase, or certain environmental factors which strip amine groups from the organic complex, before it becomes biologically available. Quite often this organic nitrogen can be quite recalcitrant, and is highly resistant to enzymatic hydrolysis. This recalcitrant organic nitrogen is often referenced as refractory dissolved organic nitrogen or RDON.

The blended ATS™ influent as an average over the monitoring period was composed of 91% TKN (0.73 mg/l), with 28% (0.25 mg/L) as ammonia-N and 63% (0.56 mg/L) as organic nitrogen. NOx-N made up the remaining 9% at 0.08 mg/L. The ATS™ effluent as an average over the monitoring period was composed of 82.5% TKN (0.56 mg/L), with 4% (0.02 mg/L) as ammonia-N and 78.5% as organic nitrogen. NOx-N made up the remaining 17.5% at 0.10 mg/L. This pattern clearly indicates a preferential removal of ammonia nitrogen, as would be expected, with 91.2% removal. Twenty-two percent of organic nitrogen was removed, while NOx-N actually increased slightly by over 13%. These patterns are suggestive of a minor level of nitrification occurring on the ATS™, with a high level of ammonia removal associated both with direct biological uptake and nitrification, and a moderate vulnerability of the organic nitrogen fraction to enzymatic hydrolysis or destruction associated with certain environmental factors such a sunlight, pH shifts, and temperature variations. The fact that the RO Concentrate is comparatively high in ammonia-N appears to contribute to the high levels of algal turf production and overall system performance in terms of nutrient reduction. There appears to be a synergistic influence from the blending of the higher ammonia-nitrogen RO Concentrate with the higher ortho-phosphorus laden water of the South Relief Canal. The ratio of available nitrogen to available phosphorus, on a concentration basis, averaged 4.7:1, which is suggestive of a reasonable balance, well suited for supporting biological uptake. As a comparison, this ratio averaged 1.3:1 within the South Relief Canal water, and 2.2:1 at the Lateral D canal which serves as the feed water to the County's Egret Marsh ATS™. Both of these ratios are indicative of a potential nitrogen limitation. The difference in these ratios is likely responsible to a large extent for the higher productivity and high nutrient reduction performance noted at the South Relief Canal ATS™ pilot.

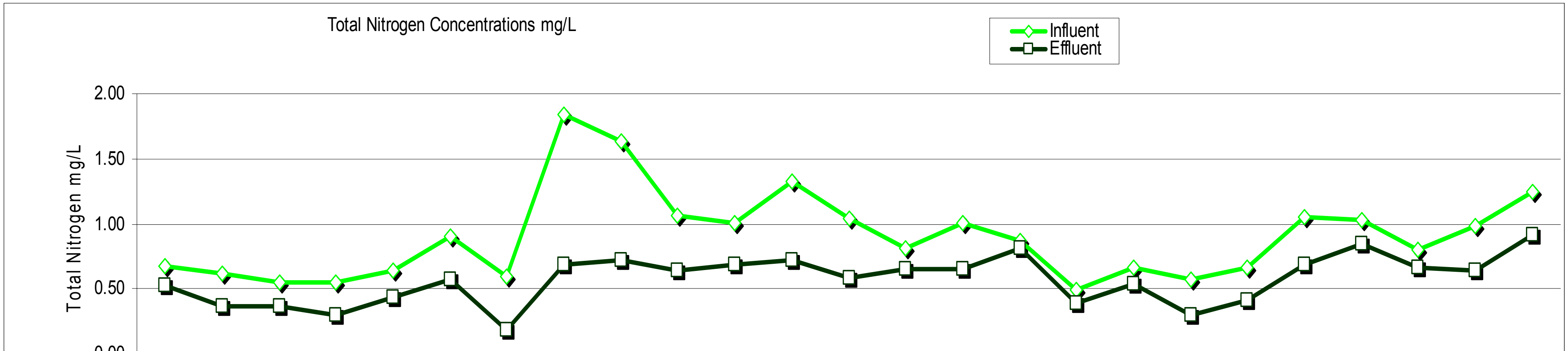
Table 6: Months 1 through 6 Total Phosphorus and Total Nitrogen Removal Performance South Canal ATS™ Pilot Study

	Canal Water (Grab)		**RO Concentrate (Grab)**		**Blended Influent to ATS™ (Composite)**		**ATS™ Effluent (Composite)**		**Percent Removal**		**Areal Removal Rate (g/m^2-yr)**	
Week Ending	TP mg/L	TN mg/L	TP mg/L	TN mg/L	TP mg/L	TN mg/L	TP mg/L	TN mg/L	TP	TN	TP	TN
1/24/11	-	-	0.023	-	0.073	0.67	0.053	0.53	27.1%	20.8%	18.11	127.89
1/31/11	0.118	0.48	0.038	1.51	0.092	0.62	0.061	0.37	35.0%	41.5%	26.68	211.42
2/07/11	-	-	-	-	0.095	0.55	0.059	0.37	38.4%	32.8%	24.05	117.81
2/14/11	0.106	0.53	0.046	1.48	0.084	0.55	0.049	0.30	42.2%	46.1%	28.78	206.79
Month 1	**0.112**	**0.51**	**0.036**	**1.50**	**0.086**	**0.60**	**0.055**	**0.39**	**35.7%**	**34.4%**	**24.42**	**166.00**
2/21/11					0.073	0.65	0.041	0.43	44.7%	34.4%	27.12	184.22
2/28/11	0.128	0.50	0.032	1.55	0.067	0.91	0.033	0.57	50.9%	37.4%	32.31	323.09
3/07/11					0.093	0.59	0.035	0.18	63.2%	69.8%	47.38	334.67
3/14/11	0.326	1.15	0.032	1.54	0.470	1.84	0.028	0.69	94.2%	64.0%	316.83	844.71
Month 2	**0.227**	**0.83**	**0.032**	**1.55**	**0.176**	**1.00**	**0.034**	**0.47**	**79.1%**	**52.8%**	**105.95**	**421.91**
3/21/11					0.327	1.63	0.073	0.72	78.4%	57.0%	206.12	352.49
3/28/11	0.192	0.71	0.030	1.41	0.139	1.07	0.043	0.64	70.9%	43.9%	89.86	359.96
4/04/11					0.064	1.01	0.033	0.68	52.0%	37.3%	22.27	350.19
4/11/11	0.148	0.88	0.031	1.62	0.107	1.33	0.030	0.72	72.2%	45.8%	60.87	360.05
Month 3	**0.170**	**0.80**	**0.031**	**1.52**	**0.159**	**1.26**	**0.045**	**0.69**	**73.4%**	**47.6%**	**94.73**	**476.71**
4/18/11					0.126	1.04	0.029	0.58	77.2	43.8	80.22	373.76
4/25/11	0.153	0.89	0.034	1.62	0.086	0.81	0.029	0.65	66.2	19.3	40.40	110.90
5/02/11					0.093	1.00	0.043	0.66	53.5	34.6	36.67	255.34
5/09/11	0.148	0.60	0.032	1.54	0.085	0.86	0.034	0.81	60.6	6.4	55.61	59.74
Month 4	**0.151**	**0.73**	**0.033**	**1.57**	**0.098**	**0.93**	**0.034**	**0.68**	**65.5%**	**25.8%**	**53.21**	**199.88**
5/16/11					0.118	0.49	0.064	0.39	45.7%	19.3%	25.86	45.25
5/23/11	0.139	0.64	0.028	1.52	0.109	0.67	0.058	0.53	46.8%	19.9%	24.35	63.09
5/30/11					0.120	0.57	0.053	0.30	58.3%	51.0%	44.82	186.71
6/06/11	0.143	0.54	0.031	1.54	0.178	0.66	0.059	0.41	64.5%	33.1%	96.97	185.20
Month 5	**0.141**	**0.59**	**0.030**	**1.53**	**0.131**	**0.60**	**0.059**	**0.41**	**57.2%**	**33.2%**	**49.45**	**126.64**
7/18/11					0.154	1.05	0.100	0.68	39.7%	39.9%	56.59	388.73
7/25/11	0.170	1.03	0.038	1.66	0.150	1.03	0.092	0.85	44.2%	24.9%	60.03	231.63
8/01/11					0.154	0.80	0.112	0.66	35.9%	26.3%	42.69	161.88
8/08/11	0.199	0.92		3.82	0.189	0.98	0.090	0.64	52.6%	34.8%	84.74	290.40
8/15/11					0.191	1.25	0.124	0.91	38.9%	9.3%	64.66	76.48
Month 6	**0.185**	**0.98**	**0.038**	**2.74**	**0.170**	**1.02**	**0.099**	**0.71**	**42.5%**	**27.4%**	**61.47**	**227.81**
Total Period	**0.163**	**0.77**	**0.033**	**1.78**	**0.135**	**0.89**	**0.054**	**0.56**	**59.4%**	**37.61**	**64.38**	**264.76**



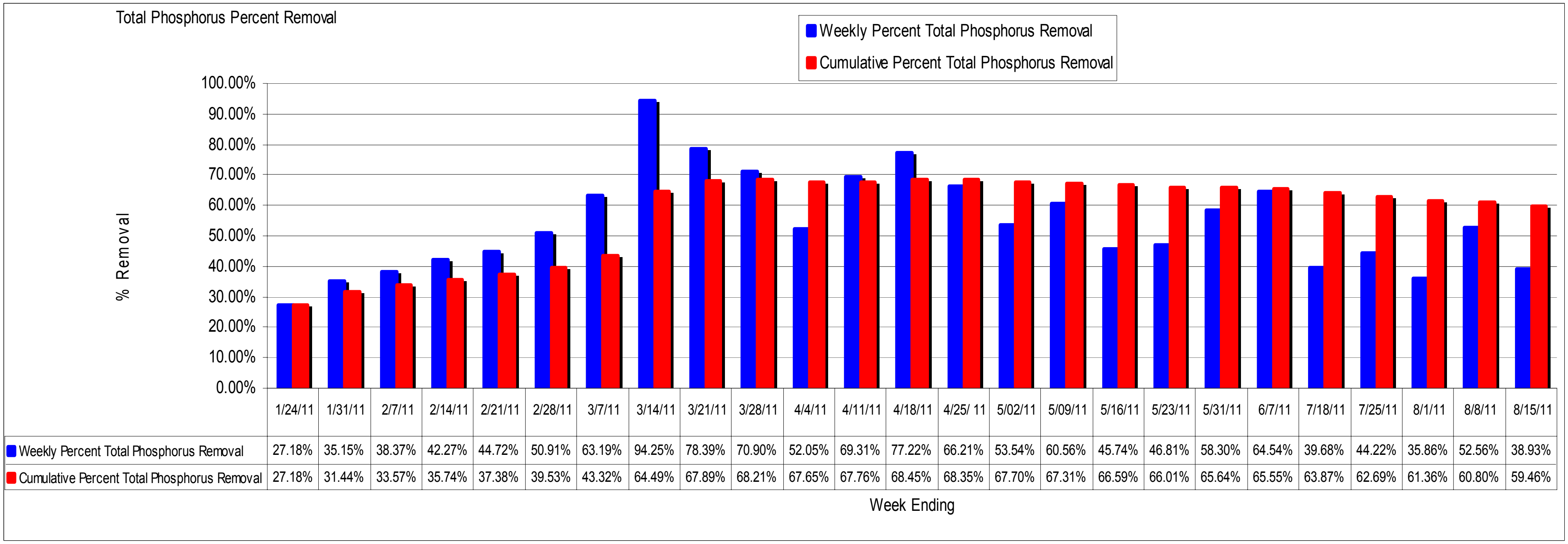
	1/24/11	1/31/11	2/7/11	2/14/11	2/21/11	2/28/11	3/7/11	3/14/11	3/21/11	3/28/11	4/4/11	4/11/11	4/18/11	4/25/ 11	5/02/11	5/09/11	5/16/11	5/23/11	5/31/11	6/7/11	7/18/11	7/25/11	8/1/11	8/8/11	8/15/11
Influent	0.073	0.092	0.095	0.084	0.073	0.067	0.093	0.470	0.327	0.139	0.064	0.107	0.126	0.086	0.093	0.085	0.118	0.109	0.120	0.178	0.154	0.150	0.154	0.189	0.191
Effluent	0.053	0.061	0.059	0.049	0.041	0.033	0.035	0.028	0.073	0.043	0.033	0.030	0.029	0.029	0.043	0.034	0.064	0.058	0.053	0.059	0.100	0.092	0.112	0.090	0.124

Figure 2: ATS™ Influent and Effluent Total Phosphorus Concentrations Months 1 through 6 South Canal ATS™ Pilot Study



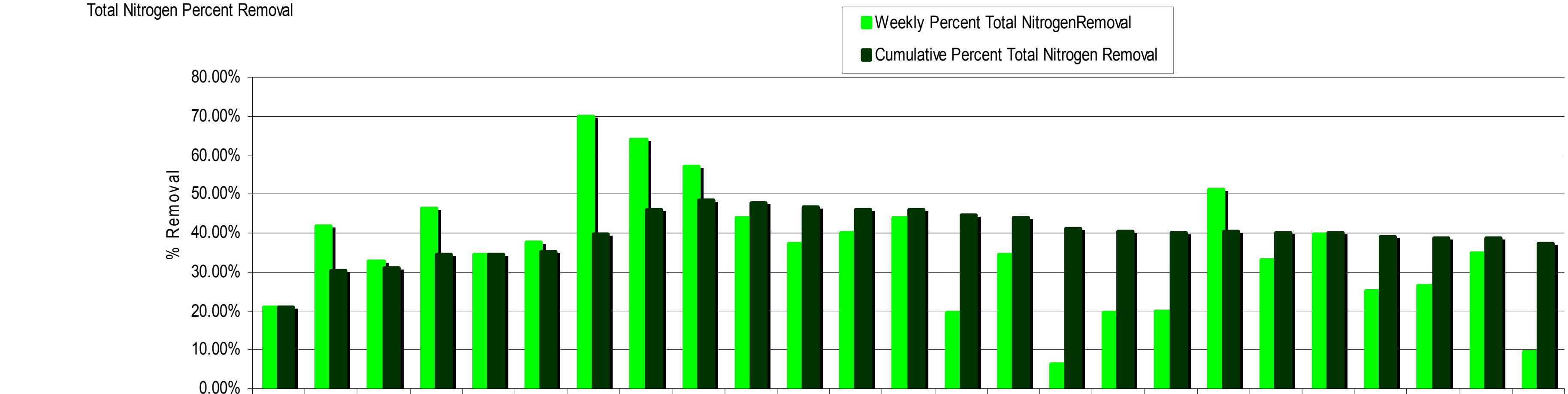
	1/24/11	1/31/11	2/7/11	2/14/11	2/21/11	2/28/11	3/7/11	3/14/11	3/21/11	3/28/11	4/4/11	4/11/11	4/18/11	4/25/ 11	5/02/11	5/09/11	5/16/11	5/23/11	5/31/11	6/7/11	7/18/11	7/25/11	8/1/11	8/8/11	8/15/11
Influent	0.67	0.62	0.55	0.55	0.65	0.91	0.59	1.84	1.63	1.07	1.01	1.33	1.04	0.81	1.00	0.86	0.49	0.67	0.57	0.66	1.05	1.03	0.80	0.98	1.25
Effluent	0.53	0.37	0.37	0.30	0.43	0.57	0.18	0.69	0.72	0.64	0.68	0.72	0.58	0.65	0.66	0.81	0.39	0.53	0.30	0.41	0.68	0.85	0.66	0.64	0.91

Figure 3: ATS™ Influent and Effluent Total Nitrogen Concentrations Month 1 through 6 South Canal ATS™ Pilot Study



	1/24/11	1/31/11	2/7/11	2/14/11	2/21/11	2/28/11	3/7/11	3/14/11	3/21/11	3/28/11	4/4/11	4/11/11	4/18/11	4/25/ 11	5/02/11	5/09/11	5/16/11	5/23/11	5/31/11	6/7/11	7/18/11	7/25/11	8/1/11	8/8/11	8/15/11
Weekly Percent Total Phosphorus Removal	27.18%	35.15%	38.37%	42.27%	44.72%	50.91%	63.19%	94.25%	78.39%	70.90%	52.05%	69.31%	77.22%	66.21%	53.54%	60.56%	45.74%	46.81%	58.30%	64.54%	39.68%	44.22%	35.86%	52.56%	38.93%
Cumulative Percent Total Phosphorus Removal	27.18%	31.44%	33.57%	35.74%	37.38%	39.53%	43.32%	64.49%	67.89%	68.21%	67.65%	67.76%	68.45%	68.35%	67.70%	67.31%	66.59%	66.01%	65.64%	65.55%	63.87%	62.69%	61.36%	60.80%	59.46%

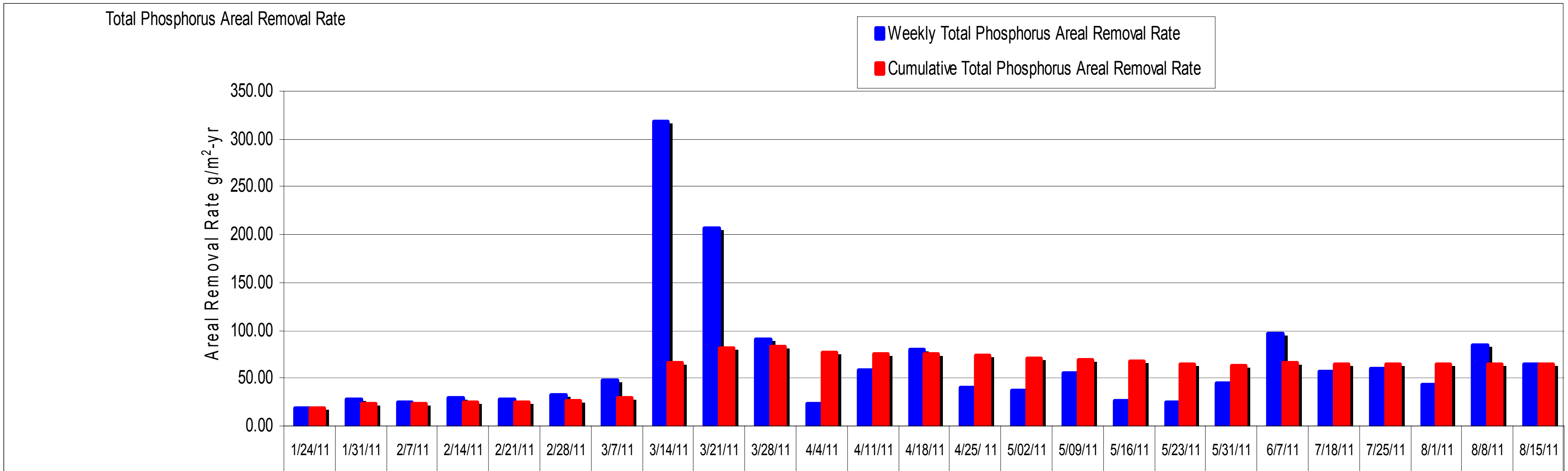
Figure 4: ATS™ Total Phosphorus Percent Removal Month 1 through 6 South Canal ATS™ Pilot Study



	1/24/11	1/31/11	2/7/11	2/14/11	2/21/11	2/28/11	3/7/11	3/14/11	3/21/11	3/28/11	4/4/11	4/11/11	4/18/11	4/25/ 11	5/02/11	5/09/11	5/16/11	5/23/11	5/31/11	6/7/11	7/18/11	7/25/11	8/1/11	8/8/11	8/15/11
Weekly Percent Total NitrogenRemoval	20.86%	41.64%	32.84%	46.20%	34.39%	37.43%	69.87%	64.08%	57.05%	43.95%	37.39%	40.12%	43.78%	19.30%	34.59%	6.41%	19.39%	19.85%	51.04%	33.14%	39.82%	24.87%	26.34%	34.77%	9.34%
Cumulative Percent Total Nitrogen Removal	20.86%	30.32%	30.93%	34.49%	34.47%	35.24%	39.64%	45.93%	48.19%	47.63%	46.78%	46.01%	45.82%	44.38%	43.74%	40.90%	40.49%	39.98%	40.33%	40.04%	40.03%	39.12%	38.64%	38.45%	37.11%

