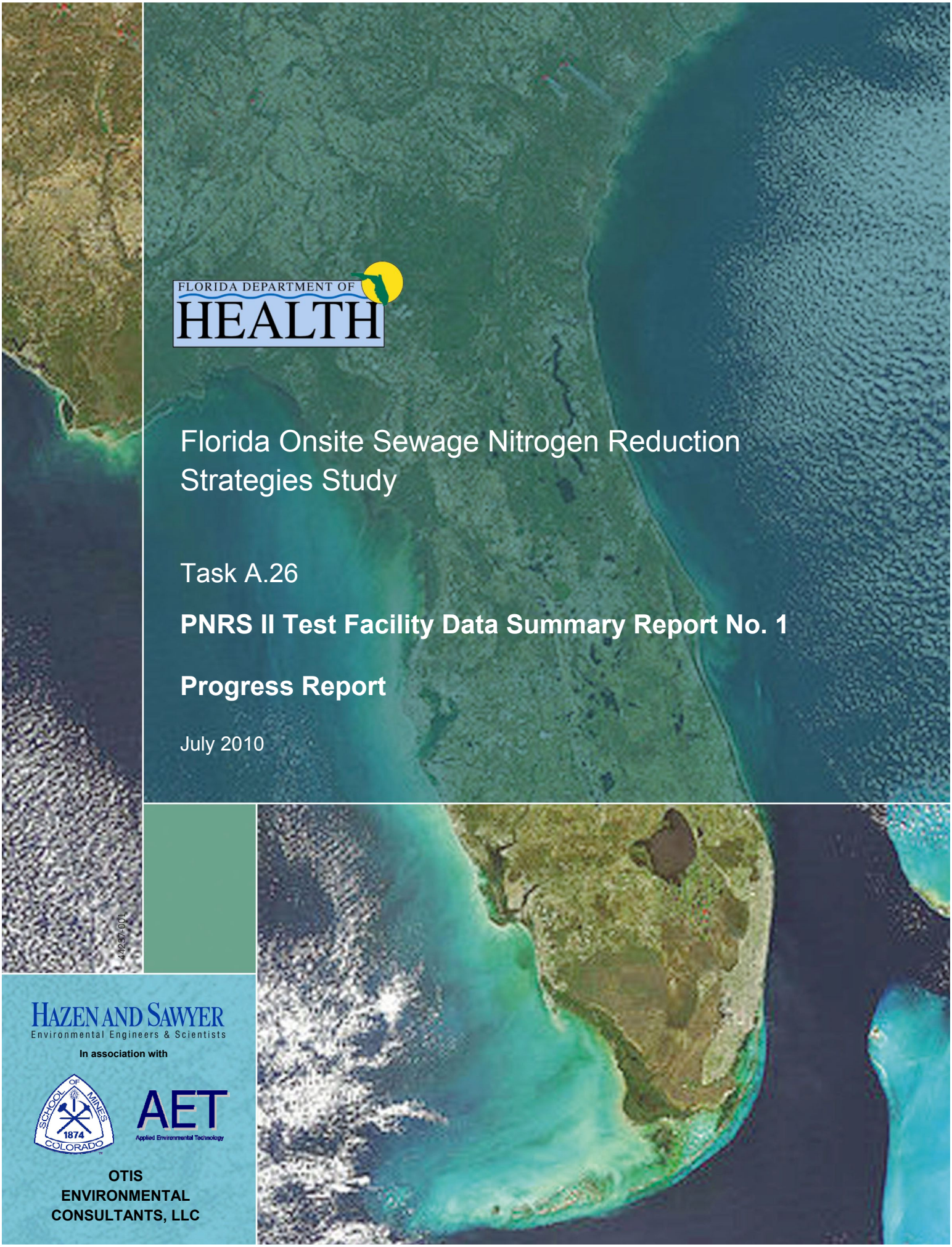

FLORIDA DEPARTMENT OF HEALTH

Florida Onsite Sewage Nitrogen Reduction Strategies Study

Task A.26

PNRS II Test Facility Data Summary Report No. 1

Progress Report

July 2010

4423-001

HAZEN AND SAWYER
Environmental Engineers & Scientists

In association with

SCHOOL OF MINES 1874 COLORADO

AET
Applied Environmental Technology

OTIS ENVIRONMENTAL CONSULTANTS, LLC

Florida Onsite Sewage Nitrogen Reduction Strategies Study

TASK A.26
PROGRESS REPORT

PNRS II Test Facility
Data Summary Report No. 1

Prepared for:

Florida Department of Health
Division of Environmental Health
Bureau of Onsite Sewage Programs
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July 2010

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PNRS II Test Facility
Data Summary Report No. 1

1.0 Background

Task A of the Florida Onsite Sewage Nitrogen Reduction Strategies Study includes the evaluation of passive treatment systems to remove nitrogen from septic tank effluent. The Passive Nitrogen Removal Study II (PNRS II) is a follow-up to the previous experimental evaluations of passive nitrogen removal technologies conducted in Passive Nitrogen Removal Study I. The objective of the PNRS II study is to extend and expand into field pilot testing the two-stage biofiltration process that was initiated in PNRS I. A unique test facility was constructed for the purpose of this evaluation. The Task A.15 PNRS II QAPP documents the objectives, experimental biofiltration systems, monitoring framework, sample frequency and duration, and analytical methods to be used at the PNRS II Test Facility.

2.0 Purpose

This data summary report documents data collected from the first PNRS II monitoring and sampling event which was conducted June 30 - July 1, 2010 and corresponds to the Task A.25 Sample Event Report No. 1 submission for June 2010. This monitoring event consisted of assessment and evaluation of PNRS II operation, measurement of flowrates, measurement of field parameters, and collection of biofilter influent and effluent samples and their laboratory analyses.