Week Ending

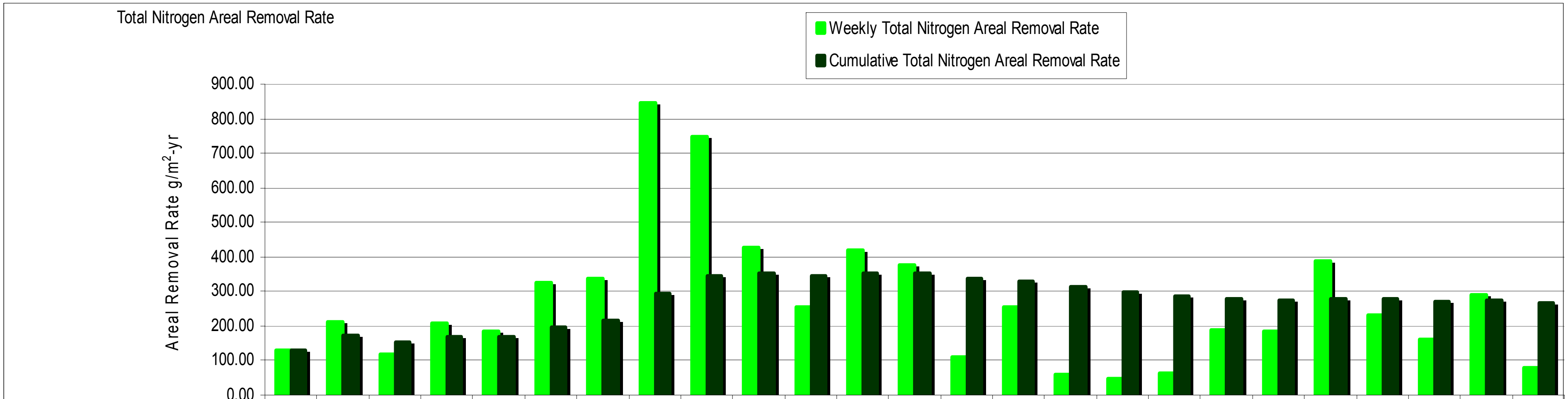
Figure 5: ATS™ Total Nitrogen Percent Removal Month 1 through 6 South Canal ATS™ Pilot Study



	1/24/11	1/31/11	2/7/11	2/14/11	2/21/11	2/28/11	3/7/11	3/14/11	3/21/11	3/28/11	4/4/11	4/11/11	4/18/11	4/25/ 11	5/02/11	5/09/11	5/16/11	5/23/11	5/31/11	6/7/11	7/18/11	7/25/11	8/1/11	8/8/11	8/15/11
Weekly Total Phosphorus Areal Removal Rate	18.14	26.83	24.05	28.87	27.12	32.32	47.48	317.15	206.12	89.95	22.36	58.40	80.22	40.40	36.70	55.61	25.94	24.35	44.82	96.97	56.59	60.03	42.69	84.74	64.66
Cumulative Total Phosphorus Areal Removal Rate	18.14	22.50	23.02	24.49	25.02	26.23	29.29	65.29	80.92	81.83	76.44	74.93	75.34	72.84	70.43	69.50	66.94	64.57	63.39	65.04	64.65	64.44	63.49	64.37	64.38

Week Ending

Figure 6: ATS™ Total Phosphorus Areal Removal Rates Months 1 through 6 South Canal ATS™ Pilot Study



	1/24/11	1/31/11	2/7/11	2/14/11	2/21/11	2/28/11	3/7/11	3/14/11	3/21/11	3/28/11	4/4/11	4/11/11	4/18/11	4/25/ 11	5/02/11	5/09/11	5/16/11	5/23/11	5/31/11	6/7/11	7/18/11	7/25/11	8/1/11	8/8/11	8/15/11
Weekly Total Nitrogen Areal Removal Rate	128.16	212.46	117.81	207.35	184.22	323.20	335.27	845.95	748.31	427.65	253.45	420.33	373.76	110.90	255.68	59.74	45.58	63.09	186.71	185.20	388.73	231.63	161.88	290.40	76.78
Cumulative Total Nitrogen Areal Removal Rate	128.16	170.44	152.79	166.47	170.03	195.48	215.62	294.46	344.81	353.13	344.10	350.47	352.26	335.01	329.72	312.83	297.11	284.10	278.24	273.67	278.99	276.84	271.86	272.62	264.76

Week Ending

Figure 7: ATS™ Total Nitrogen Areal Removal Rates Months 1 through 6 South Canal ATS™ Pilot Study

VI. Summary of Other Water Quality Parameters

A. General Review

Shown in Tables 7 through 12 is a complete listing of water quality data compiled during Months 1 through 6. Based upon this data the South Canal water may be assessed as a clear, moderately mineralized, moderately colored, oxygenated, near neutral freshwater, comparatively low in organic carbon, suspended solids[5] and available nitrogen, with some phosphorus enrichment. Note that the construction during the latter part of Month 2 resulted in some deviation from this assessment, with a noticeable increase in color, suspended solids and total phosphorus. By the end of Month 3—early to mid April—and into Month 4, the solids and nutrients began to adjust to near pre-construction levels. By Month 5 water quality conditions were similar to pre-construction periods.

The RO Concentrate is a highly mineralized, low color, oxygenated, slightly basic water with moderate salinity levels (4-6 ppt), low in suspended solids, with comparatively high levels of ammonia nitrogen and dissolved oxygen, and comparatively low phosphorus levels. The high mineral, ammonia and alkalinity content of the RO Concentrate appear to stimulate algal turf productivity when blended with the canal water, as previously mentioned.

There were no unacceptably high levels of heavy metals within the ATS™ effluent, except for mercury on 2/14/11 with 0.044 µg/L, which is above the standard per Ch 62-302.530 FAC of ≤ 0.012 µg/L. Lead was noted in the ATS™ effluent at a concentration of 5.92 µg/L on 3/14/11; 7.64 µg/L on 3/28/11; and 6.76 µg/L on 4/11/11, all being below the FDEP standard of about 10 µg/L (at hardness of 250 mg/L). It is not readily apparent why the lead levels were noted in the ATS™ effluent but not in either the canal or RO Concentrate. One logical thought would be the lead is related to sediment disruption during the canal construction, as lead is often associated with sediments deposited prior to non-leaded gasoline requirements[6]. More detailed investigations would be required to determine if such were the case.

B. Hydrogen Sulfide

While there was noted some of the typical "rotten egg" smell indicative of hydrogen sulfide associated with the RO Concentrate, water quality data for the first three months indicate an absence of detectable unionized hydrogen sulfide within the RO Concentrate, the canal water, and across the ATS™. One ATS™ effluent sample did show an unionized hydrogen sulfide level of 1.3 mg/L on 4/25/11. Otherwise no unionized hydrogen sulfide was detected within the effluent.

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[5] The suspended solids and nutrients were elevated during, and for a period after the in-canal construction during March and April 2011.
[6] Juracek, K.E. and A.C. Ziegler. (2006) "The Legacy of Leaded Gasoline in Bottom Sediments of Small Rural Reservoirs" J. Environ. Quality 35:2092-2102 doi:10.2134/jeq2006.0128

There was for a period, noted some presence of a sulfur bacteria (*Beggiotoa sp.*) growing on the algal turf along the first 20-50 feet of the floway. Unionized hydrogen sulfide is a known toxin to certain aquatic organisms. There was no indication of unionized hydrogen sulfide within the ATS™ effluent, except for the one sample cited, which appeared to be anomalous.

C. Unionized Ammonia

When water contains elevated levels of ammonium ion (NH_4^+), it is possible that under high pH and temperature that the fraction which becomes unionized (NH_3) will be at concentrations which solicit toxic effects on certain aquatic organisms. As noted, the ammonia levels within the RO Concentrate are comparatively high (circa 1.0 mg/L), composing over 67% of the total nitrogen within the RO Concentrate. The unionized portion within the RO Concentrate on 1/31/11, 2/7/11, 2/28/11, 3/14/11, 4/18/11, 5/2/11 and 5/30/11 were at 0.04 mg/L, based upon the pH and water temperature at the time of sampling. The level was noted at 0.03 mg/L on 3/7/11, 3/21/11 and 3/28/11 and 0.02 on 4/11/11, 4/25/11, 5/9/11, 5/23/11 and 6/6/11. These levels are above the standard set for freshwater within Ch 62-302.520 F.A.C of <0.02 mg/L.

The ATS™ effluent was noted to show no unionized ammonia for all six months. The ATS™ influent had an unionized value of 0.03 mg/L on 3/21/11 and 0.02 mg/L on 3/7/11, 3/28/11, 4/4/11 and 4/18/11 and the canal water 0.02 mg/L on 2/28/11. Otherwise, concentrations for both the canal water and ATS™ influent were below detectable limits.

The ammonia uptake rate by algal turf is typically high, as this is the form of nitrogen which is most readily available for plant uptake. In addition, it appears that during Months 4 and 6 some of the ammonia-nitrogen was being nitrified to NOx-N, as indicated by the increase in NOx-N levels across the ATS™ during this period. There was no indication of nitrification during Month 5. As shown in Table 13, the ATS™ facilitated over 91% total ammonia removal over the six month period.

D. Fluoride

The water quality standards for Class III freshwaters for Fluoride per Ch 62-302.500 is ≤10.0 mg/L. The permit limit is noted at ≤ 5 mg/L. All waters sampled fell below freshwater standard with the exception of the RO Concentrate on 2/14/11, 2/21/11, 5/30/11, 6/6/11, 8/1/11, 8/8/11 and 8/15/11 when the concentrations were 12.7, 15.0, 5.7 5.6, 6.0, 8.8, and 5.80 mg/L respectively. The highest level within the ATS™ effluent was 5.1 mg/L on 4/25/11, which was the only effluent sample above the permit limit. Note that all effluent samples associated with the designated dilution of 3.67:1 to 10:1 were below the permit limit of ≤ 5 mg/L.

E. Color

The RO Concentrate showed negligible color, while the canal water was at moderate levels—20-40 pcu during Month 1. Month 2 levels increased within the canal to 100 pcu, and within the ATS™ influent to 75 pcu on 3/14/11, as a result of the aforementioned construction activities. High levels of color persisted within the canal during the first two weeks of the third month. Levels dropped to pre-construction values by the fourth through sixth months The ATS™ contributed to reductions in color during the construction period and post-construction period when there was noted a substantial reduction from 75 pcu to 30 pcu on 3/14/11 and 75 pcu to 50 pcu on 3/21/11, and minor reductions of 40 pcu to 35 pcu on 4/4/11 and 50 to 45 pcu on 6/6/11. On eleven occasions during the six month period the ATS™ effluent showed minor increases in color when compared to the ATS™ influent—30 to 35 pcu on 1/24/11; 40 to 45 on 1/31/11; 25 pcu to 30 pcu on 2/21/11; 30 pcu to 50 pcu on 2/28/11; 25 pcu to 40 pcu on 4/25/11; 35 pcu to 45 pcu on 5/2/11; 30 pcu to 35 pcu on 5/9/11; 45 pcu to 50 pcu on 7/18/11; 60 pcu to 70 pcu on 7/25/11; 70 pcu to 80 pcu on 8/1/11 and 60 pcu to 70 pcu on 8/8/11. Over the six month monitoring period, the ATS™ influent and effluent were essentially the same, averaging 45 pcu and 47 pcu respectively. While typically the ATS™ technology has shown to provide little if any reduction or increase of color, it does appear in events such as those related to the construction activity in which color levels spike, that the ATS™ may offer substantive attenuation.

F. Alkalinity, pH and Available Carbon

Typically, when algal turf productivity is active and available carbon is consumed along an ATS™ floway, an upward daytime shift in pH is noted from influent to effluent. (This phenomenon is seen as well in any aquatic system which supports substantial rates of photosynthesis).The extent of this pH shift is largely dependent upon the initial pH and alkalinity, as well as the productivity level. The higher the alkalinity and the lower the initial pH, the greater the level of available carbon, and the more attenuated the pH differential. During the nighttime, when respiration dominates, CO_2 levels recover, and pH shifts downward. These patterns result in diurnal pH fluctuations which are typical of ATS™ dynamics, or for any photosynthetically active aquatic system (Figure 8). The daytime pH is not therefore reflective of a 24 hr average, but rather a peak value over a 24 hour period.

During Months 1 through 6, pH was taken during the daytime (usually 10:00AM -11:30 AM) at the four monitoring stations. The pH trends associated with these stations are shown in Figure 9. As noted, the elevation of pH within the ATS™ is indicative of a highly productive algal turf. The high alkalinities associated with the RO Concentrate (average 724 mg/L as $CaCO_3$) and the blended influent water (average 311 mg/L) provides buffering ability to attenuate the rate of pH rise within the effluent.

The upward pH shift over the monitoring period from an average ATS™ influent pH of 7.72 to an average ATS™ effluent pH of 8.27 reflects the consumption of carbon dioxide and bicarbonate and carbonate alkalinity, and the generation of hydroxyl alkalinity. The relationship of pH and alkalinity to available carbon for algal photosynthesis was investigated by Saunders et al.[7] The available carbon was expressed as a percentage of total alkalinity, as noted in Figure 10. Using this relationship, the amount of available carbon within the ATS™ influent is estimated at about 54 mg/L during Month 1, increasing to about 93 mg/l during Months 2, 106 mg/L during Month 3, 92 mg/L during Month 4, dropping to 49 mg/L during Month 5 and increasing slightly to 57 mg/L during Month 6. The consumed available carbon then is estimated at about 6.5 mg/L, or approximately 41 pounds of carbon for Month 1; 7.4 mg/L or approximately 48 pounds of carbon for Month 2; 8.4 mg/L or approximately 53 pounds of carbon for Month 3; 8.2 mg/L or approximately 54 pounds of carbon for Month 4, 7.0 mg/L or approximately 35 pounds of carbon for Month 5 and 7.0 mg/L or approximately 59 pounds of carbon for Month 6. This carbon roughly correlates to the carbon used in producing organic compounds through photosynthesis, which is expressed as gross productivity. The rise in daytime pH within the ATS™ effluent (8.27) is less than 1 unit above the canal background of 7.70—a 1 unit rise being the Class III standard per Ch62-302.520 F.A.C. During the nighttime hours the disparity between the canal and effluent pH levels will be expected to be lower—see Figure 8.

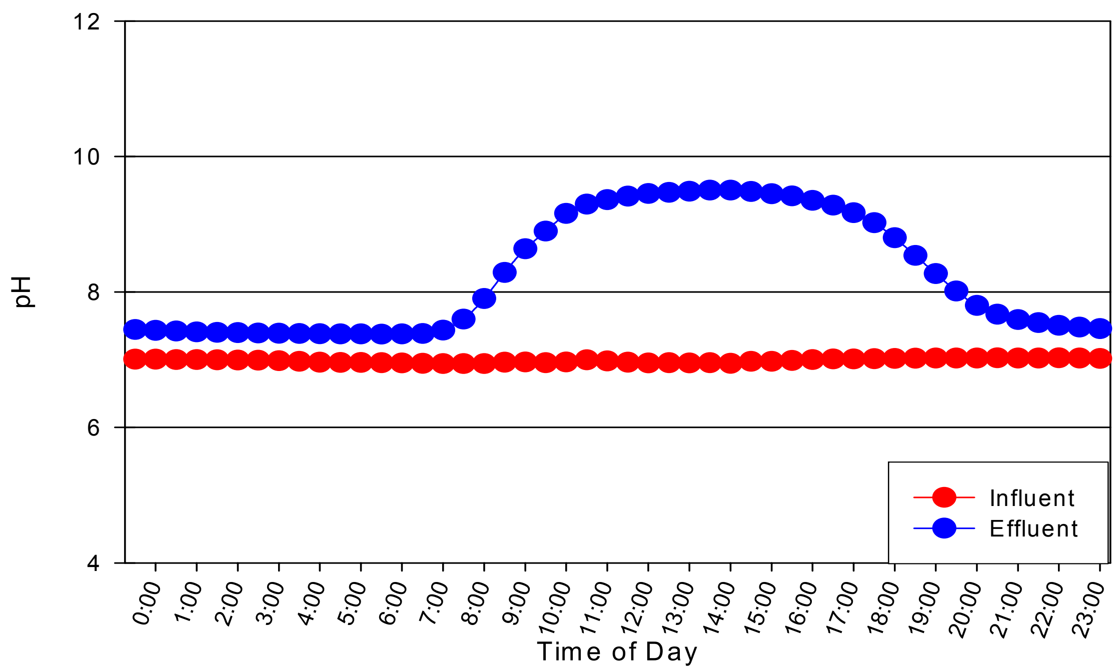


Figure 8: Typical Diurnal pH Trends Across an Active ATS™ floway [8]

[7] Saunders, G.W., F.B. Trama, and R.W. Bachman. 1962. Evaluation of a modified C14 technique for shipboard estimation of photosynthesis in large lakes. Great Lakes Research Division, Institute of Science and Technology, University of Michigan, Ann Arbor, Michigan, USA.

[8] Taken from HydroMentia (2005) "S-154 Pilot ATS™-WHS™ Aquatic Plant Treatment System Final Report" for SFWMD Contract C-13933

Table 7: Summary of Water Quality Data Month 1 South Canal ATS™ Pilot Study

Parameter	Unit	1/24/11				1/31/11				2/7/11				2/14/11			
		Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff
Total P[1]	mg/L	-	0.023	0.073	0.053	0.118	0.038	0.092	0.061	-	-	0.095	0.059	0.16	0.046	0.084	0.049
Ortho P	mg/L	-	-	0.029	0.029	0.090	0.019	0.081	0.048	-	-	0.063	0.023	0.064	0.019	0.059	0.037
Total N[1]	mg/L	-	-	0.67	0.53	0.48	1.51	0.62	0.37	-	-	0.55	0.37	0.53	1.48	0.55	0.30
TKN-N[1]	mg/L	-	1.62	0.64	0.53	0.41	1.40	0.51	0.32	-	-	0.49	0.37	0.48	1.35	0.44	0.30
NH3-N[1]	mg/L	-	-	0.13	U	0.15	1.10	0.17	0.02	0.16	0.91	0.17	U	0.04	-	0.08	U
Unionized NH3-N	mg/L	-	-	-	U	U	0.04	-	U	U	0.04	-	U	U	-	-	U
Org-N[1]	mg/L	-	-	0.51	0.53	0.26	0.30	0.34	0.30	-	-	0.32	0.37	0.44	-	0.36	0.30
NOx-N[1]	mg/L	-	0.10	0.03	U	0.06	0.11	0.11	0.05	-	-	0.06	U	0.06	0.13	0.11	U
TSS	mg/L	-	U	U	U	U	U	U	5.00	-	U	U	U	U	U	U	6.50
TOC	mg/L	-	-	45.30	7.50	-	-	31.90	8.51	-	-	-	-	-	-	-	-
Ca	mg/L	-	-	123	121	100	226	112	114	-	-	-	-	116	254	-	128
Fe	µg/L	-	-	U	U	-	-	0.132	0.086	-	-	-	-	-	-	-	0.083
Mg	mg/L	-	-	58	57	33	220	55	54	-	-	-	-	42	242	-	65
Alkalinity as $CaCO_3$	mg/L	-	728	217	221	-	734	215	218	-	-	-	-	173	729	225	234
Total Fluoride	mg/L	-	9.3	1.2	1.1	0.76	8.0	1.1	1.1	-	8.3	1.2	1.2	0.86	12.7	1.1	1.2
Total Sulfide	mg/L	-	2.4	2.2	1.1	-	U	U	U	-	4.0	3.4	1.6	-	2.0	1.2	U
Unionized H_2S	mg/L	-	U	U	U	-	U	U	U	-	U	U	U	-	U	U	U
pH	Units	7.86	7.80	7.91	8.28	7.70	7.77	8.04	8.46	7.67	7.85	7.90	8.75	7.82	7.83	7.83	8.62
Dissolved Oxygen	mg/L	5.73	5.98	5.94	13.87	8.18	8.58	8.98	22.54	5.29	5.84	5.54	14.68	5.56	6.05	5.78	18.91
Water T	°C	19.38	24.04	19.82	22.32	18.33	24.11	19.17	20.09	23.39	25.34	23.50	27.44	19.48	24.01	20.38	23.33
Conductivity	µS/cm	1,773	6,287	2,188	2,273	1.495	6,522	2,060	2,050	1,809	6,434	2,318	2,533	1,629	6,303	2,053	2,325
Color	Pcu	-	5	30	35	-	20	40	45	-	10	-	-	40	10	40	40
B	µg/L	-	-	-	-	87	324	-	109	-	-	-	-	103	338	-	126
Na	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	215	814	-	279
K	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	8.7	59.6	-	14.3
Cu	µg/L	-	-	-	-	4.2	55.4	-	5.9	-	-	-	-	U	-	-	4.1
As	µg/L	-	-	-	-	U	U	U	U	-	-	-	-	U	U	U	U
Pb	µg/L	-	-	-	-	U	U	U	U	-	-	-	-	U	U	U	U
Cr	µg/L	-	-	-	-	U	U	U	U	-	-	-	-	U	U	U	U
Cd	µg/L	-	-	-	-	U	U	U	U	-	-	-	-	U	U	U	U
Se	µg/L	-	-	-	-	U	U	U	U	-	-	-	-	U	U	U	U
Zn	µg/L	-	-	-	-	U	U	U	U	-	-	-	-	U	U	U	U
Hg	µg/L	-	-	-	-	-	U	U	U	-	-	-	-	0.043	0.034	-	0.044

1.weekly composite samples for ATS™ Influent and Effluent
U = Undetected, below detectable limits

Table 8: Summary of Water Quality Data Month 2 South Canal ATS™ Pilot Study

Parameter	Unit	2/21/11				2/28/11				3/7/11				3/14/11			
		Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff
Total P[1]	mg/L	-	-	0.073	0.041	0.128	0.032	0.067	0.033	-	-	0.093	0.035	0.326	0.032	0.470	0.068
Ortho P	mg/L	-	-	0.057	0.016	0.076	0.021	0.052	0.008	-	-	0.049	0.013	0.096	0.008	0.059	0.004
Total N[1]	mg/L	-	-	0.65	0.43	0.50	1.55	0.91	0.57	-	-	0.59	0.18	1.15	1.55	1.84	0.69
TKN-N[1]	mg/L	-	-	0.58	0.43	0.50	1.49	0.87	0.44	-	-	0.45	U	1.15	1.49	1.75	0.51
NH3-N[1]	mg/L	-	-	0.13	U	0.04	0.97	0.44	U	0.37	0.82	0.37	U	0.08	0.93	0.41	U
Unionized NH3-N	mg/L	-	-	U	U	U	0.04	U	U	0.02	0.03	U	U	U	0.04	0.02	U
Org-N[1]	mg/L	-	-	0.45	0.43	0.46	0.06	0.43	0.44	-	-	0.08	U	1.07	0.56	1.34	0.51
NOx-N[1]	mg/L	U	0.03	0.07	U	U	0.06	0.04	0.13	-	-	0.15	0.18	U	0.05	0.09	0.18
TSS	mg/L	-	-	U	U	6.0	U	U	U	-	-	18.00	8.50	51.00	6.00	79.00	U
TOC	mg/L	-	-	9.24	9.20	-	-	-	-	-	-	-	-	-	-	-	-
Ca	mg/L	-	-	136	136	114	232	167	106	-	-	-	-	108	227	-	169
Fe	µg/L	-	-	0.218	0.112	-	U	0.166	0.114	-	-	-	-	-	-	-	-
Mg	mg/L	-	-	68	68	39	223	121	48	-	-	-	-	40	224	-	135
Alkalinity as $CaCO_3$	mg/L	-	-	269	255	192	725	417	187	-	-	435	409	180	714	426	429
Total Fluoride	mg/L	-	15.0	2.0	2.0	0.9	9.3	7.6	1.1	-	7.9	5.8	0.1	-	7.70	3.80	3.9
Total Sulfide	mg/L	-	U	U	U	-	U	U	U	-	U	U	U	-	U	-	-
Unionized H_2S	mg/L	-	U	U	U	-	U	U	U	-	U	U	U	-	U	-	-
pH	Units	7.95	7.79	7.89	8.53	8.03	7.86	7.93	8.27	7.98	7.85	7.96	8.48	7.96	7.85	7.90	8.58
Dissolved Oxygen	mg/L	6.03	6.51	6.30	14.30	5.99	5.95	5.23	16.30	7.20	6.88	6.96	23.14	6.01	6.82	6.15	20.51
Water T	°C	23.18	25.28	23.46	26.13	23.94	25.69	24.49	26.88	23.45	25.28	24.49	26.23	22.62	25.47	24.09	28.71
Conductivity	µS/cm	1,792	6,227	2,529	2,589	1,923	5,903	3,213	4,329	2,051	5,945	3,816	3,644	1,858	5,843	3,928	3,644
Color	Pcu	-	-	25	35	40	10	30	50	-	-	40	40	100	10	75	30
B	µg/L	-	-	-	-	115	232	-	106	-	-	-	-	113	346	-	234
Na	mg/L	-	-	-	-	218	-	-	-	-	-	-	-	219	722	-	498
K	mg/L	-	-	-	-	8.00	-	-	-	-	-	-	-	8.43	57.40	-	32.00
Cu	µg/L	-	-	-	-	2.90	U	U	U	-	-	-	-	12.10	U	-	4.49
Zn	µg/L	-	-	-	-	14	U	U	U	-	-	-	-	U	U	U	U
As,Se,Cd,Cr	µg/L	-	-	-	-	U	U	U	U	-	-	-	-	U	U	U	U
Pb	µg/L	-	-	-	-	U	U	U	U	-	-	-	-	U	U	U	5.92
Hg	µg/L	-	-	-	-	U	U	U	U	-	-	-	-	U	U	U	U
Sulfate	mg/L	-	-	-	-	84	449	-	106	-	-	-	-	79	427	235	237
Bromide	mg/L	-	-	-	-	1.9	8.8	-	2.0	-	-	-	-	1.7	8.1	4.8	4.7
Chloride	mg/L	-	-	-	-	483	1,270	-	505	-	-	-	-	453	1,270	833	840

1.weekly composite samples for ATS™ Influent and Effluent
U = Undetected, below detectable limits

Table 9: Summary of Water Quality Data Month 3 South Canal ATS™ Pilot Study

Parameter	Unit	3/21/11				3/28/11				4/4/11				4/11/11			
		Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff
Total P[1]	**mg/L**	-	-	0.327	0.073	0.192	0.030	0.139	0.043	-	-	0.064	0.033	0.148	0.031	0.107	0.030
Ortho P	**mg/L**	-	-	0.095	0.017	0.072	0.018	0.051	0.014	-	-	0.059	0.009	0.099	0.002	0.055	0.010
Total N[1]	**mg/L**	-	-	1.63	0.72	0.71	1.41	1.07	0.64	-	-	1.01	0.68	0.88	1.62	1.33	0.72
TKN-N[1]	**mg/L**	-	-	1.57	0.54	0.68	1.34	0.88	0.40	-	-	0.94	0.47	0.88	1.57	1.29	0.64
NH3-N[1]	**mg/L**	-	0.91	0.56	0.06	0.03	0.83	0.28	0.11	-	-	0.46	0.02	0.00	0.97	0.52	0.00
Unionized NH3-N	**mg/L**	-	0.03	0.03	0.00	0.00	0.03	0.02	0.00	-	-	0.02	0.00	0.00	0.02	0.00	0.00
Org-N[1]	**mg/L**	-	-	1.01	0.48	0.65	0.51	0.60	0.29	-	-	0.48	0.45	0.88	0.60	0.77	0.66
NOx-N[1]	**mg/L**	-	-	0.06	0.18	0.03	0.07	0.19	0.24	-	-	0.07	0.21	0.00	0.05	0.04	0.08
TSS	**mg/L**	-	<5	63.30	7.50	16.50	<5	7.00	<5	-	-	5.50	<5	6.50	<5	7.00	<5
TOC	**mg/L**	-	-	-	-	-	-	-	-	-	9.16	8.99	9.16	-	-	-	-
Ca	**mg/L**	-	-	-	-	114	243	-	176	-	-	157	156	108	233	-	165
Fe	**µg/L**	-	-	-	-	-	-	-	-	-	U	318	125	-	-	-	-
Mg	**mg/L**	-	-	-	-	46	226	-	134	-	-	119	122	42	226	-	137
Alkalinity as $CaCO_3$	**mg/L**	-	715	-	-	168	710	437	440	-	-	401	384	175	718	429	420
Total Fluoride	**mg/L**	-	5.10	-	-	1.00	7.00	3.50	3.50	-	-	3.30	3.30	0.72	4.50	-	2.50
Total Sulfide	**mg/L**	-	<1	-	-	<1	<1	<1	<1	-	-	<1	<1	-	<1	<1	<1
Unionized H_2S	**mg/L**	-	<1	-	-	<1	<1	<1	<1	-	-	<1	<1	-	<1	<1	<1
pH	**Units**	7.76	7.70	7.73	8.15	7.87	7.88	7.77	8.20	7.76	7.63	7.77	8.20	7.61	7.59	7.61	8.23
Dissolved Oxygen	**mg/L**	5.61	2.26	5.22	14.67	5.10	5.19	5.88	9.81	5.00	6.57	6.14	14.28	5.47	6.93	5.95	14.00
Water T	**°C**	24.33	27.60	25.13	27.27	24.29	25.31	25.10	25.82	26.40	25.83	26.04	29.50	28.98	26.18	27.43	32.08
Conductivity	**µS/cm**	1,856	6,182	3,968	4,037	2,182	5,820	4,135	3,817	2,119	5,950	4,140	5,082	2,126	6,031	4,127	4,645
Color	**pcu**	-	15	75	50	50	10	35	35	-	-	40	35	45	15	35	35
B	**µg/L**	-	-	-	-	113	325	-	217	-	-	-	-	111	333	-	226
Na	**mg/L**	-	-	-	-	252	710	-	484	-	-	-	-	233	353	-	486
K	**mg/L**	-	-	-	-	9.18	60.7	-	33.7	-	-	-	-	8.86	58.2	-	33.4
Cu	**µg/L**	-	-	-	-	3.44	U	-	U	-	-	-	-	3.37	U	-	2.62
Zn	**µg/L**	-	-	-	-	U	U	-	U	-	-	-	-	U	U	-	U
As,Se,Cd,Cr	**µg/L**	-	-	-	-	U	U	-	U	-	-	-	-	U	U	-	U
Pb	**µg/L**	-	-	-	-	U	U	-	7.64	-	-	-	-	U	U	-	6.76
Hg	**µg/L**	-	-	-	-	U	U	-	U	-	-	-	-	0.033	U	-	U
Sulfate	**mg/L**	-	-	246	245	88	407	-	-	-	-	-	-	83	449	-	-
Bromide	**mg/L**	-	-	5.00	5.10	2.20	5.80	-	-	-	-	-	-	1.70	4.80	-	-
Chloride	**mg/L**	-	-	832	833	545	1,180	-	-	-	-	-	-	469	1,360	-	-

1.weekly composite samples for ATS™ Influent and Effluent
U = Undetected, below detectable limits

Table 10: Summary of Water Quality Data Month 4 South Canal ATS™ Pilot Study

Parameter	Unit	4/18/11				4/25/11				5/2/11				5/9/11			
		Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff
Total P[1]	mg/L	-	-	0.126	0.029	0.153	0.034	0.086	0.029	-	-	0.093	0.043	0.148	0.032	0.085	0.034
Ortho P	mg/L	-	-	0.073	0.012	0.032	0.019	0.057	0.011	-	-	0.076	0.015	0.090	0.022	0.061	0.015
Total N[1]	mg/L	-	-	1.04	0.58	3.47	1.62	0.81	0.65	-	-	1.00	0.66	0.60	1.54	0.86	0.81
TKN-N[1]	mg/L	-	-	0.94	0.42	3.47	2.68	0.76	0.51	-	-	0.98	0.56	-.60	1.44	0.81	0.68
NH3-N[1]	mg/L	-	1.10	0.39	0.00	0.05	1.10	0.44	0.00	-	1.10	0.41	0.04	0.04	1.10	0.33	0.03
Unionized NH3-N	mg/L	-	0.04	0.02	0.00	0.00	0.02	0.00	0.00	-	0.04	0.00	0.00	0.00	0.02	0.00	0.00
Org-N[1]	mg/L	-	-	0.55	0.42	-	-	0.32	0.51	-	-	0.54	0.51	-	-	0.48	0.64
NOx-N[1]	mg/L	-	-	0.10	0.16	0.00	0.07	0.05	0.14	-	-	0.05	0.10	0.00	0.10	0.05	0.13
TSS	mg/L	-	-	<5	<5	<5	<5	<5	11.0	-	-	10.5	7.5	<5	<5	<5	9.0
TOC	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ca	mg/L	-	-	-	-	106	235	-	151	-	-	-	-	106	236	-	151
Fe	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mg	mg/L	-	-	-	-	41	224	-	118	-	-	-	-	45	238	-	119
Alkalinity as $CaCO_3$	mg/L	-	-	-	-	167	712	387	379	-	-	-	-	166	722	382	351
Total Fluoride	mg/L	-	6.9	3.1	2.9	0.7	6.6	5.3	5.1	-	8.8	3.6	3.5	0.84	5.9	3.7	2.6
Total Sulfide	mg/L	-	<1	4.8	4.4	<1	<1	<1	<1	-	<1	<1	<1	-	<1	<1	<1
Unionized H_2S	mg/L		<1	<1	1.3			<1	<1	-	<1	<1	<1	-	<1	<1	<1
pH	Units	7.46	7.37	7.50	8.19	7.84	7.45	7.64	8.22	7.77	7.58	7.71	8.21	7.52	7.42	7.55	8.11
Dissolved Oxygen	mg/L	6.70	7.51	7.07	8.63	6.61	6.72	6.98	15.02	6.40	7.30	7.43	17.88	5.58	6.68	6.58	14.18
Water T	°C	27.16	26.08	27.54	31.84	28.15	26.32	27.25	30.00	29.51	26.52	28.11	31.30	28.15	26.01	27.28	31.70
Conductivity	µS/cm	2,065	5,459	4,082	4,258	2,160	6,578	4,178	4,456	2,280	6,042	3,866	4,131	2,257	5,999	3,771	3,882
Color	Pcu	-	15	35	40	35	10	-	-	-	10	35	45	40	10	30	35
B	µg/L	-	-	-	-	112	348	-	209	-	-	-	-	110	332	-	194
Na	mg/L	-	-	-	-	233	790	-	496	-	-	-	-	237	730	-	428
K	mg/L	-	-	-	-	8.2	66.3	-	31.2	-	-	-	-	7.8	59.8	-	26.4
Cu	µg/L	-	-	-	-	2.89	U	-	2.55	-	-	-	-	U	U	-	U
Zn	µg/L	-	-	-	-	U	U	-	U	-	-	-	-	U	U	-	U
As,Se,Cd,Cr	µg/L	-	-	-	-	U*	U	-	U	-	-	-	-	U	U	-	U
Pb	µg/L	-	-	-	-	U	U	-	5.44	-	-	-	-	U	U	-	U
Hg	µg/L	-	-	-	-	U	U	-	U	-	-	-	-	U	U	-	U
Sulfate	mg/L	-	-	-	-	83	374	-	-	-	-	-	-	80	439	-	217
Bromide	mg/L	-	-	-	-	1.80	8.30	-	-	-	-	-	-	1.90	5.50	-	2.30
Chloride	mg/L	-	-	-	-	493	1,260	-	-	-	-	-	-	573	1,330	-	823

1.weekly composite samples for ATS™ Influent and Effluent
U = Undetected, below detectable limits * Cr =9.90 µg/L Canal 4/25/11 grab sample

Table 11: Summary of Water Quality Data Month 5 South Canal ATS™ Pilot Study

Parameter	Unit	5/16/11				5/23/11				5/30/11				6/6/11			
		Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff
Total P[1]	mg/L	-	-	0.118	0.064	0.139	0.028	0.109	0.058	-	-	0.120	0.053	0.143	0.031	0.178	0.059
Ortho P	mg/L	-	-	0.062	0.055	0.058	0.015	0.057	0.046	-	-	0.050	0.023	0.078	0.015	0.071	0.054
Total N[1]	mg/L	-	-	0.49	0.39	0.64	1.52	0.67	0.53	-	-	0.57	0.30	0.54	1.54	0.66	0.41
TKN-N[1]	mg/L	-	-	0.49	0.39	0.64	1.38	0.67	0.53	-	-	0.48	0.30	0.54	1.32	0.63	0.41
NH3-N[1]	mg/L	-	0.99	0.06	0.00	0.05	1.10	0.05	0.03	-	0.95	0.00	0.00	0.03	1.10	0.00	0.06
Unionized NH3-N	mg/L	-	0.00	0.00	0.00	0.00	0.02	0.00	0.00	-	0.04	0.00	0.00	0.00	0.02	0.00	0.00
Org-N[1]	mg/L	-	-	0.43	0.39	0.59	0.28	0.62	0.50	-	-	0.48	0.30	0.51	0.22	0.63	0.36
NOx-N[1]	mg/L	-	-	0.00	0.00	0.00	0.14	0.00	0.00	-	-	0.09	0.00	0.00	0.22	0.04	0.00
TSS	mg/L	0.00	-	6.00	0.00	9.50	0.00	8.50	5.50	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOC	mg/L	-	-	-	-	-	-	15.40	8.98	-	-	-	-	-	-	23.40	9.59
Ca	mg/L	-	-	-	-	111	128	-	-	-	-	-	-	110	240	119	114
Fe	µg/L	-	-	-	-	-	-	388	123	-	-	-	-	-	-	1,130	-
Mg	mg/L	-	-	-	-	52	229	-	-	-	-	-	-	39	229	55	51
Alkalinity as $CaCO_3$	mg/L	-	729	202	192	150	772	185	157	-	709	192	182	172	709	202	200
Total Fluoride	mg/L	-	-	-	-	1.0	4.8	1.1	1.1	-	5.6	1.1	1.2	0.8	5.7	1.0	1.0
Total Sulfide	mg/L	-	-	-	-	U	U	U	U	U	U	U	U	U	U	U	U
Unionized H_2S	mg/L	-	-	-	-	U	U	U	U	U	U	U	U	U	U	U	U
pH	Units	7.41	7.37	7.67	8.32	7.68	7.50	7.78	8.41	7.77	7.51	7.80	8.35	7.89	7.55	7.83	8.28
Dissolved Oxygen	mg/L	5.56	7.03	6.34	11.15	5.94	7.00	6.68	9.42	5.75	7.79	5.32	13.48	7.36	7.32	8.33	13.20
Water T	°C	27.20	25.96	27.23	28.90	28.85	26.95	28.68	32.83	29.79	26.23	29.55	32.00	28.94	26.48	28.48	31.35
Conductivity	µS/cm	2,300	5,923	2,725	2,797	2,547	6,118	2,777	2,940	2,660	5,891	2,972	3,082	2,082	6,028	2,361	2,461
Color	Pcu	-	10	40	40	45	15	45	45	-	15	40	40	45	10	50	45
B	µg/L	-	-	-	-	128	350	-	130	-	-	-	-	111	356	-	124
Na	mg/L	-	-	-	-	293	727	-	308	-	-	-	-	219	718	-	225
K	mg/L	-	-	-	-	9.55	60.3	-	11.7	-	-	-	-	7.84	64.4	-	10.9
Cu	µg/L	-	-	-	-	U	9.23	-	U	-	-	-	-	U	11.4	-	U
Zn	µg/L	-	-	-	-	U	12.31	-	U	-	-	-	-	U	U	-	U
As,Se,Cd,Cr	µg/L	-	-	-	-	U	U	-	U	-	-	-	-	U	U	-	U
Pb	µg/L	-	-	-	-	U	19.12	-	U	-	-	-	-	U	U	-	U
Hg	µg/L	-	-	-	-	U	U	-	U	-	-	-	-	U	U	-	U
Sulfate	mg/L	-	-	-	-	88	432	107	108	-	-	-	-	-	431	-	-
Bromide	mg/L	-	-	-	-	2.30	5.40	2.40	2.40	-	-	-	-	-	6.10	-	-
Chloride	mg/L	-	-	-	-	580	1,330	619	630	-	-	-	-	-	1,330	-	-