3.0 Materials and Methods

3.1 Project Site

The PNRS II Test Facility was constructed at the University of Florida Gulf Coast Research and Education Center (GCREC) in southeast Hillsborough County, Florida. The specially designed facility enables the operation and performance testing of numerous biofilter treatment trains simultaneously using a similar wastewater source. The source of the wastewater for testing is the septic tank effluent from the existing onsite wastewater system serving the GCREC. Details of the design and construction of the PNRS II test facility can be found in previous Task A documents.

3.2 Monitoring and Sampling Locations and Identification

A schematic of the biofilter configuration and the monitoring and sampling locations for the PNRS II test facility is shown in Figure 1. Septic tank effluent from GCREC is pumped from PNRS II-STE-T1 into the PNRS II systems through three points of entry: Hydro-1, Hydro-2, and UNSAT-IS-1. The nomenclature and reactor/sample identification used for the PNRS II test facility sampling events are listed in Table 1.

Table 1
PNRS II Sample Identification

Sample Location	Sample Identification
STE PNRS II Storage Tank 1	PNRS II-STE-T1
Stage 1 Single Pass Biofilters	UNSAT-EC1
	UNSAT-EC3
	UNSAT-CL1
	UNSAT-CL3
	UNSAT-PS1
Stage 2 Single Pass Upflow Biofilters	DENIT-SU4
	DENIT-LS3
	DENIT-SU3
	DENIT-LS2
	DENIT-LS4
Recirculation Tanks	RC1
	RC2
	RC3
	RC4
Stage 1 Recirculating Biofilters	UNSAT-SA2
	UNSAT-EC4
	UNSAT-CL2
	UNSAT-CL4
Denite Feed Collection Tank	DFT
Stage 2 Horizontal Biofilters	UNSAT-SU1
	UNSAT-SU2
	UNSAT-LS1
	UNSAT-GL1
In-Situ In-Tank Simulator Single Pass Biofilter	UNSAT-IS1
	UNSAT-IS2

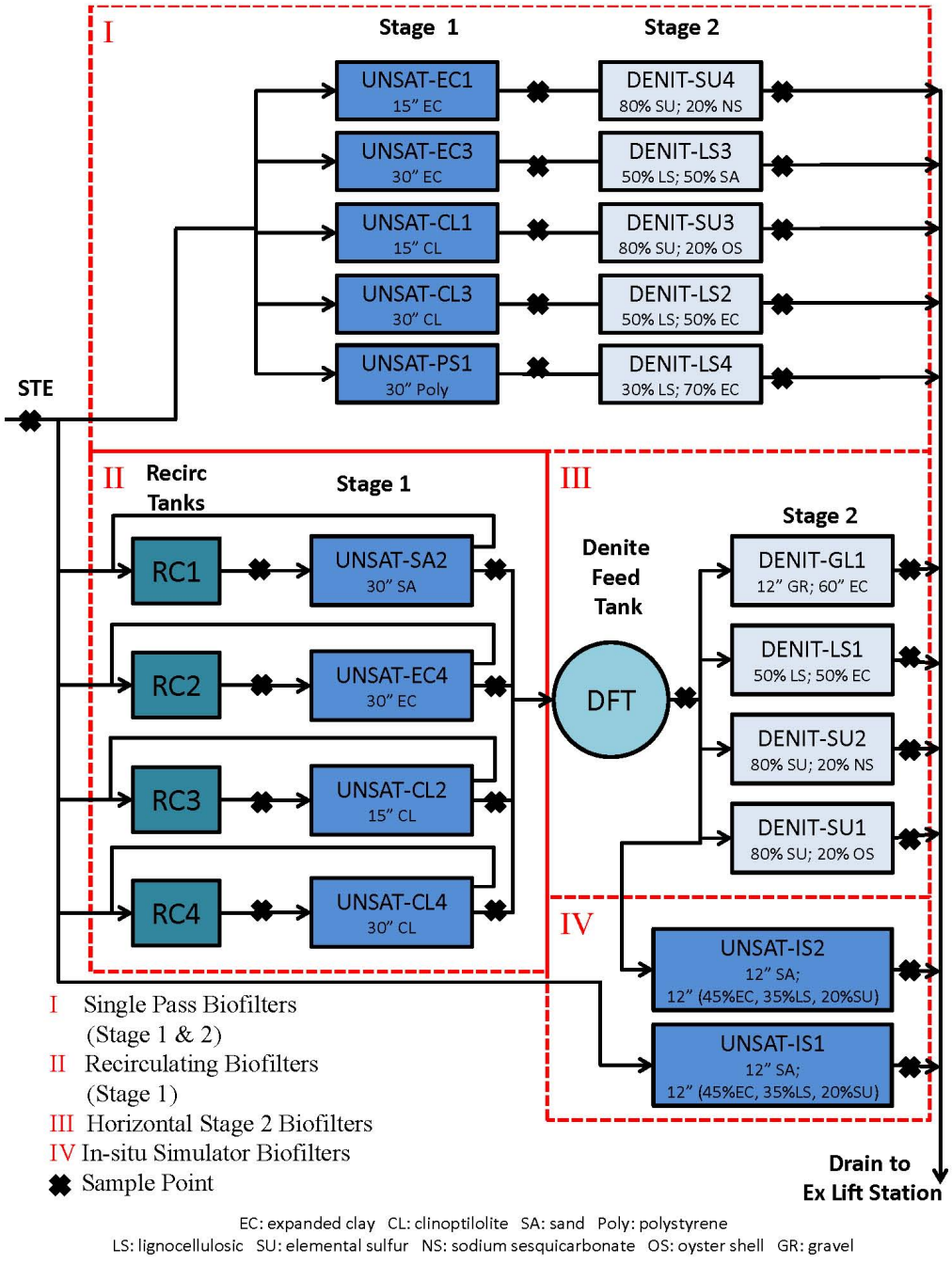

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Figure 1
PNRS II Test Facility System Schematic

3.3 Operational Monitoring

The PNRS II test facility start-up occurred on May 17th, 2010 and has been operated continually since that time. Operation of the facility is checked at least on a weekly basis and a detailed log of operational observations and activities is maintained. In addition, the programmable logic controller (PLC) which controls many of the dosing and pump controls also records pump run times and flow data from flow meters at the facility, and these data can provide useful insight on facility operations.