1.weekly composite samples for ATS™ Influent and Effluent
U = Undetected, below detectable limits

Table 12: Summary of Water Quality Data Month 6 South Canal ATS™ Pilot Study

Parameter	Unit	7/18/11				7/25/11				8/1/11				8/8/11			
		Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff	Canal	RO Con	ATS In	ATS Eff
Total P[1]	mg/L	-	-	0.154	0.100	0.170	0.038	0.150	0.092	-	-	0.154	0.112	0.179		0.189	0.090
Ortho P	mg/L	-	-	0.130	0.60	0.114	0.023	0.101	0.079	-	-	0.103	0.083	0.120	0.021	0.104	0.079
Total N[1]	mg/L	-	-	1.05	0.68	1.03	1.66	1.03	0.85	-	-	0.80	0.66	0.92	3.82	0.98	0.64
TKN-N[1]	mg/L	-	-	0.97	0.62	0.96	1.40	0.91	0.68	-	-	0.66	0.47	0.28	3.26	0.79	0.51
NH3-N[1]	mg/L	-	-	0.18	0.09	0.04	0.84	0.13	0.04	-	0.66	0.04	U	0.08	0.58	0.16	0.03
Unionized NH3-N	mg/L	-	-	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Org-N[1]	mg/L	-	-	0.79	0.53	0.92	0.56	0.78	0.64	-	-	0.62	0.47	0.68	2.68	0.63	0.48
NOx-N[1]	mg/L	-	-	0.09	0.06	0.08	0.26	0.12	0.17	-	-	0.13	0.20	0.15	0.56	0.19	0.13
TSS	mg/L	-	U	-	-	U	U	-	-	U	-	-	-	U	23	-	-
TOC	mg/L	-	-	-	-	-	-	28.8	14.0	-	-	-	-	-	-	12.1	12.8
Ca	mg/L	-	-	-	-	108	240	132	131	-	-	-	-	106	253	131	126
Fe	µg/L	-	-	-	-	-	-	403	73	-	-	-	-	-	-	568	55
Mg	mg/L	-	-	-	-	35	242	67	70	-	-	-	-	36	240	67	68
Alkalinity as $CaCO_3$	mg/L	-	-	-	-	169	725	251	254	-	-	-	-	-	-	-	-
Total Fluoride	mg/L	-	-	0.75	0.75	0.19	3.20	0.73	0.85	-	6.00	1.40	1.50	0.87	8.80	1.30	0.85
Total Sulfide	mg/L	-	-	U	U	U	U	U	U	-	U	-	-	U	U	U	U
Unionized H_2S	mg/L	-	-	U	U	U	U	U	U	-	U	-	-	U	U	U	U
pH	Units	7.77	7.44	7.64	8.15	7.53	7.24	7.53	8.01	7.33	7.14	7.34	8.00	7.29	7.15	7.44	7.86
Dissolved Oxygen	mg/L	-	-	-	-	5.13	5.95	5.21	13.49	5.02	6.81	4.85	8.45	5.25	6.88	5.22	7.56
Water T	°C	30.5	26.7	29.9	30.6	31.3	26.8	30.4	30.1	31.4	27.3	30.3	33.8	30.4	26.7	29.5	31.7
Conductivity	µS/cm	1,956	6,778	2,820	2,832	1,920	6,696	2,908	2,999	2,004	7,027	3,158	3,318	1,957	6,705	2,832	2,962
Color	Pcu	-	-	45	50	70	10	60	70	-	10	70	80	70	20	60	70
B	µg/L	-	-	-	-	118	544	-	152	-	-	-	-	107	339	-	144
Na	mg/L	-	-	-	-	188	834	-	305	-	-	-	-	182	820	-	290
K	mg/L	-	-	-	-	8.0	60.7	-	17.0	-	-	-	-	7.7	57.7	-	15.8
Cu	µg/L	-	-	-	-	U	9.7	U	U	-	-	-	-	U	41.7	-	U
Zn	µg/L	-	-	-	-	U	U	-	U	-	-	-	-	U	U	-	U
As,Se,Cd,Cr	µg/L	-	-	-	-	U	U	-	U	-	-	-	-	U	U	-	U
Pb	µg/L	-	-	-	-	U	13.9	-	U	-	-	-	-	U	11.2	-	U
Hg	µg/L	-	-	-	-	U	U	-	U	-	-	-	-	U	U	-	U
Sulfate	mg/L	-	-	-	-	92	481	-	-	-	-	-	-	77	439	-	-
Bromide	mg/L	-	-	-	-	0.52	2.07	-	-	1.80	10.70	-	-	-	-	-	-
Chloride	mg/L	-	-	-	-	876	1,750	-	-	-	-	-	-	399	1,450	-	-

1.weekly composite samples for ATS™ Influent and Effluent
U = Undetected, below detectable limits

Table 12 (continued): Summary of Water Quality Data Month 6 South Canal ATS™ Pilot Study

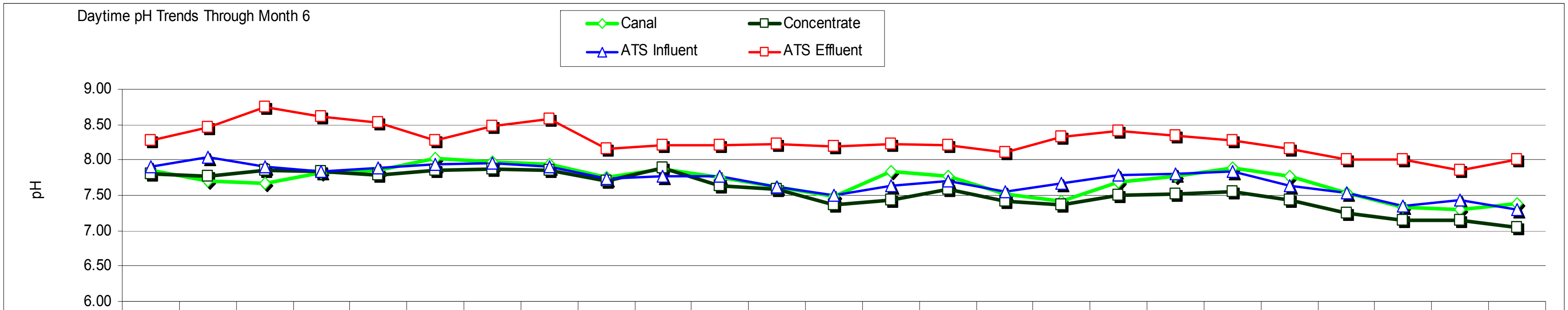
Parameter	Unit	8/15/11			
		Canal	RO Con	ATS In	ATS Eff
Total P[1]	mg/L	0.191	0.124	0.191	0.124
Ortho P	mg/L	-	-	0.133	0.094
Total N[1]	mg/L	-	-	1.25	0.91
TKN-N[1]	mg/L	-	-	0.94	0.61
NH3-N[1]	mg/L	-	1.00	0.29	0.03
Unionized NH3-N	mg/L	-	-	U	U
Org-N[1]	mg/L	-	-	0.65	0.58
NOx-N[1]	mg/L	-	U	0.31	0.30
TSS	mg/L	-	-	-	-
TOC	mg/L	-	-	-	-
Ca	mg/L	-	-	-	-
Fe	µg/L	-	-	-	-
Mg	mg/L	-	-	-	-
Alkalinity as $CaCO_3$	mg/L	-	-	-	-
Total Fluoride	mg/L	-	5.80	1.30	1.40
Total Sulfide	mg/L	-	-	U	U
Unionized H_2S	mg/L	-	U	U	U
Ph	Units	7.38	7.05	7.30	8.01
Dissolved Oxygen	mg/L	3.83	4.51	3.65	7.58
Water T	°C	29.7	27.4	29.0	32.9
Conductivity	µS/cm	1,524	6,070	2,453	2,598
Color	Pcu	-	10	90	90
B	µg/L	-	-	-	-
Na	mg/L	-	-	-	-
K	mg/L	-	-	-	-
Cu	µg/L	-	-	-	-
Zn	µg/L	-	-	-	-
As,Se,Cd,Cr	µg/L	-	-	-	-
Pb	µg/L	-	-	-	-
Hg	µg/L	-	-	-	-
Sulfate	mg/L	-	-	130	141
Bromide	mg/L	-	-	2.10	2.00
Chloride	mg/L	-	-	458	489

1.weekly composite samples for ATS™ Influent and Effluent
U = Undetected, below detectable limits

Table 13: Ammonia Concentrations and Removals Months 1 through 6 South Canal ATS™ Pilot Study

Canal Water Ammonia	Canal Water Ammonia		RO Concentrate Ammonia		Blended Influent to ATS™ Ammonia		ATS™ Effluent Ammonia		Percent Total Ammonia Removal
Week Ending	Total mg/L	NH_3 mg/L	Total mg/L	NH_3 mg/L	Total mg/L	NH_3 mg/L	Total mg/L	NH_3 mg/L	
1/24/11	-	-	-	-	0.13	U	U	U	100%
1/31/11	0.15	U	1.10	0.04	0.17	U	0.02	U	92%
2/07/11	0.16	U	0.91	0.04	0.17	U	U	U	100%
2/14/11	0.04	U	-	-	0.08	U	U	U	100%
2/21/11	-	-	-	-	0.13	-	U	U	100%
2/28/11	0.04	U	0.97	0.04	0.44	U	U	U	100%
3/07/11	0.37	0.02	0.82	0.03	0.37	U	U	U	100%
3/14/11	0.08	U	0.93	0.04	0.41	0.02	U	U	100%
3/21/11	-	-	0.91	0.03	0.56	0.03	0.06	U	89%
3/28/11	0.03	U	0.83	0.03	0.28	0.02	0.11	U	87%
4/04/11	-	-	-	-	0.46	0.02	0.02	U	96%
4/11/11	U	U	0.97	0.02	0.52	U	U	U	100%
4/18/11	-	-	1.10	0.04	0.39	0.02	U	U	100%
4/25/11	0.05	U	1.10	0.02	0.44	U	U	U	100%
5/02/11	-	-	1.10	0.04	0.41	U	0.04	U	89%
5/09/11	0.04	U	1.10	0.02	0.33	U	0.03	U	90%
5/16/11	-	-	0.99	0.00	0.06	U	U	U	100%
5/23/11	0.05	U	1.10	0.02	0.05	U	0.03	U	28%
5/30/11	-	-	0.95	0.04	U	U	U	U	100%
6/06/11	0.03	U	1.15	0.02	U	U	0.06	U	-
7/18/11	-	-	-	-	0.18	U	.09	U	54%
7/25/11	0.04	U	0.84	U	0.13	U	0.04	U	72%
8/01/11	-	U	0.66	U	0.04	U	U	U	100%
8/08/11	0.08	U	0.58	-	0.16	U	0.03	U	81%
8/15/11	-	-	1.00	-	0.29	U	0.03	U	92%
Avg	**0.07**	**U**	**0.95**	**0.03**	**0.25**	**U**	**0.02**	**U**	**91%**

U = Undetected, below detectable limits. NH_3 represents unionized ammonia



	1/24/11	1/31/11	2/7/11	2/14/11	2/21/11	2/28/11	3/7/11	3/14/11	3/21/11	3/28/11	4/4/11	4/11/11	4/18/11	4/25/ 11	5/02/11	5/09/11	5/16/11	5/23/11	5/31/11	6/7/11	7/18/11	7/25/11	8/1/11	8/8/11	8/15/11
Canal	7.86	7.70	7.67	7.82	7.85	8.03	7.98	7.94	7.76	7.87	7.76	7.61	7.49	7.84	7.77	7.52	7.41	7.68	7.77	7.89	7.77	7.53	7.33	7.29	7.38
Concentrate	7.80	7.77	7.85	7.83	7.78	7.86	7.87	7.85	7.70	7.88	7.63	7.59	7.37	7.43	7.58	7.42	7.37	7.50	7.51	7.55	7.44	7.24	7.14	7.15	7.05
ATS Influent	7.91	8.04	7.90	7.83	7.89	7.93	7.96	7.90	7.73	7.77	7.77	7.61	7.50	7.64	7.71	7.55	7.67	7.78	7.80	7.83	7.64	7.53	7.34	7.44	7.30
ATS Effluent	8.28	8.46	8.75	8.62	8.53	8.27	8.48	8.58	8.15	8.20	8.20	8.23	8.19	8.22	8.21	8.11	8.32	8.41	8.35	8.28	8.15	8.01	8.00	7.86	8.01

Week Ending

Figure 9: Daytime pH Trends Months 1 through 6 South Canal ATS™ Pilot Study

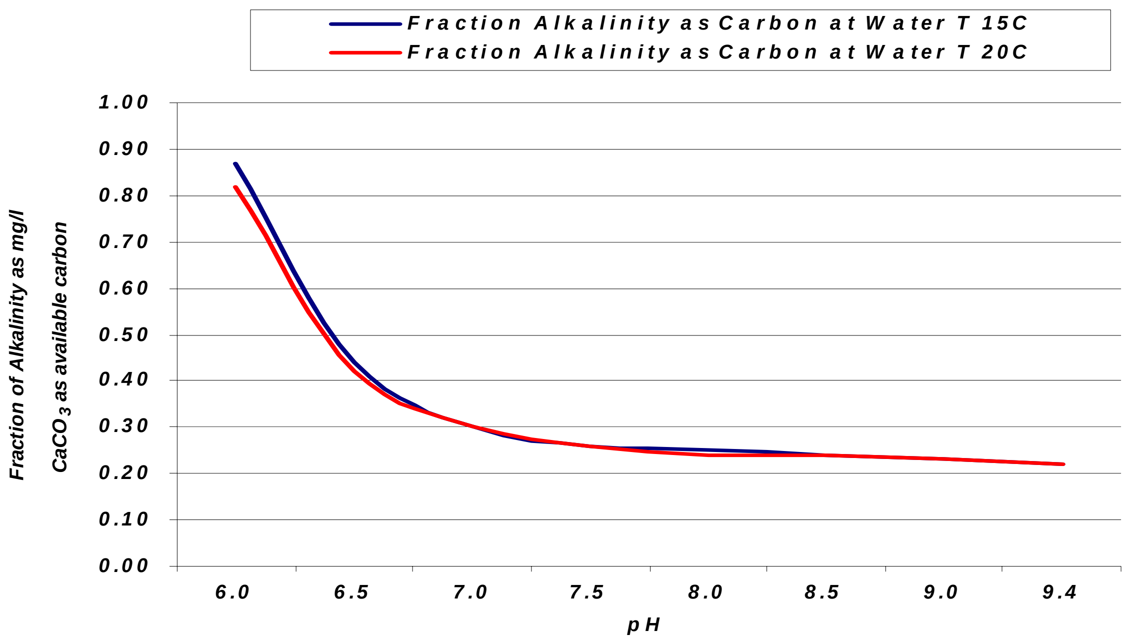


Figure 10: Available Carbon, Alkalinity, pH relationship per Saunders et. al.[2]

G. Dissolved Oxygen

Oxygen is a product of photosynthesis. During the daytime when photosynthesis rates are typically high, enough oxygen is generated by the ATS™ that levels in the effluent exceed saturation. It is not unusual for dissolved oxygen (DO) levels to surpass15 mg/L, even during the summer when saturation concentrations can be as low as 6-7 mg/L. At night, while there is no photosynthetic DO contributed to the floway, the shallow flow associated with the ATS™ process facilitates comparatively high reaeration rates, thereby typically avoiding the severe DO "sag" often associated with highly productive systems. Therefore, while there may be a drop in DO levels at night, the levels typically remain higher than the influent levels, and above 5 mg/L. A typical diurnal pattern for DO associated with the ATS™ is noted in Figure 11.

For Months 1 through 6, daytime DO levels across the ATS™ showed this typical pattern, with effluent levels well above saturation. The daytime DO levels in both the canal and the RO Concentrate were above the water quality standard for Class III waters of 5 mg/L per Ch62-302.530 F.A.C. The daytime increase across the ATS™ as noted in Figure 12 was from an average of 6.16 mg/L within the influent to 14.05 mg/L within the effluent. Monitoring DO provides a general indication of productivity levels across the ATS™, and to the overall health of the algal turf community. High DO levels within the effluent assist in maintaining a healthy aquatic ecostructure within the receiving waters—e.g. as seen at the County's Egret Marsh Facility.[9]

H. Water Temperature

Water temperature changes from influent to effluent across an ATS™ floway depends largely upon the differential between air temperature and water temperature. A typical pattern for Florida when the daytime air temperature is normally higher than the water temperature is for the water to gain heat down the ATS™ floway during the daytime, and then release heat at night (Figure 13).

The daytime water temperature patterns for Months 1 through 5, as seen in Figure 14, indicate a higher temperature within the RO Concentrate when compared to the canal water by an average of 1.11 °C (24.42°C as compared to 25.55°C). This differential was lower during Month 2 (2.06 °C) and Month 3 (0.23°C) than that noted for Month 1 (4.23 °C), and during Month 4 and Month 5, the canal water was warmer than the RO Concentrate by 2.01 °C (28.24°C as compared to 26.23°C) and 2.08 °C (28.49°C as compared to 26.41°C) respectively. The blended water (ATS™ influent) averaged 25.36 °C, with the average ATS™ effluent averaging 28.24 °C, or an increase of 2.88 °C or about 5.2 °F across the floway. Typically, during the nighttime the ATS™ effluent temperature drops below the influent temperature, as noted in Figure 13, so the average 24-hour influent and effluent temperatures are usually nearly equal.

Pilot systems, because they are elevated and thus exposed to air and not temperature buffered by the soil, typically show somewhat higher rates of temperature increases across the floway. For example, while the increase was 2.88 °C for Months 1 through 5 at the PC-South Pilot ATS™, it was only 1.87 °C for the same time period at the nearby full scale facility at Egret Marsh. Regulations related to temperature within receiving waters are included in CH62-302.520 F.A.C. It is not expected that the increases in water temperature associated with the ATS™ would result in violation of these standards, especially considering that over a 24 hour average there is typically little change noted in influent and effluent water temperatures.

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[9] Egret Marsh Stormwater Park Algal Turf Scrubber® 319(h) Grant (Contract G0143) Quarterly Performance Report Quarter One, December 2010, Prepared for Indian River County, Florida by HydroMentia, Inc. Ocala, Fl

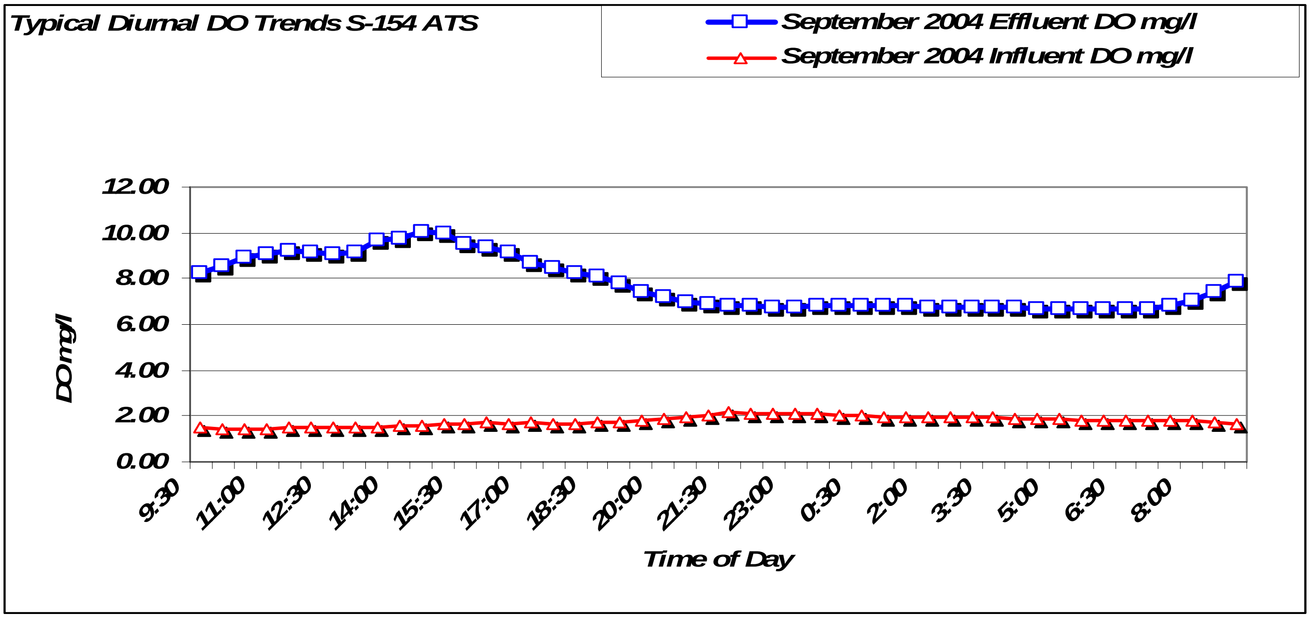
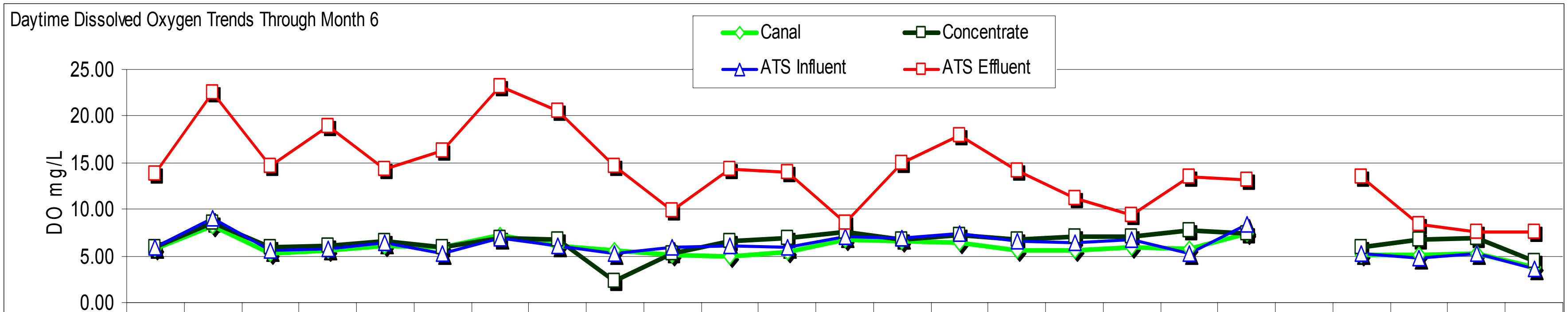


Figure 11: Typical Diurnal DO Trends Across an Active ATS™ Floway[10]

[10] Taken from HydroMentia (2005) "S-154 Pilot ATS™-WHS™ Aquatic Plant Treatment System Final Report" for SFWMD Contract C-13933



	1/24/11	1/31/11	2/7/11	2/14/11	2/21/11	2/28/11	3/7/11	3/14/11	3/21/11	3/28/11	4/4/11	4/11/11	4/18/11	4/25/ 11	5/02/11	5/09/11	5/16/11	5/23/11	5/31/11	6/7/11	7/18/11	7/25/11	8/1/11	8/8/11	8/15/11
Canal	5.73	8.18	5.29	5.56	6.03	5.99	7.20	6.01	5.61	5.10	5.00	5.47	6.70	6.61	6.40	5.58	5.56	5.94	5.75	7.36		5.13	5.02	5.25	3.83
Concentrate	5.98	8.58	5.84	6.05	6.51	5.95	6.88	6.82	2.26	5.19	6.57	6.93	7.51	6.72	7.30	6.68	7.03	7.00	7.79	7.32		5.95	6.81	6.88	4.51
ATS Influent	5.94	8.98	5.54	5.78	6.39	5.23	6.96	6.15	5.22	5.88	6.14	5.95	7.07	6.98	7.43	6.58	6.34	6.68	5.32	8.33		5.21	4.85	5.22	3.65
ATS Effluent	13.87	22.54	14.68	18.91	14.30	16.30	23.14	20.57	14.67	9.81	14.28	14.00	8.63	15.02	17.88	14.18	11.15	9.42	13.48	13.20		13.49	8.45	7.56	7.58

Week Ending

Figure 12: Daytime DO Trends Months 1 through 6 South Canal ATS™ Pilot Study

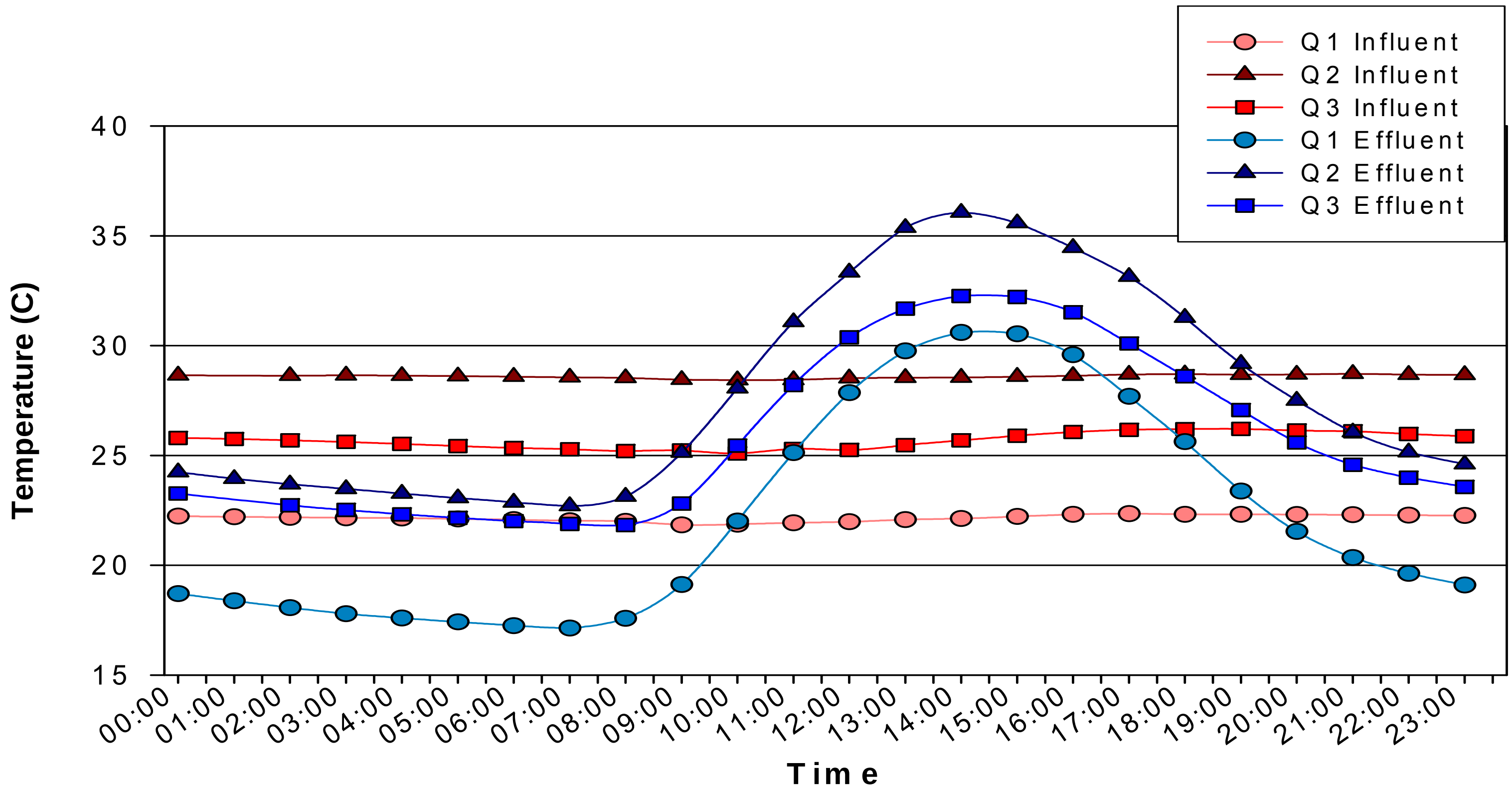
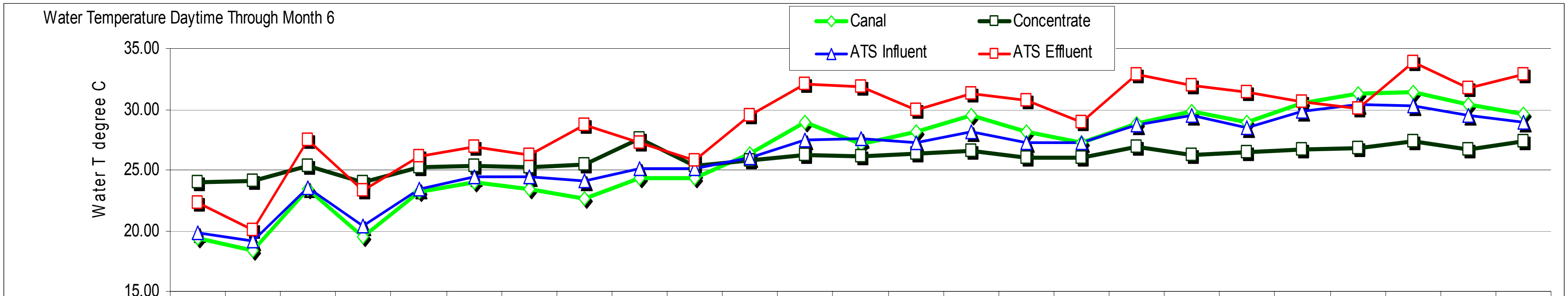


Figure 13: Typical Diurnal Water Temperature Trends Across an Active ATS™ floway[11]

[11] Taken from HydroMentia (2005) "S-154 Pilot ATS™-WHS™ Aquatic Plant Treatment System Final Report" for SFWMD Contract C-13933



	1/24/11	1/31/11	2/7/11	2/14/11	2/21/11	2/28/11	3/7/11	3/14/11	3/21/11	3/28/11	4/4/11	4/11/11	4/18/11	4/25/ 11	5/02/11	5/09/11	5/16/11	5/23/11	5/31/11	6/7/11	7/18/11	7/25/11	8/1/11	8/8/11	8/15/11
Canal	19.38	18.33	23.39	19.48	23.17	23.94	23.45	22.62	24.33	24.29	26.40	28.98	27.16	28.15	29.51	28.15	27.20	28.85	29.79	28.94	30.53	31.34	31.40	30.39	29.65
Concentrate	24.04	24.11	25.34	24.01	25.28	25.39	25.28	25.47	27.60	25.31	25.83	26.18	26.08	26.32	26.52	26.01	25.96	26.95	26.23	26.48	26.70	26.79	27.33	26.65	27.38
ATS Influent	19.82	19.17	23.50	20.38	23.46	24.49	24.49	24.09	25.13	25.10	26.04	27.43	27.54	27.25	28.11	27.28	27.23	28.68	29.55	28.48	29.88	30.41	30.29	29.45	28.95
ATS Effluent	22.32	20.09	27.44	23.33	26.13	26.88	26.23	28.71	27.27	25.82	29.50	32.08	31.84	30.00	31.30	30.70	28.90	32.83	32.00	31.35	30.64	30.05	33.83	31.74	32.90

Week Ending

Figure 14: Daytime Water Temperature Trends Months 1 through 6 South Canal ATS™ Pilot Study

I. Conductivity

Water from the South Canal would be considered freshwater, with moderate to high ionic activity, characterized during Months 1 through 6 by an average conductivity of 2.013 µS/cm[12]. When flows move across an ATS™ floway, there normally is very little shift in conductivity from influent to effluent, as algae production does little to change the conductivity signature of a water. The changes that are noted are typically attributable to temperature changes, with the effluent normally having somewhat higher conductivity levels during the warm daytime period (Figure 15). The RO Concentrate, as expected, had a much higher conductivity, averaging of the first five months 6,210 µS/cm, while the canal water averaged 2,013 µS/cm. During the first month the ATS™ influent which represented an approximate blend of 10:1 Canal Water to RO Concentrate averaged 2,155 µS/cm, with the Month 1 ATS™ effluent averaging 2,295 µS/cm. During Month 2, as a result of adjusting the blend ratio to approximately 1:1, the ATS™ influent averaged 3,374 µS/cm, with the ATS™ effluent averaging 3,552 µS/cm. During Month 3, with the blend ratio remaining at approximately 1:1, the ATS™ influent averaged 4,093 µS/cm with the ATS™ effluent averaging 4,395 µS/cm. Similarly, during Month 4, the ATS™ influent averaged 3,974 µS/cm with the ATS™ effluent averaging 4,183 µS/cm. During Month 5, after adjustment of the blend ratio to the design levels of 6:1 to 10:1 the ATS™ influent conductivity averaged 2,709 µS/cm and the ATS™ effluent averaged 2,820 µS/cm. During Month 6, after adjustment of the blend ratio to the 7Q10 levels of circa 3.67:1 the ATS™ influent conductivity averaged 2,834 µS/cm and the ATS™ effluent averaged 2,942 µS/cm These trends are noted in Figure 16. The ATS™ effluent even at the lower dilution rate is well below the conductivity limited cited within the aforementioned Consent Order of 6,500 µS/cm. Because conductivity in the South Relief Canal is typically higher during drought periods (note it averaged 2.409 µS/cm during May, 2011) it is not anticipated that the ATS™ effluent even at the 7Q10 blend of 3.67:1, when released to the South Canal will result in violation of Class III standards for conductivity of 50% increase as cited in the existing permit and Ch62-302.530 F.A.C.

[12] 1 microS/cm is the same as the older unit, microMHO/cm

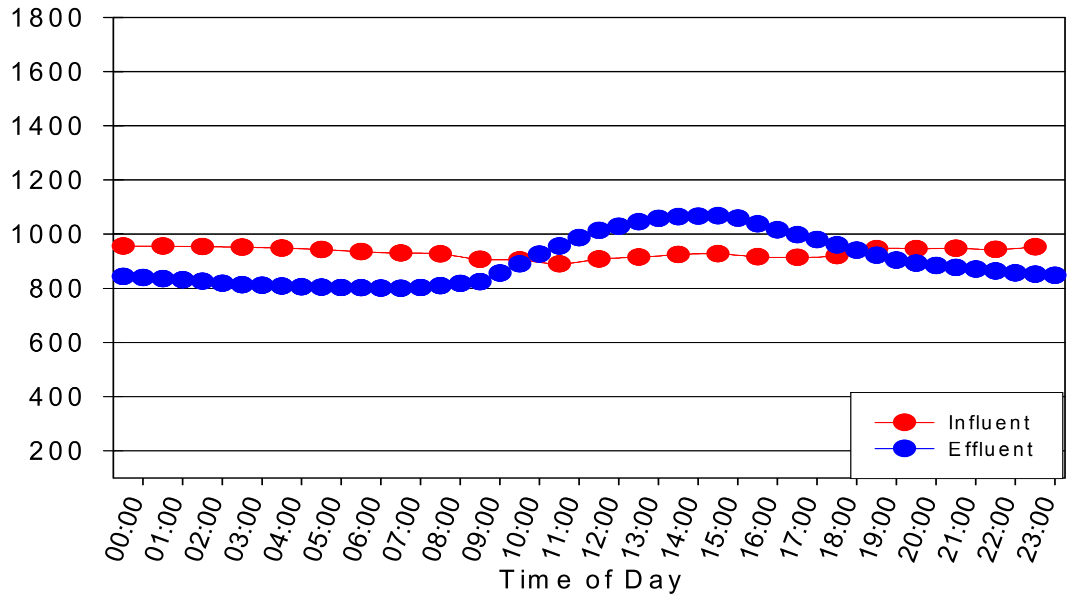
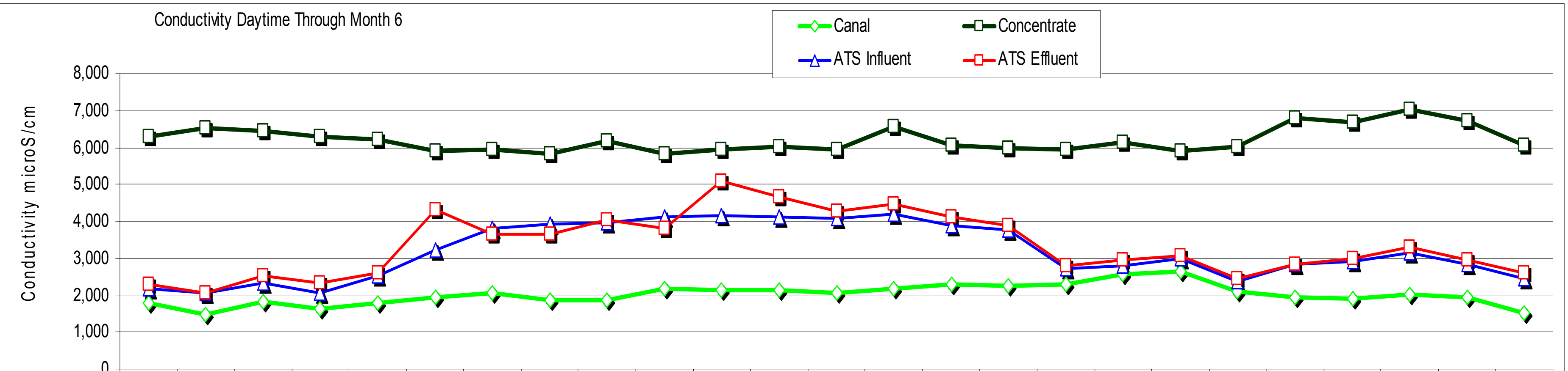


Figure 15: Typical Diurnal Conductivity Trends Across an Active ATS™ floway[13]

[13] Taken from HydroMentia (2005) "S-154 Pilot ATS™-WHS™ Aquatic Plant Treatment System Final Report" for SFWMD Contract C-13933



	1/24/11	1/31/11	2/7/11	2/14/11	2/21/11	2/28/11	3/7/11	3/14/11	3/21/11	3/28/11	4/4/11	4/11/11	4/18/11	4/25/ 11	5/02/11	5/09/11	5/16/11	5/23/11	5/31/11	6/7/11	7/18/11	7/25/11	8/1/11	8/8/11	8/15/11
Canal	1,773	1,495	1,809	1,629	1,792	1,923	2,051	1,858	1,856	2,182	2,119	2,126	2,065	2,160	2,280	2,257	2,300	2,547	2,660	2,082	1,956	1,920	2,004	1,957	1,524
Concentrate	6,287	6,522	6,434	6,303	6,227	5,903	5,945	5,843	6,182	5,820	5,950	6,031	5,959	6,578	6,042	5,999	5,923	6,118	5,891	6,028	6,778	6,696	7,027	6,705	6,070
ATS Influent	2,188	2,060	2,318	2,053	2,529	3,213	3,816	3,938	3,968	4,135	4,141	4,127	4,082	4,178	3,866	3,771	2,725	2,777	2,972	2,361	2,820	2,908	3,158	2,832	2,453
ATS Effluent	2,273	2,050	2,533	2,325	2,589	4,329	3,644	3,644	4,037	3,817	5,082	4,645	4,258	4,456	4,131	3,887	2,797	2,940	3,082	2,461	2,832	2,999	3,318	2,962	2,598

Week Ending

Figure 16: Daytime Conductivity Trends Months 1 through 6 South Canal ATS™ Pilot Study

J. Heavy Metals

Analysis was conducted on the following heavy metals for all four water sampling sites (Tables 7-10)

- Arsenic
- Lead
- Mercury
- Copper
- Selenium
- Cadmium
- Chromium
- Zinc

For all samples, levels were noted to be below detection limits with the exceptions noted in Table 14. The copper and zinc levels within the canal, and the ATS™ effluent, the chromium levels in the RO Concentrate on 4/25/11, the Zinc levels in the RO Concentrate on 5/23/11, and the lead levels noted in the ATS™ effluent and RO Concentrate are below FDEP standards for Class III waters, while the copper content for the RO Concentrate on 1/31/11 may be above these standards.[14] For the week of 2/14/11, mercury was noted to be above the FDEP standard for the canal, RO Concentrate and the ATS™ effluent, and for the canal for the week of 4/11/11. Review of historical records of the waters associated with the canals in this region of Indian River County indicate intermittent events of elevated mercury—see reference to Q1 Egret Marsh Report. The source of this mercury is most likely from atmospheric discharges associated with power stations (www.dep.state.fl.us/water/sas/mercury/index.htm).