3.4 Flow Monitoring

The PNRS II test system dose rates were calibrated and set at initial start-up. These flow rates are then checked at each sampling event and adjusted as necessary to maintain flow rates consistent with the experimental design. Flow rates are measured and adjusted after each sampling event so as not to change flow conditions immediately prior to sampling. Influent dose flows were measured and recorded on July 8th for this sampling event and were reported in the Sampling Event No. 1 Report. Further flow monitoring was conducted on the Stage 1 and 2 biofilters during July to better understand the hydraulic residence time in these biofilters. For this monitoring, outflow volume from the biofilters was collected and measured in 5 minute intervals over the one hour dose period of each system.

3.5 Water Quality Sample Collection and Analyses

Influent and effluent water quality samples from the PNRS II test systems for Sample Event 1 were collected July 1, 2010. A STE sample was collected from the feed line that connects STE PNRS II Storage Tank 1 (PNRS II-STE-T1) to Hydrosplitter 1 that supplies STE to the single pass Stage 1 biofilters (Figure 1). A manual dose event was initiated on the control panel until sufficient STE sample volume was collected in a clean sample container. Stage 1, 2, and in-situ simulator biofilter and recirculation tank effluents were each sampled by directing the entire flow from the biofilter into a large, clean sample container over a period of time sufficient to obtain the desired sample volume (approximately 3.5 liters). Sample containers were immediately placed in coolers on ice prior to sample subdivision.

The large sample collection containers were then used to fill analysis-specific sample containers with appropriate preservatives that were supplied by the analytical laboratory. The laboratory containers were labeled, placed in coolers and transported on ice to the analytical laboratory. Each sample container was secured in packing material as appropriate to prevent damage and spills, and was recorded on chain-of-custody forms supplied by the laboratory.

Field parameters were measured directly in the outlet pipe at each sample location immediately following sample collection using portable electronic probes. Field parameters included pH, specific conductance, temperature (Temp), and dissolved oxygen (DO). The influent and effluent samples were analyzed by the laboratory for: total alkalinity, total Kjeldahl nitrogen (TKN-N), ammonia nitrogen (NH_3-N), nitrate/nitrite nitrogen (NO_X-N), carbonaceous biochemical oxygen demand ($CBOD_5$), total dissolved solids (TDS), and total suspended solids (TSS). For the biofilters with elemental sulfur media, the influent and effluent samples also included laboratory analysis of sulfate (SO_4) and hydrogen sulfide (H_2S). Table 2 lists the analytical parameters, analytical methods, and detection limits for these analyses.

Table 2
Analytical Parameters, Method of Analysis, and Detection Limits

Analytical Parameter	Method of Analysis	Laboratory Detection Limit (mg/L)
Total Alkalinity as $CaCO_3$	SM 2320B	2
Total Kjeldahl Nitrogen (TKN-N)	EPA351.2	0.05
Ammonia Nitrogen	EPA350.1	0.01
Nitrate/Nitrite Nitrogen (NO_X-N)	EPA353.2	0.01
Carbonaceous BOD ($CBOD_5$)	SM 5210B	2
Total Dissolved Solids (TDS)	SM 2540C	10
Total Suspended Solids (TSS)	SM 2540D	1
Sulfate (SO_4)	EPA300.0	0.2
Hydrogen Sulfide Unionized (H_2S)	SM4500S F	0.01
Sulfide	SM4500S F	0.1

4.0 Results and Discussion

4.1 Operational Monitoring

Start up of the PNRS II test facility occurred on May 17, 2010. The test systems have been operated continuously since the May 17th start up, with the exception of two power outages that occurred June 20th and June 28th. The power outages were of relatively short duration. For the most part, the pilot biofilters automatically resumed operation when power was restored. The only exceptions were the two peristaltic pumps: Pump 5 which supplies the two In-Situ simulators and Pump 11 which supplies the four horizontal flow denitrification biofilters. The peristaltic pumps displayed an error message, required manual restarting, and their off times were somewhat longer than the other system pumps. The peristaltic pump settings were saved through the power outage, and the pumps resumed operation once the error code was acknowledged. Appendix A provides the operation and maintenance log which includes actions taken since start-up. Appendix B provides the PLC recorded data tables for daily flows and runtimes for the

test facility. The peristaltic pumps have since been reprogrammed to start automatically in the event of temporary discontinuance of the power supply.

The recycle rates to the recirculating systems are monitored and recorded in the PLC as Pumps 5, 6, 7, and 8 flows. The data shows that the recycle flows are very close to the initially set 44 gpd rate for these four systems, indicating that the desired recycle ratio of approximately 3:1 is being met.

4.2 Flow Monitoring

Dose volumes to the PNRS II systems were measured on July 8th, 2010 (Day 42) to verify dose event volumes and confirm average hydraulic loading rates to the systems. The measured and target dose volumes based on the design hydraulic loading rates are presented in Table 3. The measured dose volumes compared favorably to target levels for all systems (relative errors less than 9%), with the exception of the lower than target flowrates measured for the in-situ simulators (IS1 and IS2). The peristaltic pump that feeds IS1 and IS2 was recalibrated on July 8th. All other systems required no recalibration.