Table 14: Summary of Heavy Metals above Detectable Limits Months 1 through 6 South Canal ATS™ Pilot Study

	Canal Water			RO Concentrate					ATS™ Effluent		
Week Ending	Zn	Cu	Hg	Cu	Zn	Hg	Cr	Pb	Pb	Cu	Hg
1/31/11	U	4.2	-	55.4	U	U	U	U	U	5.9	U
2/14/11	U	U	0.043	-	U	0.034	U	U	U	4.1	0.044
2/28/11	14	2.9	U	U	U	U	U	U	U	U	U
3/14/11	U	12.1	U	U	U	U	U	U	5.9	4.49	U
3/28/11	U	3.4	U	U	U	U	U	U	7.6	U	U
4/11/11	U	3.4	0.033	U	U	U	U	U	6.8	2.62	U
4/25/11	U	U	U	2.89	U	U	9.90	U	5.4	2.55	U
5/23/11	U	U	U	9.23	12.3	U	U	19.1	U	U	U
6/6/11	U	U	U	11.4	U	U	U	U	U	U	U
7/25/11	U	U	U	9.7	U	U	U	13.9	U	U	U
8/8/11	U	U	U	41.7	20.5	U	U	11.2	U	U	U

[14] Copper standards depend upon water hardness. There was no hardness data for the Concentrate. However, if a hardness of 300 mg/L is assumed, the copper standard would be about 24 µg/L.

VII. Algal Turf Productivity

Upon system start-up, algal turf development was comparatively rapid, with filamentous diatoms (e.g. *Melosira sp)* initially dominating, as expected, with filamentous green algae, such as *Cladophora sp* and *Rhizoclonium sp.*, eventually establishing a substantial base. This is what has been observed as a typical successional process associated with most ATS™ floways. A picture of typical algal turf on the system is shown within Appendix A.

During the second month there was noted a shift in the algal turf community towards filamentous diatoms, attributable largely to increased conductivity associated with the 1:1 blend - Canal Water to RO Concentrate. In addition, the influx of solids associated with the aforementioned construction within the South Canal appeared to disrupt algal turf development. This pattern of turf developed continued through Month 4. During Months 5 and 6, because of the return to higher dilution ratios, some filamentous green algae again became part of the turf community, although diatoms remained predominant. The productivity during month 6 was considerably lower than month 5, largely because the system, having been shut down for a month, had returned to the start-up phase, and had not yet stabilized sufficiently to establish a large working standing crop.

Because of the higher levels of ammonia nitrogen associated with the RO Concentrate, and the high alkalinity, there is ample nitrogen and carbon available within the blended water for algal productivity. Therefore, unlike some systems operating in low alkalinity, low nitrogen waters, growth of a healthy algal turf extended down the full 500 foot length of the floway, indicating that macro and micro nutrient limitations were avoided. Productivity for the monitoring period averaged 15.16 g/m^2-day, with a standard deviation of 8.58 g/m^2-day. This is notably higher than what has been observed at the Egret Marsh ATS™--12.70 g/m^2-day with a standard deviation of 7.64 g/m^2-day.

Over the monitoring period the ATS™ pilot floway was harvested 12 times, twice for each of the six months. A summary of these harvests are noted in Table 15.

With the ATS™ process it is possible to evaluate nutrient accountability by calculating and comparing removals based upon water quality and flow data and upon harvested material. As the ATS™ relies largely upon direct uptake, precipitation and filtration as the means of nutrient removal, then it would be reasonable to expect the total phosphorus and total nitrogen removed to be reasonably similar when calculated by both methods[15].

Mass total phosphorus removal (also applicable to other nutrients) based upon harvested biomass is calculated as:

$P_{mh} = (sH_w)p$

Where P_{mh} = mass of total phosphorus removed through harvesting

[15] The water quality data is considered the more reliable because of the homogeneity of the matrix (water), and the higher level of reliability of composite sampling.

s = solids content as fraction of wet harvest
H_w = mass of wet harvest
(sH_w) = mass of dry harvest
p = tissue phosphorus content as fraction of dry harvest

Mass removal based upon water quality is calculated as[16]:

$P_{mw} = I_p Q_I – E_p Q_E$
Where P_{mw} = mass of phosphorus removed based upon water quality
I_p = Influent total phosphorus concentration
E_p = Effluent total phosphorus concentration
Q_I = Influent totalized flow
Q_E = Effluent totalized flow

As noted, it would typically be expected that the harvest based removals would be similar to the water quality based removals. The extent of similarity[17] of these two calculations provides some insight into system dynamics and the following may be indicated:

A. If the harvest based total nitrogen removal estimate is similar to the water quality based total nitrogen removal calculation, then direct biological uptake by the algal turf community may be considered the principal means of nitrogen removal.

B. If the harvest based total nitrogen removal estimate is considerably lower than the water quality based total nitrogen removal calculation, then;

   1. Either the analytical methods or field sampling methods are not sufficiently reliable, or
   2. Extensive nitrogen loss is attributable to denitrification, ammonia volatilization, or emigration (e.g. emerging insects from pupae stage, and/or external grazing/ predation) or
   3. A combination of these.

C. If the harvest based total nitrogen removal estimate is considerably higher than the water quality based nitrogen removal calculation, then;

   1. Either the analytical methods or field sampling methods are not sufficiently reliable, or
   2. There is a net immigration from external sources (e.g. deposits from birds, or wind blown material) or
   3. Fixation of atmospheric nitrogen may be indicated or
   4. A combination of these

[16] While rainfall can contribute some nitrogen and phosphorus to the system, it is considered negligible and not included in these calculations.
[17] Harvest recovery from pilot investigations may not be as complete as with full scale systems because of incidental loss of drainage water from the harvested mass. With a full scale operation this drainage water, often referenced as “diverted harvest water”, is more effectively captured, measured and recovered.

Table 15: Summary of Harvest Related Performance Months 1 through 6 South Canal ATS™ Pilot Study

Day of Harvest	**1/31/11**	**2/14/11**	**Month1**
Wet Harvest (pounds)	117	206	323
Wet Harvest (% Solids)	7.4%	9.9%	9.1%
Harvest Dry Solids (pounds)	8.6	20.5	29.1
Net Community Productivity (g/m^2-day)	6.03	14.32	10.17
Net Community Specific Growth Rate (1/hr)	0.0063	0.0089	0.0076
Average Standing Crop (g/m^2)	37.61	70.57	54.09
%P Dry Solids	0.58%	0.58%	0.58%
% N Dry Solids	2.40%	2.40%	2.40%
P Removed through Harvest (pounds)	0.05	0.12	0.17
N Removed through Harvest (pounds)	0.21	0.49	0.70
Harvest Based P Areal Removal Rate (g/m^2-yr)	12.88	30.58	21.73
Harvest Based N Areal Removal Rate (g/m^2-yr)	52.82	125.43	89.13
Day of Harvest	**3/3/11**	**3/14/11**	**Month 2**
Wet Harvest (pounds)	219	264	583
Wet Harvest (% Solids)	12.7%	12.7%	12.7%
Harvest Dry Solids (pounds)	28.47	27.85	56.32
Net Community Productivity (g/m2-day)	16.34	24.72	20.53
Net Community Specific Growth Rate (1/hr)	0.0082	0.0125	0.0104
Average Standing Crop (g/m2)	76.95	91.85	90.00
%P Dry Solids	0.38%	0.38%	0.38%
% N Dry Solids	1.10%	1.10%	1.10%
P Removed through Harvest (pounds)	0.11	0.11	0.22
N Removed through Harvest (pounds)	0.31	0.31	0.62
Harvest Based P Areal Removal Rate (g/m2-yr)	22.20	34.31	27.26
Harvest Based N Areal Removal Rate (g/m2-yr)	65.70	99.32	78.91
Day of Harvest	**3/29/11**	**4/11/11**	**Month 3**
Wet Harvest (pounds)	264	319	583
Wet Harvest (% Solids)	12.70	7.95	10.01
Harvest Dry Solids (pounds)	33.53	25.34	58.87
Net Community Productivity (g/m2-day)	21.84	19.05	20.45
Net Community Specific Growth Rate (1/hr)	0.0097	0.0103	0.010
Average Standing Crop (g/m2)	102.61	83.56	92.79
%P Dry Solids	0.34	0.34	0.34
%N Dry Solids	1.78	1.78	1.78
P Removed through Harvest (pounds)	0.13	0.09	0.22
N Removed through Harvest (pounds)	0.60	0.45	1.05
Harvest Based P Areal Removal Rate (g/m2-yr)	27.15	23.68	25.42
Harvest Based N Areal Removal Rate (g/m2-yr)	141.88	123.75	132.82

Table 15 (continued): Summary of Harvest Related Performance Months 1 through 6 South Canal ATS™ Pilot Study

Day of Harvest	**4/26/11**	**5/9/11**	**Month 4**
Wet Harvest (pounds)	447	316	763
Wet Harvest (% Solids)	9.5%	9.5%	9.5%
Harvest Dry Solids (pounds)	42.2	29.9	72.1
Net Community Productivity (g/m^2-day)	27.51	22.44	25.16
Net Community Specific Growth Rate (1/hr)	0.0103	0.0108	0.0105
Average Standing Crop (g/m^2)	101.48	94.81	98.14
%P Dry Solids	0.34%	0.71%	0.53%
% N Dry Solids	1.78%	3.28%	2.53%
P Removed through Harvest (pounds)	0.14	0.21	0.35
N Removed through Harvest (pounds)	0.75	0.98	1.73
Harvest Based P Areal Removal Rate (g/m^2-yr)	34.21	58.29	45.39
Harvest Based N Areal Removal Rate (g/m^2-yr)	178.76	268.60	220.47
Day of Harvest	**5/25/11**	**6/8/11**	**Month 5**
Wet Harvest (pounds)	236	216	452
Wet Harvest (% Solids)	8.8%	8.8%	8.8%
Harvest Dry Solids (pounds)	20.77	19.01	39.78
Net Community Productivity (g/m^2-day)	12.68	13.66	13.17
Net Community Specific Growth Rate (1/hr)	0.0078	0.0087	0.0083
Average Standing Crop (g/m^2)	61.5	66.6	64.1
%P Dry Solids	0.71%	0.71%	0.71%
% N Dry Solids	3.28%	3.28%	3.28%
P Removed through Harvest (pounds)	0.15	0.14	0.29
N Removed through Harvest (pounds)	0.68	0.62	1.30
Harvest Based P Areal Removal Rate (g/m^2-yr)	32.95	34.46	33.71
Harvest Based N Areal Removal Rate (g/m^2-yr)	151.82	158.81	155.32
Day of Harvest	**7/25/11**	**8/22/11**	**Month 6**
Wet Harvest (pounds)	5	45	60
Wet Harvest (% Solids)	18.9%	18.9%	18.9%
Harvest Dry Solids (pounds)	0.98	8.51	9.49
Net Community Productivity (g/m^2-day)	0.69	2.97	2.20
Net Community Specific Growth Rate (1/hr)	0.0047	0.0032	0.0040
Average Standing Crop (g/m^2)	5.12	35.84	20.48
%P Dry Solids	0.24%	0.24%	0.24%
% N Dry Solids	1.96%	1.96%	1.96%
P Removed through Harvest (pounds)	0.00	0.02	0.02
N Removed through Harvest (pounds)	0.02	0.17	0.19
Harvest Based P Areal Removal Rate (g/m^2-yr)	0.61	2.65	1.69
Harvest Based N Areal Removal Rate (g/m^2-yr)	4.91	21.23	16.06
Total Monitoring Period Dry Harvest lb			**265.72**

D. If the harvest based total phosphorus removal estimate is similar to the water quality based total phosphorus removal calculation, then direct plant uptake, precipitation and filtration into the turf may be considered the principal means of phosphorus removal.

E. If the harvest based total phosphorus removal estimate is considerably lower than the water quality based total phosphorus removal calculation, then:

    1. Either the analytical methods or field sampling methods are not sufficiently reliable, or
    2. Extensive phosphorus loss is attributable to emigration (e.g. emerging insects from pupae stage, or external grazing/ predation) or
    3. A combination of these.

F. If the harvest based total phosphorus removal estimate is considerably higher than the water quality based phosphorus removal calculation, then;

    1. Either the analytical methods or field sampling methods are not sufficiently reliable, or
    2. There is a net immigration from external sources (e.g. deposits from birds, or wind blown material) or
    3. A combination of these

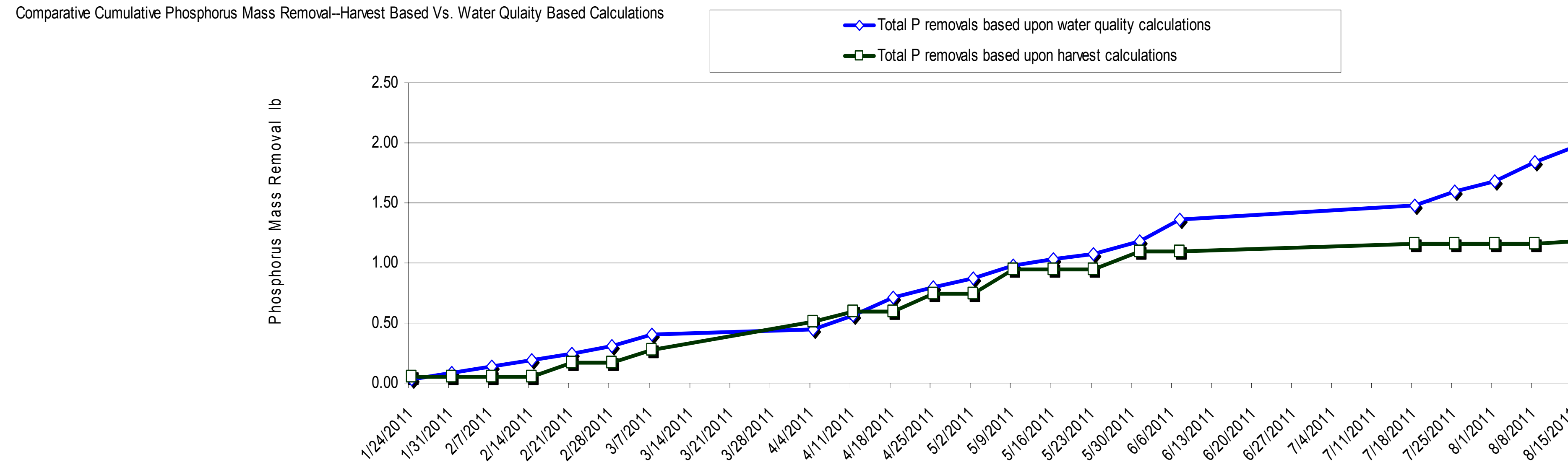
Shown in Figure 17 and 18 are Months 1 through 6 comparisons of harvest based and water quality based mass nutrient removals for total phosphorus and total nitrogen, with the exclusion of the data from the three week construction period—3/14/11, 3/21/11 and 3/28/11. There is reasonable closeness between the water quality and harvest based calculations for total phosphorus mass removal, with the harvest based value at 1.18 lbs and the water quality based value at 1.97 lb (%RPD= 43%). The values remained very close until the end of Month 5, when they began to diverge.

There was a slightly larger disparity between the water quality based and harvest based mass removal calculations for total nitrogen, as shown in Figure 18. The harvest based value at 5.15 lb was lower than the water quality based value of 9.08 lb, with the % RPD at 55.2%. Considering the challenges in recovering all of the harvested solids associated with a pilot unit[18], these differences are not unexpected. While the higher nitrogen in the water quality based value might suggest substantial losses to the atmosphere, such as through denitrification, this is likely not the case, because the highly oxygenated environment of the ATS™ combined with the low NOx-N levels are not conducive to denitrification. Similarly, pH levels were not sufficiently high to facilitate much atmospheric

[18] With a full scale system suspended solids associated with harvest are easier to quantify when compared to a pilot unit, as these solids are contained within a diverted flow after passing through a Flexrake, which can be easily measured both in terms of flow volume and solids and nutrient content. There is no similar mechanism for recovering these solids with a pilot operation.

loss from ammonia-volatilization. The fact that the %RPD for both nitrogen and phosphorus are similar indicate the differences are likely associated with either larval emergence[19], or, more likely, with sampling error related to the gathering and quantifying the harvested biomass .

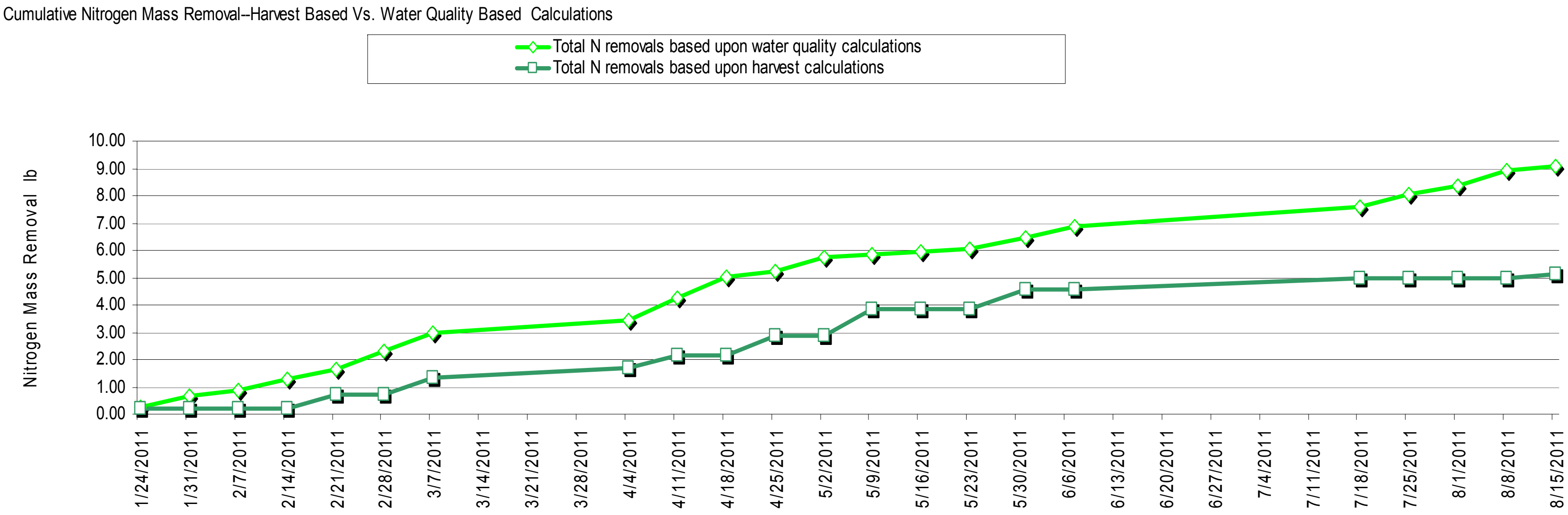
[19] Note that sampling harvested material, because of its heterogeneity and difficulty in recovery on a pilot system, is not nearly as precise as calculations based upon water quality sampling. Losses through emergence of insect larvae and other biological emigrations would be expected to be rather modest, and is considered a secondary contributor to the disparity between harvest based and water quality based mass nutrient removal calculations.



	01/24/11	01/31/11	02/07/11	02/14/11	02/21/11	02/28/11	03/07/11	04/04/11	04/11/11	04/18/11	04/25/11	05/02/11	05/09/11	05/16/11	05/23/11	05/31/11	06/07/11	07/18/11	07/25/11	08/01/11	08/08/11	08/15/11
Total P removals based upon water quality calculations	0.04	0.09	0.14	0.19	0.25	0.31	0.40	0.45	0.56	0.72	0.80	0.87	0.98	1.03	1.08	1.18	1.37	1.48	1.59	1.68	1.84	1.97
Total P removals based upon harvest calculations	0.05	0.05	0.05	0.05	0.17	0.17	0.28	0.51	0.60	0.60	0.74	0.74	0.95	0.95	0.95	1.10	1.10	1.16	1.16	1.16	1.16	1.18

Week Ending

Figure 17: Phosphorus Mass Removal Comparison Harvest Based Vs. Water Quality Based Calculations Months 1 through 6 South Canal ATS™ Pilot Study



	01/24/11	01/31/11	02/07/11	02/14/11	02/21/11	02/28/11	03/07/11	04/04/11	04/11/11	04/18/11	04/25/11
Total N removals based upon water quality calculations	0.25	0.66	0.90	1.30	1.67	2.30	2.96	3.46	4.28	5.01	5.23
Total N removals based upon harvest calculations	0.21	0.21	0.21	0.21	0.70	0.70	1.32	1.69	2.14	2.14	2.89

	05/02/11	05/09/11	05/16/11	05/23/11	05/31/11	06/07/11	07/18/11	07/25/11	08/01/11	08/08/11	08/15/11
Total N removals based upon water quality calculations	5.73	5.85	5.94	6.06	6.49	6.85	7.59	8.05	8.36	8.93	9.08
Total N removals based upon harvest calculations	2.89	3.87	3.87	3.87	4.55	4.55	4.97	4.97	4.97	4.97	5.15

Week Ending

Figure 18: Nitrogen Mass Removal Comparison Harvest Based Vs. Water Quality Based Calculations Months 1 through 6 South Canal ATS™ Pilot Study

VIII. ATS™ Model (ATSDEM) Assessment

A. Statistical Review of Nutrient Data

Because the level of reliability of the laboratory analyses for nutrients is about 20% Relative Percent Difference (RPD), the influent and effluent data needs to be evaluated to determine if the differences noted between influent and effluent nutrient levels are statistically indicative of removal. To do this a one tailed t-Test was completed on the difference of paired influent and effluent concentrations for TP, Ortho-P, organic/polyphosphate P, TN, TKN, Ammonia-N and NOx-N, with the null hypothesis being that the paired differences between influent and effluent concentrations are statistically equal to or less than zero. This is a one-tailed hypothesis, with the critical level set at 95%. The results are noted in Table 16. Several things are particularly noteworthy regarding this analysis.

- There is >95% confidence that the effluent TP concentration is less than the influent TP concentration through the ATS™, and consequently there is statistical support that a net removal occurs through the ATS™. The p-value is very low (<0.0001) indicating a very high level of confidence of net removal of TP through the ATS™.
- There is >95% confidence that the effluent Ortho P concentration is less than the influent Ortho P concentration through both the ATS™, and consequently there is statistical support that a net removal occurs through the ATS™. The p-value is very low (<0.0001) indicating a very high level of confidence of net removal of Ortho P through the ATS™.
- There is >95% confidence that the effluent organic/polyphosphate P concentration is less than the influent organic/polyphosphate P concentration through the ATS™, and consequently there is statistical support that there is a net removal through the ATS™. The p-value is low at 0.0007 indicating a high level of confidence of net removal of organic/polyphosphate through the ATS™. These statistical findings provide indication that a significant amount of the organic phosphorus is labile, and vulnerable to enzymatic or environmental disassociation.
- There is >95% confidence that the effluent TN concentration is less than the influent TN concentration through the ATS™ and consequently there is statistical support that a net removal occurs through the ATS™. The p-value is very low (<0.0001) indicating a very high level of confidence of net removal of TN through the ATS™.
- There is >95% confidence that the effluent TKN concentration is less than the influent TKN concentration through the ATS™ and consequently there is statistical support that a net removal occurs through the ATS™ . The p-value is very low (<0.0001) indicating a very high level of confidence of net removal of TKN through the ATS™.
- There is >95% confidence that the effluent ammonia-N concentration is less than the influent ammonia-N concentration through the ATS™ and consequently there is statistical support that a net removal occurs through the ATS™. The p-value is

very low (<0.0001) indicating a very high level of confidence of net removal of ammonia-N through the ATS™.

- There is >95% confidence that the effluent Org-N concentration is less than the influent Org-N concentration through the ATS™ and consequently there is statistical support that a net removal occurs through the ATS™. The p-value is low (<0.0066) indicating a very high level of confidence of net removal of Org-N through the ATS™. These statistical findings provide indication that a significant amount of the organic nitrogen is labile, and vulnerable to enzymatic or environmental disassociation.
- There is no statistical support for a 95% confidence that the effluent organic N concentration is less than the influent organic N concentration through the ATS™, and consequently there is statistical support that there is not a net removal through the ATS™. The p-value is high at 0.588 indicating a lower probability of NOx-N removal through the ATS™. This is attributable to the development of nitrification capabilities upon the ATS™ in response to comparatively high ammonia-N levels, and the highly oxygenated environment associated with the floway..

Table 16: One tailed t-Test analysis of paired differences influent and effluent nutrient data South Canal ATS™ Pilot Study

Parameter/Floway Degree of Freedom = 12 Null Hypothesis: Paired differences are less than or equal to zero	**Critical value at 0.05 significance one-tailed**	**t- value**	**Comment**
Total P influent through ATS™	1.73	10.48	Null Hypothesis rejected
Ortho P influent through ATS™	1.73	9.45	Null Hypothesis rejected
Organic/Polyphosphate P influent through ATS™	1.73	3.70	Null Hypothesis rejected
Total N influent through ATS™	1.73	9.41	Null Hypothesis rejected
TKN influent through ATS™	1.73	4.46	Null Hypothesis rejected
NH_3-N influent through ATS™	1.73	5.63	Null Hypothesis rejected
Org-N influent through ATS™	1.73	2.72	Null Hypothesis rejected
NOx-N influent through ATS™	1.73	-0.50	Null Hypothesis accepted

B. Model Review

1. Critical Input Parameters

The ATS™ Design Model (ATSDEM) was developed by HydroMentia to establish a means of developing initial assessments of system performance, and for sizing facilities during preliminary engineering efforts. The model can also be used during operations for establishing harvesting regimens and projecting influence of adjustments to hydraulic loading. The model is based upon the Monod[20] relationship and first order dynamics applied to a community, such as is done with other commercial biological process (e.g.

[20] Monod J. (1942) *Recherches sur la Croissance ds Cultures Bacteriennes,* Herman et Cie, Paris

activated sludge), rather than an isolated enzyme or an individual species. The Monod relationship is expressed as:

$$\mu = \mu_{max} S/(K_s + S)$$

Where μ_{max} is the maximum potential growth rate of the community and K_s is the half-rate constant for growth limited by **S**, or the value of **S** when $\mu = ½ \mu_{max}$.

A review of how the ATSDEM model was initially developed is included as Appendix H. To effectively apply the Monod relationship to the ATSDEM model, certain critical parameters need to be quantified. These include:

- **a.** Water Temperature
- **b.** Linear hydraulic loading rate (LHLR)
- **c.** Relationship between tissue nutrient content and nutrient water levels
- **d.** Total Phosphorus concentration
- **e.** Total Nitrogen Concentration
- **f.** Initial crop density
- **g.** Average crop density between harvests
- **h.** Harvest frequency
- **i.** Alkalinity
- **j.** pH
- **k.** Maximum Net Community Specific Growth rate--μ_{max} (1/hr)
- **l.** Half Rate Concentration (S_N) of Limiting Nutrient
- **m.** Half Rate Concentration of LHLR (S_H)
- **n.** V'ant Hoff-Arrhenius Constant (for adjusting growth rate to temperature)

For applications within most freshwater systems, phosphorus, hydraulic loading and water temperature have been used as key parameters (**S**) for estimating specific growth rate. However, in some cases nitrogen and carbon can be more influential in limiting production. Carbon limitation is not an issue at the South Canal Pilot because of the high alkalinities and near neutral pH levels within the blended influent. While it does appear that, at times, some nitrogen fractions, such as ammonia, could influence the rate of productivity to a certain extent, phosphorus does appear to be strongly correlated with productivity, and is used within this modeling effort as the limiting nutrient

2. Temperature Adjusted Field Estimates of Specific Growth Rate

During the course of the monitoring period, specific growth rate was calculated with each harvest. This rate expresses in the case of the ATS™ a net community growth rate, and is used to project net productivity through the first order equation:

$$Z_t = Z_0 e^{\mu t} \qquad \text{or } \mu = [\ln(Z_t/Z_0)]/t$$

Where **Z** is the dry biomass weight, **t** is the time interval between harvests, Z_0 is the initial standing crop and **μ** is the net community specific growth rate (1/time)

Specific growth rates can be adjusted for temperature by using the V'ant Hoff-Arrhenius equation:

$$\mu_2 / \mu_1 = \Theta^{(T2-T1)} \quad \text{or} \quad \mu_1 = \mu_2 / \Theta^{(T2-T1)}$$

Where μ_2 is the growth rate for given **S** at an optimal growing temperature ^oC, T_2, and μ_1 is the growth rate for the same given **S** at some temperature ^oC, T_1, when $T_1 < T_2$, and Θ is an empirical constant ranging from 1.03 to 1.10.

As noted, the algal turf harvested mass removal calculations during the monitoring period balanced fairly well with the water quality calculations (Figures 17 and 18). Therefore the specific growth values developed from the harvest data appeared to correlate well with the nutrient levels or with removal rates. The specific growth rates were calculated assuming a constant initial standing crop (Z_0) of 10 g/m^2 which represents the residual biomass left after the previous harvest. Typically Θ as applied to ATS™ has been found to be about 1.03. Using these two values for Z_0 and Θ and T_2 = 30° C, the values for **μ** can be adjusted to optimal temperature as shown in Table 17.

3. Assessment of Nutrient Influence on Growth Rate

There are several methods which have been developed to assess the general range of the Monod parameters of maximum specific growth rate (μ_{max}) and half rate concentration K_S. The one which was used in developing the ATSDEM model is the Hanes[21] method as described by Brezonik[22]. Note that the plots include specific growth rates adjusted to optimal temperature in an effort to negate the influence of water temperature. Also, data from the last two sampling periods are not included as these represent a period when the algal turf was just beginning to develop after an extended period of shut-down. The Hanes equation as developed from the Monod relationship is:

$$[S]/\mu = K_S/(\mu_{max}) + (1/(\mu_{max}) [S]$$

When plotted, the slope is $1/\mu_{max}$, and y-intercept is K_S/μ_{max}. A Hanes plot was conducted for **S** using all of the phosphorus and nitrogen fractions as **S.** A linear regression analysis was completed for each of the nutrient fractions, as shown in Table 18.

The plots of total and organic/polyphosphate phosphorus, which reveal high correlation (r^2 of 0.92 and 0.96 respectively), are shown as Figure 19. Note that ammonia nitrogen also showed a high regression coefficient of 0.94. Ortho phosphorus shows poor correlation, suggestive that perhaps much of the organic phosphorus may in fact have included Ortho phosphorus adsorbed to the fine silt particles during periods of high color. It is suggested the values associated with TP be used as a general guide for calibrating

[21] Hanes, C.S. (1942) *Biochem. J.* , 26, 1406
[22] Brezonik, P.L. (1993) Chemical Kinetics and Process Dynamics in Aquatic Systems Lewis Publishers, Boca Raton, Fl pp 421-427 ISBN 0-87371-431-8

the ATSDEM model, although the chosen value may differ somewhat as necessary to accommodate calibration. The values for μ_{max} at 0.0166/hr and K_S at 0.075 mg/L total phosphorus is typical of what have been calculated for other ATS™ operations. The values for these two parameters will be adjusted as appropriate to facilitate model calibration.

Table 17: Field net community specific growth rates adjusted to optimal water temperature South Canal ATS™ Pilot Study

Harvest Date Q=1.03 T_2 =30° C Z_0 = 10 g/m^2	Calculated Field Net Community Growth Rate 1/hr	Water T °C	T adjusted Field Net Community Growth Rate 1/hr
1/31/11	0.0064	18.86	0.0088
2/14/11	0.0089	21.44	0.0115
3/3/11	0.0082	23.52	0.0099
3/14/11	0.0125	22.62	0.0156
3/29/11	0.0097	24.31	0.0115
4/11/11	0.0103	27.69	0.0110
4/26/11	0.0103	27.66	0.0111
5/9/11	0.0108	28.83	0.0112
5/25/11	0.0078	28.03	0.0083
6/8/11	0.0087	29.37	0.0089

4. Assessment of Nutrient Concentrations Influence on Tissue Nutrient Levels

The influence of nutrient concentrations upon nutrient levels within the algal turf tissue can be reviewed as a linear relationship through regression analysis. Noted in Table 19 are the results of a regression analysis completed for the South Canal ATS™ Pilot Study. As shown, the correlations do not offer high levels of confidence related to direct shifts in tissue nutrients with concentrations within the water. This is due largely to the fact that while water quality data reflects weekly composite samples, tissue sample data is from monthly composite samples. In addition, nutrient fluxes associated with the aforementioned construction activity and the extended summer shut-down period interrupted the system dynamics, which could well have influenced the tissue nutrient Vs. water nutrient concentration relationship. Tissue levels ranged from 0.24% to 0.71% phosphorus and 1.10% to 3.28% nitrogen.

Considering these factors, it is suggested that for modeling purposes the nutrient tissue levels be set as constants, to levels in the general range of values observed during the monitoring period. As with the other critical parameters, tissue nutrient levels will be adjusted to facilitate model calibration.

Table 18: Summary of Hanes' plots for various nutrient fractions South Canal ATS™ Pilot Study

Nutrient Fraction Q=1.03 T_2 =29° C Z_0 = 10 g/m^2	"a" Slope	"b" y-intercept	r^2 Regression Coefficient	μ_{max} 1/hr	K_N mg/L
Total Phosphorus	60.11	4.53	0.92	0.0166	0.075
Ortho Phosphorus	42.83	3.37	0.07	0.0234	0.079
Organic/Poly	64.98	1.78	0.96	0.0154	0.027
Total Nitrogen	52.71	37.51	0.85	0.0190	0.71
TKN	69.11	51.71	0.20	0.0145	0.75
Ammonia Nitrogen	84.86	1.83	0.94	0.0118	0.022
Organic Nitrogen	61.21	51.59	0.17	0.0164	0.84
Nitrate	157.66	-0.34	0.50	0.0063	-0.006
Nitrate + Nitrite	213.83	-15.83	0.63	0.0047	-0.074

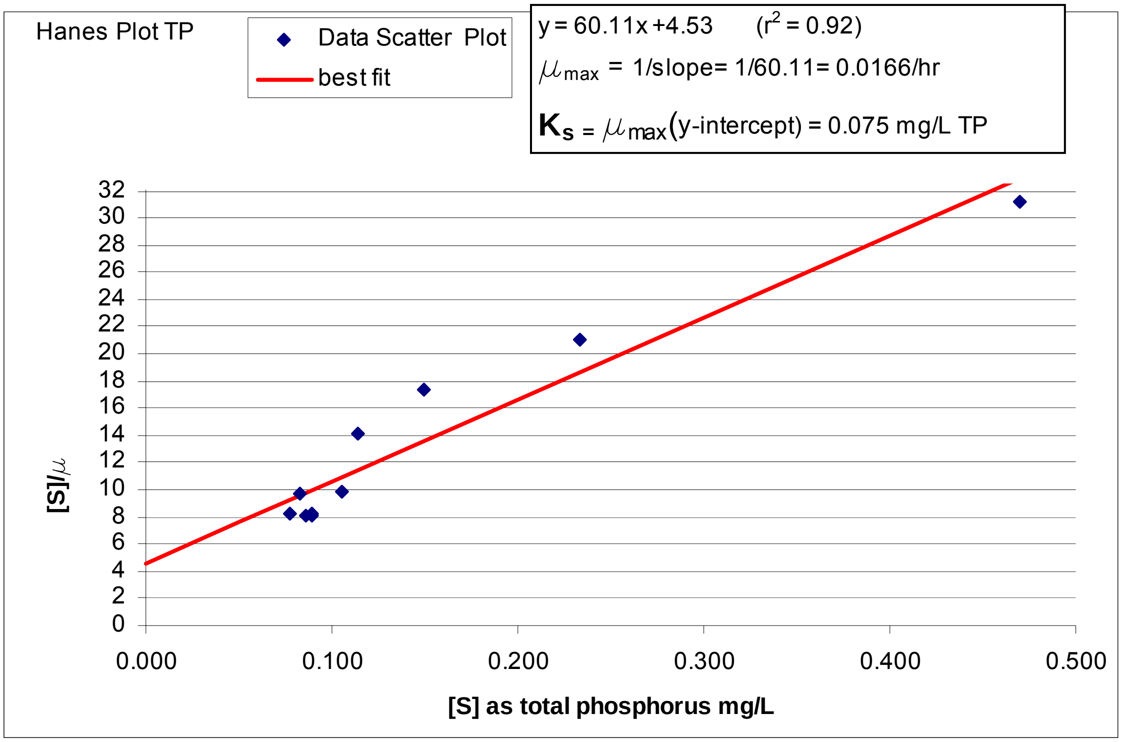
Table 19: Summary of Linear Regression Analysis Tissue Nutrients Vs. Water Nutrient Concentrations South Canal ATS™ Pilot Study

Water Concentration = x Tissue Concentration =y	"a" Slope	"b" y-intercept	r^2 Regression Coefficient
Total Phosphorus mg/L Vs %P Tissue	0.00214	0.033	0.22
Total Phosphorus mg/L Vs %N Tissue	0.00881	-0.0044	0.33
Total Nitrogen mg/L Vs %P Tissue	0.00361	0.207	0.34
Total Nitrogen mg/L Vs %N Tissue	0.034	-0.0127	0.11

`

5. Linear Hydraulic Loading Rate Influence on Specific Growth Rate

In the development of ATSDEM, the hydraulic loading to the ATS™ across the width measured as gpm/ft, was shown to influent productivity, with the $\mathbf{K_{LHLR}}$ typically about 9.0 gpm/lf. This value will be adjusted during model calibration to optimize model precision and used at this same value during verification.