Flow monitoring was also conducted to evaluate the temporal breakthrough of water in the effluent of the Stage 1 and 2 biofilters during an individual dosing cycle. These results are presented in Figures 2 through 5, where the once per hour dosing event occurred at time zero. The water breakthrough data is included in Appendix C. As depicted in Figure 2, the Stage 1 single pass biofilter with polystyrene media biofilter (UNSAT-PS1) exhibited a rapid breakthrough of water during its dosing cycle, versus the Stage 1 single pass biofilters with clinoptilolite and expanded clay media.

Single Pass Biofilters (Figure 2 and 3) – The flow monitoring results from the Stage 1 single pass biofilter effluents indicate that the polystyrene and 15-inch clinoptilolite media biofilters (UNSAT-PS1 and UNSAT-CL1 respectively) exhibited the most rapid water breakthrough while the other three biofilters provided more equalized effluent flowrates. Effluent flowrate profiles for the Stage 2 single pass biofilters (Figure 3) were similar to those of the Stage 1 biofilters to which they are directly connected (Figure 2), as would be expected. The DENIT-LS4 biofilter, which is directly connected to UNSAT-PS1, has the most rapid discharge profile.

Stage 1 Recirculating Biofilters (Figure 4) - The 15-inch clinoptilolite media depth exhibited rapid water breakthrough compared to the 30-inch depth clinoptilolite (UNSAT-CL2 and UNSAT-CL4 respectively). The 30-inch sand and expanded clay biofilters had similar water breakthrough profiles.

Stage 2 Horizontal Biofilters (Figure 5) - The Stage 2 horizontal biofilters are saturated biofilters that receive the same nitrified effluent (from DFT) delivered by the same peristaltic pump. These had relatively rapid and similar effluent discharge curves, as would be expected based on the saturated conditions.

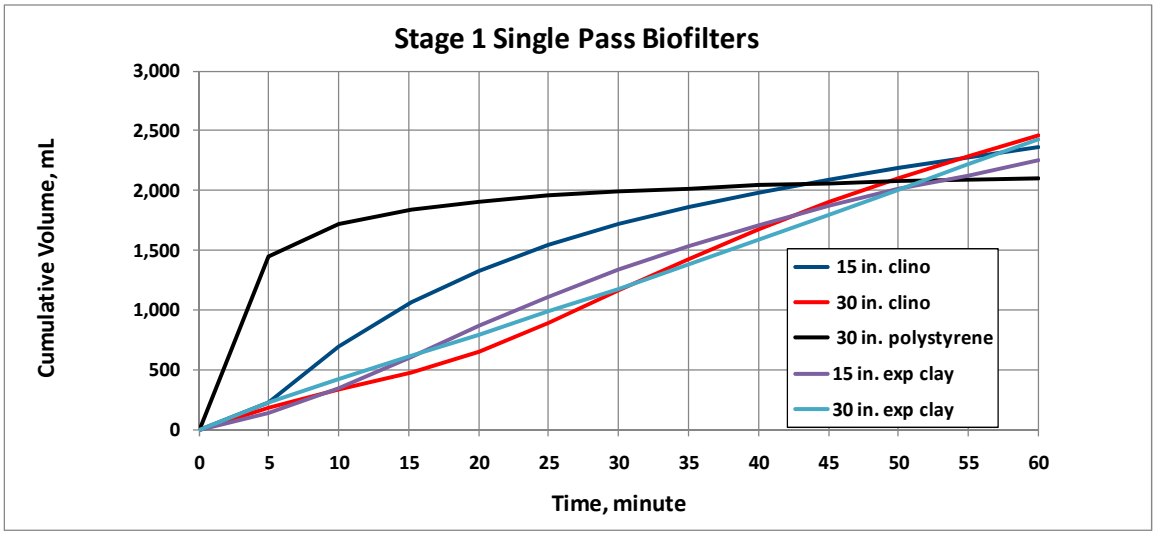

Figure 2
Single Pass Systems: Stage 1 Effluent Flow Profiles

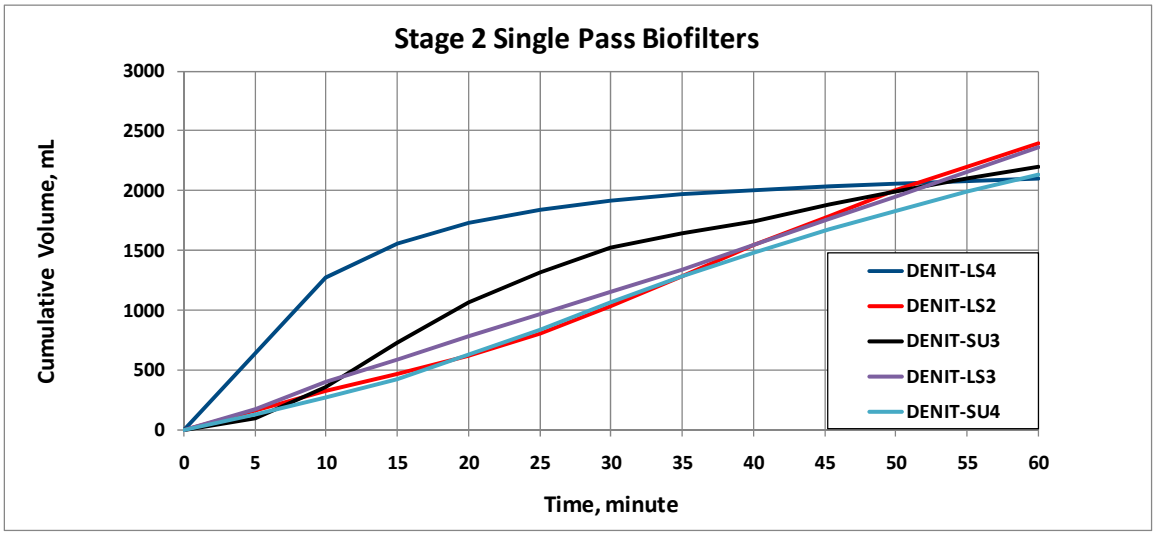

Figure 3
Single Pass Systems: Stage 2 Effluent Flow Profiles

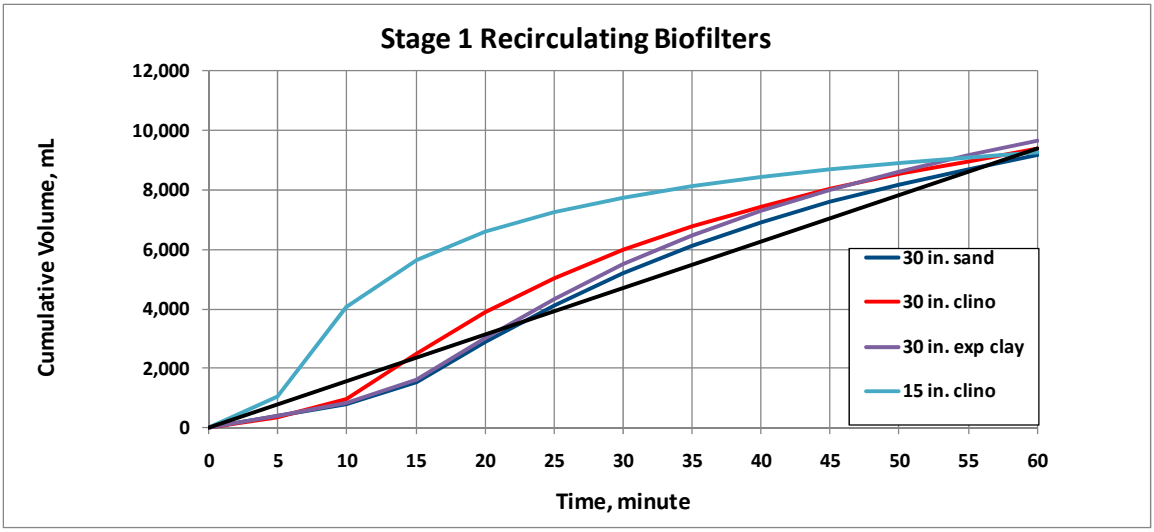

Figure 4
Recirculating Systems: Stage 1 Effluent Flow Profiles

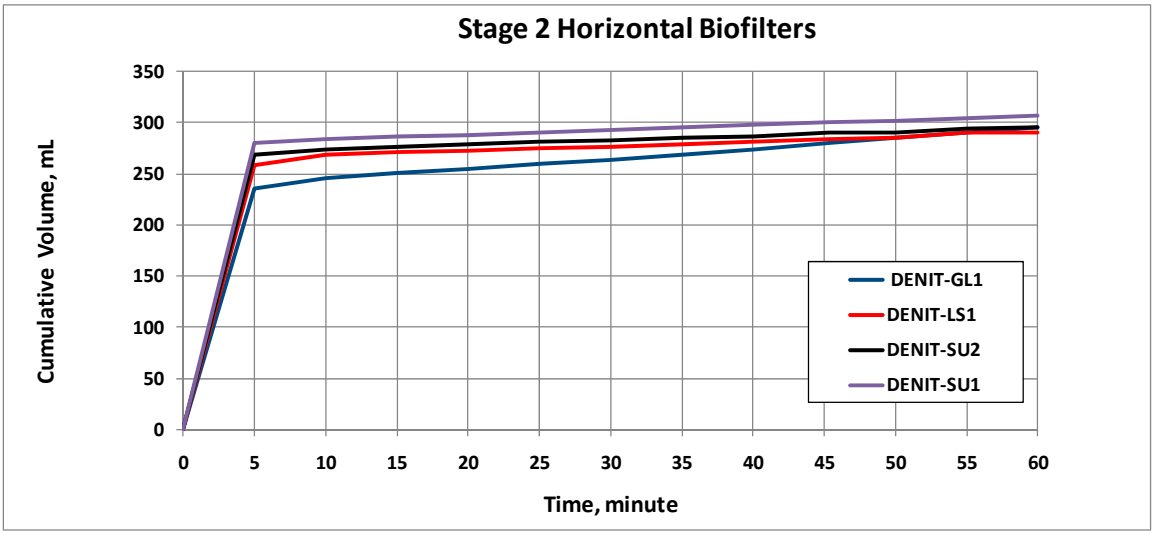

Figure 5
Stage 2 Horizontal Biofilters: Effluent Flow Profiles

Table 3
Flow Measurement Data

	Target volume (mL/dose)	Target volume (mL/day)	Measured Input (mL/dose)	Measured Input (mL/day)	Input (mL/day)	Measured Output mL	Output (mL/day)	RE (%) Input/Output	RE (%) Target Input/Output
Dose of STE to Stage 1 Single Pass Biofilters (Hydrosplitter 1)			7/8/10			7/13/10 10:00 - 11:00 am			
UNSAT-PS1	2,319	55,656	2,235		53,640	2,198	52,752	1.7%	5.2%
UNSAT-CL3			2,440		58,560	2,482	59,568	-1.7%	-7.0%
UNSAT-CL1			2,400		57,600	2,115	50,760	11.9%	8.8%
UNSAT-EC3			2,350		56,400	2,420	58,080	-3.0%	-4.4%
UNSAT-EC1			2,310		55,440	2,392	57,408	-3.5%	-3.1%
Mean			2,347		56,328	2,321	55,714	1.1%	-0.1%
Stage 2 Single Pass Biofilters			7/8/10			7/13/10 8:00 - 9:00 am			
DENIT-LS4	2,319	55,656	2,198		52,752	2,156	51,744	1.9%	7.0%
DENIT-LS2			2,482		59,568	2,431	58,344	2.1%	-4.8%
DENIT-SU3			2,115		50,760	2,380	57,120	-12.5%	-2.6%
DENIT-LS3			2,420		58,080	2,320	55,680	4.1%	0.0%
DENIT-SU4			2,392		57,408	2,271	54,504	5.1%	2.1%
Mean			2,321		55,714	2,312	55,478	0.4%	0.3%
Dose of STE to Stage 1 Recirculating Biofilters (Hydrosplitter 2)			Q (7/8/10)	R - PLC recorded (7/13/10)		7/13/10 8:30 -9:30 am			
RC1 : UNSAT-SA2	2,319	222,624	2,542	166,558	227,566	9,510	228,240	-0.3%	-2.5%
RC2 : UNSAT-EC4			2,434	181,699	240,115	10,044	241,056	-0.4%	-8.3%
RC3 : UNSAT-CL2			2,580	170,343	232,263	9,277	222,648	4.1%	0.0%
RC4 : UNSAT-CL4			2,595	166,558	228,838	9,371	224,904	1.7%	-1.0%
Mean			2,538	171,289	232,195	9,551	229,212	1.3%	-3.0%
Dose of Combined Stage 1 Effluent to Horizontal Denitrification Biofilters									
Biofilter Designation			7/8/10			7/13/10 9:28 - 12:28 am			
DENIT-SU1	308.7	7408.8	298		7,152	983	7,864	-10.0%	-6.1%
DENIT-SU2			298		7,152	940	7,520	-5.1%	-1.5%
DENIT-GL1			282		6,768	949	7,592	-12.2%	-2.5%
DENIT-LS1			290		6,960	940	7,520	-8.0%	-1.5%
Mean			8,307		7,008	953	7,624	-8.8%	-2.9%
Dose to In-Situ Simulators			7/8/10			7/13/10 1:10 pm - 7/14/10 1:10 pm	7/13/10 1:10 pm - 7/14/10 1:10 pm		
UNSAT-IS1 (STE)	2,469	14,814	1,940		11,640	14,990	14,990	-28.8%	-1.2%
UNSAT-IS2 (Nitrified STE)			2,380		14,280	14,275	14,275	0.0%	3.6%

Notes:
Yellow-shaded data are measured values.
Gray-shaded data are calculated values.

4.3 Water Quality Analyses

Water quality analytical results for Sample Event 1 are listed in Table 4. A statistical summary of the water quality data collected to date for the PNRS II systems is presented in Table 5. The following discussion summarizes these results. The laboratory report containing the raw analytical data is included in Appendix D.