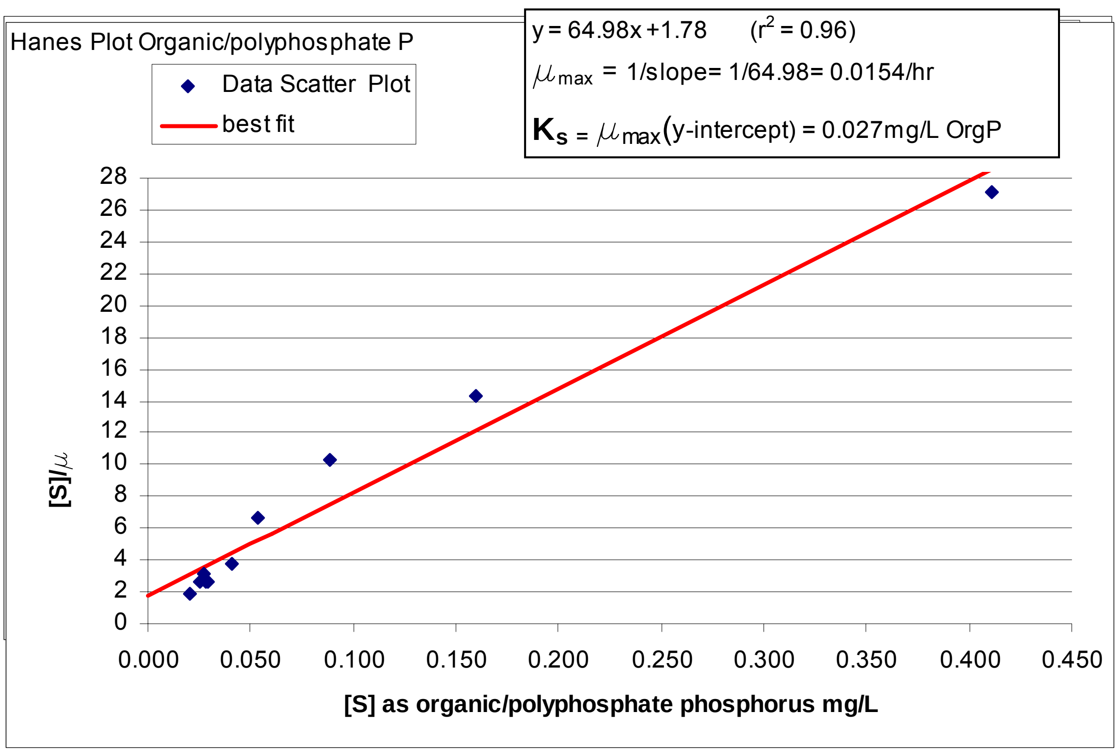


Figure 19: Hanes' Plots Total and Organic/Polyphosphate Phosphorus South Canal ATS™ Pilot

6. Average Crop Density

The average crop density over the monitoring period as presented in Table 15, ranged from 5 to 102 g/m^2, and averaging 71 g/ m^2. The ranges shown in this table will be used as a general guide during model calibration. As noted previously, the initial crop density, that is the density immediately following harvest, is set at 10 dry g/m^2.

7. Harvesting Frequency

For modeling purposes the harvest frequency is established based upon the time required to achieve the average crop density. This is explained in the tutorial within the ATSDEM spreadsheet.

8. Model Calibration and Verification

The ATSDEM model is calibrated by applying the model to the first eight weeks of the monitoring period, excluding the period of construction activity. The results as noted in Table 20, provide indication that the model as developed is effective at projecting effluent total phosphorus and nitrogen levels. Values of critical values developed during are as noted in Table 20. These values were applied during model verification. Tissue phosphorus levels were set as a constant 0.43%, and issue nitrogen levels were set as a constant at 2.80%.

The calibrated ATSDEM was applied to the final 14 weeks of the monitoring period in an effort to verify the model. The results as noted in Table 21, indicate that the model as developed can effectively be applied to varying conditions associated with the Lateral D watershed. Scattergrams for both phosphorus and nitrogen showing actual versus projections for both phosphorus and nitrogen over the monitoring period are presented in Figure 20. A typical ATSDEM summary sheet is shown as Figure 21. The scattergram patterns indicate that with phosphorus the model may slightly underestimate performance, with more points above the best fit line, than below. With nitrogen, the opposite is indicated, with more points below the best fit line, indicting estimates of performance may be slight over estimates of performance. The t-tests of the differences between projected and actual effluent values provide statistical support that there is no difference at a 95% level of confidence between actual and projected effluent values, for both total phosphorus and total nitrogen.

Table 20: ATSDEM Calibration Run Weeks 1 through 8 South Canal ATS™ Pilot Study

K_{lhlr} = 9 gpm/lf
K_p = 0.065 mg/L
μmax = 0.025/hr
Zave ~ 100 g/sm
Topt = 29 C
Zo = 10 g/sm
Θ = 1.03

Week Ending	Zave g/sm	Effluent TP mg/L	Projected Effluent TP mg/L	TP Difference mg/L	Effluent TN mg/L	Projected Effluent TN mg/L	TN Difference mg/L
1/24/11	101	0.053	0.046	0.007	0.53	0.37	0.16
1/31/11	101	0.061	0.060	0.001	0.37	0.41	-0.04
2/7/11	104	0.059	0.052	0.007	0.37	0.27	0.10
2/14/11	101	0.049	0.052	-0.003	0.30	0.34	-0.04
2/21/11	104	0.041	0.041	0.000	0.43	0.44	-0.01
2/28/11	99	0.033	0.039	-0.006	0.57	0.73	-0.16
3/7/11	104	0.035	0.054	-0.019	0.18	0.34	-0.16
4/4/11	99	0.033	0.028	0.005	0.68	0.78	-0.10

	TP		TN
Mean Difference	**-0.001**	**Mean Difference**	**-0.032**
Standard Error	**0.009**	**Standard Error**	**0.113**
two tail t-test Critical Value*	**2.36**	**two tail t-test Critical Value***	**2.36**
sensitivity	**0.05**	**sensitivity**	**0.05**
t-value	**-0.36**	**t-value**	**-2.22**
Accept null hypothesis		**Accept null hypothesis**	

*** Null hypothesis that the difference between actual and projected is equivalent to zero at 95% confidence level**

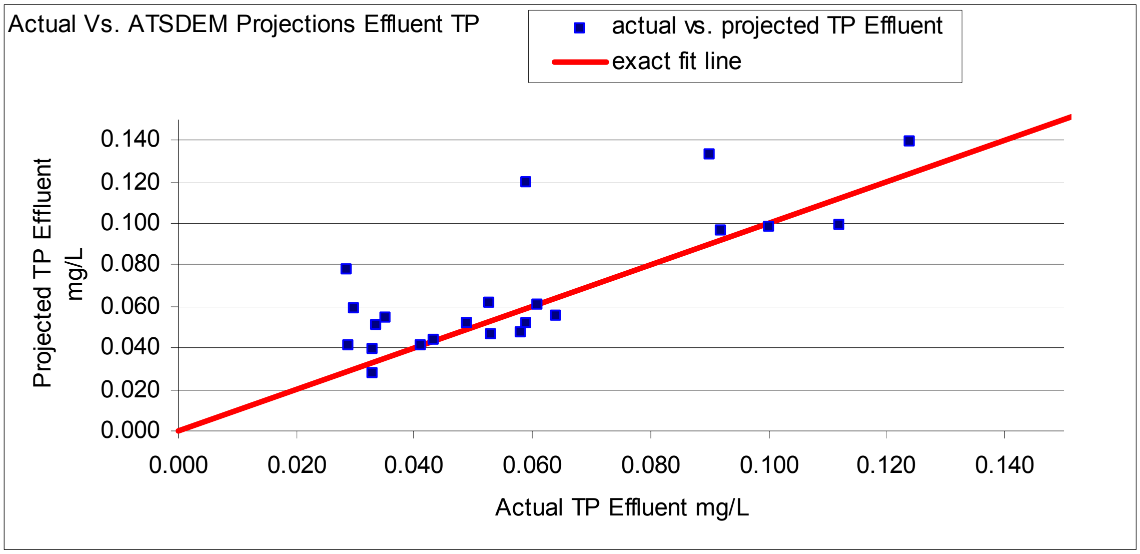
Table 21: ATSDEM Verification Run Months 9 through 22 South Canal ATS™ Pilot Study

K_{lhlr} = 9 gpm/lf
K_p = 0.065 mg/L
μmax = 0.025/hr
Zave ~ 100 g/sm
Topt = 29 C
Zo = 10 g/sm
Θ = 1.03

Week Ending	Zave g/sm	Effluent TP mg/L	*Projected Effluent TP mg/L*	TP Difference mg/L	Effluent TN mg/L	*Projected Effluent TN mg/L*	TN Difference mg/L
4/11/11	110	0.030	***0.059***	-0.029	0.72	***1.02***	-0.30
4/18/11	102	0.029	***0.078***	-0.049	0.58	***0.73***	-0.15
4/25/11	110	0.029	***0.041***	-0.012	0.65	***0.52***	0.13
5/2/11	98	0.043	***0.044***	-0.001	0.66	***0.68***	-0.02
5/9/11	108	0.034	***0.051***	-0.017	0.81	***0.64***	0.17
5/16/11	106	0.064	***0.055***	0.009	0.39	***0.20***	0.19
5/23/11	104	0.058	***0.047***	0.011	0.53	***0.27***	0.26
5/30/11	115	0.053	***0.062***	-0.009	0.30	***0.20***	0.10
6/7/11	107	0.059	***0.120***	-0.061	0.41	***0.27***	0.14
7/18/11	112	0.100	***0.098***	0.002	0.68	***0.69***	-0.01
7/25/11	112	0.092	***0.096***	-0.004	0.85	***0.66***	0.19
8/1/11	99	0.112	***0.099***	0.013	0.66	***0.43***	0.23
8/8/11	100	0.090	***0.133***	-0.043	0.64	***0.61***	0.03
8/15/11	99	0.124	***0.139***	-0.015	0.91	***0.90***	0.01

	TP		TN
Mean Difference	**-0.015**	**Mean Difference**	**0.070**
Standard Error	**0.023**	**Standard Error**	**0.156**
two tail t-test		**two tail t-test**	
Critical Value*	**2.16**	**Critical Value***	**2.16**
sensitivity	**0.05**	**sensitivity**	**0.05**
t-value	**-0.57**	**t-value**	**-1.68**
Accept null hypothesis		**Accept null hypothesis**	

*** Null hypothesis that the difference between actual and projected is equivalent to zero at 95% confidence level**



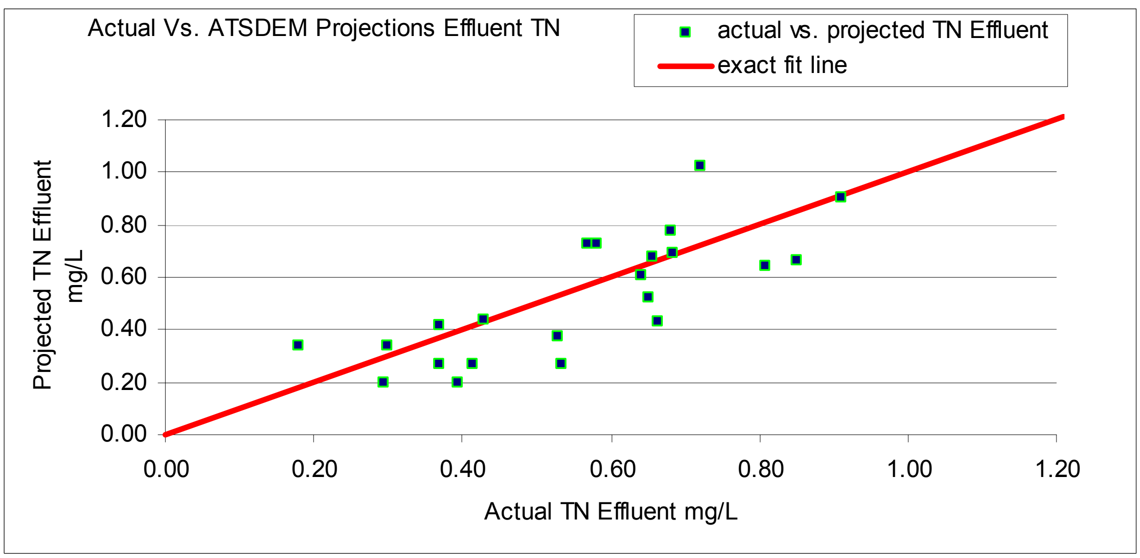


Figure 20: ATSDEM Projection Scattergrams for Effluent Nitrogen and Phosphorus South Canal ATS™ Pilot Study

ATSDEM Model Run Verification
South Canal Pilot -ATS™
Verification 8/15/11
500 ft

Panel A Velocity Conditions

Floway slope (s)	Manning n	Manning Factor (1)	Manning Factor (2) Match	LHLR gpm/lf	LHLR cfs/lf	LHLR liters/sec-lf	Average flow depth (d) ft	Velocity fps	Flow length interval ft
0.005	0.02	0.0086062	0.00861	20.35	0.045	1.302	0.060	0.75	0.75

Panel B Process Conditions

Water T °C	Optimal T °C	Θ	K_{sp} as ppb TP	K_{sh} as LHLR gpm/ft	μ_{max} 1/hr	S_o ppb Total P	Harvest Cycle days	Z_{ave} dry-g/m^2	Z_0 dry-g/m^2	S^*_p Total Phosphorus ppb	N_o mg/l Total N	N* Total Nitrogen mg/l
28.95	29.0	1.03	65	9.0	0.026	191	11	99.29	10.00	10	1.25	0.20

Panel C Performance

Control Time Seconds	Control Volume liter	Final Total P S_f ppb	Total Flow Time seconds	% Total P removal	Floway Length ft	Areal Loading Rate TP g/m2-yr	Areal Loading Rate TP lb/acre-year	Areal Removal Rate TP g/m2-yr	Areal Removal Rate TP lb/acre-yr	Average Production dry-g/m^2-day	Area per time sequence m^2	Final Total N N_f mg/l	Areal Loading Rate TN g/m2-yr	Areal Loading Rate TN lb/acre-year	Areal Removal Rate TN g/m2-yr	Areal Removal Rate TN lb/acre-yr
1	1.302	137	667	28.50%	500	166	1,483	47	423	30.63	0.070	0.90	1,088	9,705	309	2,752

Panel D System Design

Total Flow mgd	Floway Width ft	Floway Area acres	Total P removed lb/period	Moisture % wet harvest	Moisture % compost	Period Wet net production lbs	Period Estimated Dry Harvest lbs	Period Compost Production wet lbs	Performance Period days	μ_{ave} 1/hr	Total N removed lb/period	% N Removal
0.029304	1	0.01	0.15	8%	40%	431	10	13	11	0.0129	0.95	28.36%

Panel E pH Dynamics

Influent pH	Influent Alkalinity mg/l as $CaCO_3$	Influent Available Carbon mg/l	Effluent pH	Algae Tissue Carbon % dw
7.44	320	91.03	7.86	35%

Figure 21: Typical ATSDEM Summary Sheet South Canal ATS™ Pilot Study

Projections from Historical Data

Projections for a typical year were developed from historical water quality from the Main Canal, as developed within the Egret Marsh Basis of Design Report[23], and the RO Concentrate average water quality as developed during the monitoring period. The RO Concentrate flow was assumed at 1.2 MGD, and the Canal Flow at 8.8 MGD—or a blend of 7.33:1, at a flow of 10 MGD. The baseline water quality as developed is shown in Table 22. The values of the critical model parameters were as developed during the mode calibration.

The revised projections are shown in Table 23. The phosphorus removal is projected at 2,008 lb/yr. The expected RO Concentrate influent load is projected at just over 124 lb/yr. Therefore the system can be expected to remove all of the RO Concentrate phosphorus load, and about 1,884 lb/yr of phosphorus from the south canal. The nitrogen removal is projected at 13,034 lb/yr. The expected RO Concentrate influent load is projected at about 7,123 lb/yr. Therefore the system can be expected to remove all of the RO Concentrate nitrogen load, and about 5,911 lb/yr of nitrogen from the south canal.

Not included in the load reduction projections are the impact of the proposed pond/wetland system. The 4+/- acres of the pond/wetland system, assuming areal removal rates similar to Egret Marsh at TP-ARR of 5.55 g/m^2-yr and TN-ARR of 18.86 g/m^2-yr, could provide another 198 lb/yr phosphorus reduction and 673 lb/yr nitrogen reduction. Compost produced over the year, based upon the historical water quality projections, and assuming 50% as bulking material, such as grass clippings or mulch, are estimated at 178 tons. Wet harvest is projected at 1,84 wet tons at 13% moisture, of which about 50% would be rake harvest requiring immediate haul to the Egret Marsh Composting Facility, and the remainder diverted harvest which will be dredged from the settling pond about every six months, and hauled to the Egret Marsh Composting Facility

[23] "Egret Marsh 10 MGD Algal Turf Scrubber® Final Basis of Design Report" July, 2005. Prepared for Indian River County by HydroMentia, Inc. Note that the historical water quality data available for the south canal was inconsistent and incomplete, so the main canal data was applied.

Table 22: Historical Nutrient Concentrations for ATSDEM Modeling Proposed South Canal ATS™ Facility

Month	RO Concentrate Flow MGD	South Canal Flow Concentrate Flow MGD	Water T °C	TP RO Concentrate mg/L	TP South Canal mg/L	TP Blended Influent mg/L	TN RO Concentrate mg/L	TN South Canal mg/L	TN Blended Influent mg/L
January	1.2	8.8	19.4	0.034	0.110	0.101	1.95	1.04	1.15
February	1.2	8.8	22.8	0.034	0.140	0.127	1.95	1.02	1.13
March	1.2	8.8	23.9	0.034	0.140	0.127	1.95	1.24	1.33
April	1.2	8.8	27.5	0.034	0.140	0.127	1.95	0.94	1.06
May	1.2	8.8	28.4	0.034	0.180	0.162	1.95	1.04	1.15
June	1.2	8.8	28.6	0.034	0.310	0.277	1.95	1.64	1.68
July	1.2	8.8	30.4	0.034	0.310	0.277	1.95	1.59	1.63
August	1.2	8.8	30.1	0.034	0.330	0.294	1.95	1.48	1.54
September	1.2	8.8	29.2	0.034	0.350	0.312	1.95	1.62	1.66
October	1.2	8.8	25.3	0.034	0.260	0.233	1.95	1.49	1.55
November	1.2	8.8	21.5	0.034	0.190	0.171	1.95	0.98	1.10
December	1.2	8.8	16.8	0.034	0.120	0.110	1.95	0.90	1.03
Average	1.2	8.8	25.3	0.034	0.215	0.193	1.95	1.25	1.33

Table 23: ATSDEM Modeling Projections Typical Annual Conditions Proposed South Canal ATS™ Facility

K_{lhlr} = 9 gpm/lf
Kp = 0.065 mg/L
Zave ~ 100 g/sm
μmax = 0.025/hr
Topt = 29 C
Zo = 10 g/sm
Θ = 1.03

Month	Flow MGD	Water T °C	Historical Influent TP mg/L	Projections Effluent TP	Projected TP Removal lbs	Historical Influent TN mg/L	Projections Effluent TN	Projected TN Removal lbs	Wet Harvest tons	Compost Produced tons
January	10.00	19.4	0.101	0.055	119	1.15	0.85	774	108	11
February	10.00	22.8	0.127	0.075	122	1.13	0.79	798	111	11
March	10.00	23.9	0.127	0.076	133	1.33	0.99	867	121	12
April	10.00	27.5	0.127	0.067	151	1.06	0.67	979	138	13
May	10.00	28.4	0.162	0.093	180	1.15	0.70	1,161	163	16
June	10.00	28.6	0.277	0.188	222	1.68	1.10	1,444	203	20
July	10.00	30.4	0.277	0.190	225	1.63	1.07	1,456	203	20
August	10.00	30.1	0.294	0.206	229	1.54	0.96	1,490	207	20
September	10.00	29.2	0.312	0.227	213	1.66	1.11	1,375	192	19
October	10.00	25.3	0.233	0.167	170	1.55	1.11	1,125	155	15
November	10.00	21.5	0.171	0.110	153	1.10	0.70	992	140	14
December	10.00	16.8	0.110	0.074	92	1.03	0.80	574	83	8
Average	10.00	25.3	0.193	0.127		1.33	0.90			
Total					2,008			13,034	1,824	178