Influent Water Quality – The STE analytical results indicated that the influent feed to the PNRS II systems was extremely weak at the time of this sampling event, and all parameters were lower than typical STE values. Reasons for this are under investigation, however it appears that the GCREC air conditioning systems were discharging considerable quantities of A/C condensate to the sewer, thus diluting wastewater strength. Previous STE sampling at GCREC during study site identification had occurred in winter and early spring months when A/C systems evidently had minimal use.

The measured total nitrogen (TN) concentration in the STE at this sampling event was 35 mg N/L. This was on the low side for septic tank effluent, but not as low as other parameters when compared to typical STE values. The performance of the various test systems was compared using the reductions in TKN-N, NH_3-N, and NO_X-N to get a preliminary idea of nitrogen reduction performance of the systems.

Single Pass Biofilters – Single pass Stage 1 biofilters generally performed very well as anticipated from PNRS I results. NH_3-N levels were at or below 0.01 mg/L for all single pass Stage 1 biofilters with the exception of biofilter UNSAT-PS1. Effluents exhibited organic N of 2.2 to 2.8 mg/L with the exception of UNSAT-PS1. Visual observations of UNSAT-PS1 suggested that wastewater was dosed to a relatively small portion of the horizontal cross section of the biofilter media where wastewater was applied at the surface. The large particle size of the polystyrene media and limited water retention characteristics may not be sufficient to affect horizontal spreading of the wastewater through the media. Flow tests found rapid water breakthrough and confirmed that polystyrene media will require more uniform flow distribution to increase utilization of the full horizontal cross section of media. NO_x was significantly elevated in all Stage 1 biofilter effluents, with UNSAT-PS-1 having significantly lower effluent NO_x corresponding to its higher NH_3-N.

The Stage 2 single pass denitrification biofilters generally performed very well as expected based on PNRS I results. DENIT-LS2 reduced NO_X-N to 1.4 mg/L, while all others reduced NO_X-N to 0.01 mg/L or less. DENIT-LS4 received the effluent from the polystyrene biofilter (UNSAT-PS1) which was only partially successful at NH_3-N reduction. Comparison of nitrogen species concentrations in DENIT-LS4 influent and effluent provide a striking illustration of the two-stage biofilter concept. Across DENIT-LS4, reduced nitrogen species (i.e. organic N and NH_3-N) were largely conserved, while NO_x reduction was complete; Total Nitrogen and Total Inorganic Nitrogen concentrations in DENIT-LS4 were determined largely by influent levels of organic and ammonia nitrogen that passed through the Stage 2 denitrification biofilter.

Stage 1 Recirculating Biofilters - Recirculating Stage 1 biofilters generally performed very well. NH_3-N levels were at or below 0.021 mg/L for all recirculating Stage 1 biofilters. Effluents exhibited Organic N of 1.9 to 2.4 mg/L. Effluent NO_x were 7.0 to 17 mg/L, which provided evidence of the operation of biochemical nitrification processes.

Stage 2 Horizontal Biofilters - Two of the Stage 2 horizontal biofilters showed good NO_X-N reduction. Effluent NO_x-N was 0.039 mg/L and less in effluent from DENIT-SU1 and DENIT-LS1. Efforts are being made to identify the factors contributing to less than complete denitrification in the other two horizontal flow denitrification biofilters. DENIT-SU2 contained sodium sesquicarbonate media, which resulted in high effluent pH and possible inhibition. DENIT-GL1 had potential glycerol dosing issues that are currently under evaluation.

In situ Simulator Systems – The In-Situ simulator biofilters, UNSAT IS1 and IS2, exhibited the lowest effluent Total Nitrogen levels of the PNRS II systems, with TN concentrations less than 1 mg/L and NH_3-N and NO_x values at or below detection levels. However, sulfate (SO_4) concentrations from these systems exceeded 1000 mg/L during this sample event. These systems use a mixture of expanded clay, lignocellulosic material, and elemental sulfur in an unsaturated lower media layer intended to foster denitrification. While non-detect effluent NO_x demonstrate a successful denitrification function, effluent also contains effluent sulfate levels that are quite high. It appears that oxygen ingress into the lower media layers is resulting in oxidation of elemental sulfur to sulfate. While this phenomenon was anticipated during the design of biofilters UNSAT IS1 and IS2, the extent to which it would occur was not well understood. Efforts are underway to modify UNSAT IS1 and IS2 to reduce effluent SO_4.

Table 4
Water Quality Analytical Results

Sample ID	Media Composition	Sample Date/Time	Sample Type	Temp (°C)	pH	Total Alkalinity (mg/L)	DO (mg/L)	Specific Conductance (µS)	TDS (mg/L)	TSS (mg/L)	$CBOD_5$ (mg/L)	TN (mg/L N)[1]	TKN (mg/L N)	Organic N (mg/L N)[2]	NH3-N (mg/L N)	NOx (mg/L N)	TIN (mg/L N)[3]	Sulfide (mg/L)	H_2S (mg/L)	SO_4 (mg/L)
STE Sample																				
STE-Tank 1		7/1/10 14:00	G	26.0	6.9	210	0.1	649	240	23	22	35.0	35	15.0	20	0.023	20.0			
Stage 1 Single Pass Biofilters Effluent																				
UNSAT-EC1	15" EC	7/1/10 13:45	G	27.2	7.3	110	7.1	617	350	1	2	21.2	2.2	2.2	0.01	19.0	19.0	0.17	0.06	46
UNSAT-EC3	30" EC	7/1/10 13:40	G	27.6	7.3	84	6.9	712	410	2	2	21.2	2.2	2.2	0.01	19.0	19.0			
UNSAT-CL1	15" CL	7/1/10 13:30	G	27.2	8.3	230	3.5	857	470	7	2	20.7	2.7	2.7	0.01	18.0	18.0	0.1	0.01	37
UNSAT-CL3	30" CL	7/1/10 13:20	G	26.6	8.6	270	6.9	974	550	1	2	22.8	2.8	2.8	0.01	20.0	20.0			
UNSAT-PS1	30" PS	7/1/10 13:15	G	27.0	7.3	160	2.7	599	270	4	3.0	25.3	16.0	9.6	6.4	9.3	15.7			
Stage 2 Single Pass Upflow Biofilters Effluent																				
DENIT-SU4	80% SU; 20% NS	7/1/10 10:40	G	27.1	7.3	140	0.1	929	560	1	3.9	0.8	0.8	0.7	0.1	0.01	0.1	1.8	0.6	260
DENIT-LS3	50% LS; 50% Sand	7/1/10 10:30	G	28.1	7.7	200	0.1	695	370	2	12.0	2.0	2.0	1.1	1.0	0.01	1.0			
DENIT-SU3	80% SU; 20% OS	7/1/10 10:10	G	27.6	7.2	170	0.1	1,257	710	16	13.0	2.7	2.7	2.2	0.5	0.01	0.5	4.7	1.8	340
DENIT-LS2	50% LS; 50% EC	7/1/10 10:00	G	27.2	8.1	370	0.1	998	510	9	5.5	2.8	1.4	1.2	0.2	1.4	1.6			
DENIT-LS4	30% LS; 70% EC	7/1/10 9:45	G	28.1	7.6	180	0.5	618	270	1	9.1	14.0	14	8.2	5.8	0.01	5.8			
Recirculation Tanks Effluent																				
RC1		7/1/10 14:10	G	30.8	7.3	160		637	330	5	2.8	27.0	15	9.3	5.7	12	17.7			
RC2		7/1/10 13:45	G	30.5	7.3	140		679	340	3	2	27.0	15	9.7	5.3	12	17.3			
RC3		7/1/10 12:50	G	29.2	7.6	200		760	360	6	2	27.0	16	10.5	5.5	11	16.5			
RC4		7/1/10 12:40	G	28.8	7.6	220		811	400	21	2.7	27.0	16	10.5	5.5	11	16.5			
Stage 1 Recirculating Biofilters Effluent																				
UNSAT-CL4	30" CL	7/1/10 11:15	G	27.6	6.7	220	7.3	860	480	8	2	10.3	2.4	2.4	0.021	7.9	7.9			
UNSAT-CL2	15" CL	7/1/10 11:20	G	27.1	7.9	200	6.7	781	440	3	2	17.1	2.1	2.1	0.01	15.0	15.0			
UNSAT-EC4	30" EC	7/1/10 11:50	G	27.4	7.3	160	7.2	661	350	1	2	18.9	1.9	1.9	0.01	17.0	17.0			
UNSAT-SA2	30" Sand	7/1/10 12:25	G	26.7	6.0	110	7.0	604	330	1	2	19.2	2.2	2.2	0.01	17.0	17.0			
Denite Feed Tank (Tank 3)																				
DFT		7/1/10 12:15	G	26.9	8.1	160	7.3	744	390	1	2	21.2	3.2	3.2	0.01	18.0	18.0	0.1	0.01	46
Stage 2 Horizontal Biofilters Effluent																				
DENIT-SU1	80% SU; 20% OS	7/1/10 14:20	G	27.5	7.2	200	0.5	1,192	660	1	26.0	2.4	2.4	0.9	1.5	0.01	1.5	29.0	11	230
DENIT-SU2	80% SU; 20% NS	7/1/10 14:25	G	27.9	9.1	260	1.2	1,398	690	1	4.9	6.4	1.2	1.2	0.01	5.2	5.2	0.1	0.01	140
DENIT-LS1	50% LS; 50% EC	7/1/10 13:05	G	27.3	7.5	250	0.5	738	370	1	56.0	1.5	1.5	0.7	0.8	0.039	0.8			
DENIT-GL1	12" GR; 60" EC	7/1/10 12:08	G	27.8	8.0	220	1.5	794	380	1	39.0	6.6	1.9	0.9	1.0	4.7	5.7			
In-situ Simulator Biofilters Effluent																				
UNSAT-IS1 (STE)	12" Sand; 12" Mix (45% EC, 35% LS, 20% SU)	7/1/10 14:35	G	26.7	6.4	130	0.1	2,438	1,600	113	7.8	0.4	0.41	0.4	0.045	0.022	0.1	0.1	0.01	1,100
UNSAT-IS2 (NO_3)	12" Sand; 12" Mix (45% EC, 35% LS, 20% SU)	7/1/10 14:35	G	26.6	6.1	210	0.4	3,506	3,000	108	13.0	0.6	0.62	0.5	0.11	0.01	0.1	0.1	0.01	1,800

Notes:

[1]Total Nitrogen (TN) is a calculated value equal to the sum of TKN and NO_X.

[2]Organic Nitrogen (ON) is a calculated value equal to the difference of TKN and NH_3.

[3]Total Inorganic Nitrogen (TIN) is a calculated value equal to the sum of NH_3 and NO_X.

EC: expanded clay, CL: clinoptilolite, PS: polystyrene, SU: elemental sulfur, LS: lignocellulosic, GL: glycerol, OS: oyster shell, NS: sodium sesquicarbonate, GR: gravel

D.O. - Dissolved oxygen

G - Grab sample

Gray-shaded data points indicate values below method detection level (mdl), mdl value used for statistical analyses.

Yellow-shaded data points indicate the reported value is between the laboratory method detection limit and the laboratory practical quantitation limit, value used for statistical analysis.

Table 5
Statistical Summary of Water Quality Data

Sample ID	Media Composition	Statistical Parameter	Temp (°C)	pH	Total Alkalinity (mg/L)	DO (mg/L)	Specific Conductance (µS)	TDS (mg/L)	TSS (mg/L)	$CBOD_5$ (mg/L)	TN (mg/L N)[1]	TKN (mg/L N)	Organic N (mg/L N)[2]	NH3-N (mg/L N)	NOx (mg/L N)	TIN (mg/L N)[3]	Sulfide (mg/L)	H_2S (mg/L)	SO_4 (mg/L)
STE Sample																			
STE-Tank 1		n	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		MEAN	26.0		210	0.1	649	240	23	22	35	35.0	15.0	20	0.023	20.0			
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-			
		MIN	26.0	6.9	210	0.1	649	240	23	22	35	35.0	15.0	20	0.023	20.0			
		MAX	26.0	6.9	210	0.1	649	240	23	22	35	35.0	15.0	20	0.023	20.0			
Stage 1 Single Pass Biofilters Effluent																			
UNSAT-EC1	15" Expanded Clay	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		MEAN	27.2		110	7.1	617	350	1	2	21.2	2.2	2.2	0.01	19	19.0	0.17	0.06	46
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		MIN	27.2	7.3	110	7.1	617	350	1	2	21.2	2.2	2.2	0.01	19	19.0	0.17	0.06	46
		MAX	27.2	7.3	110	7.1	617	350	1	2	21.2	2.2	2.2	0.01	19	19.0	0.17	0.06	46
UNSAT-EC3	30" Expanded Clay	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		MEAN	27.6		84	6.9	712	410	2	2	21.2	2.2	2.2	0.01	19	19.0			
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-			
		MIN	27.6	7.3	84	6.9	712	410	2	2	21.2	2.2	2.2	0.01	19	19.0			
		MAX	27.6	7.3	84	6.9	712	410	2	2	21.2	2.2	2.2	0.01	19	19.0			
UNSAT-CL1	15" Clinoptilolite	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		MEAN	27.2		230	3.5	857	470	7	2	20.7	2.7	2.7	0.01	18	18.0	0.10	0.01	37
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		MIN	27.2	8.3	230	3.5	857	470	7	2	20.7	2.7	2.7	0.01	18	18.0	0.10	0.01	37
		MAX	27.2	8.3	230	3.5	857	470	7	2	20.7	2.7	2.7	0.01	18	18.0	0.10	0.01	37
UNSAT-CL3	30" Clinoptilolite	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		MEAN	26.6		270	6.9	974	550	1	2	22.8	2.8	2.8	0.01	20	20.0			
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-			
		MIN	26.6	8.6	270	6.9	974	550	1	2	22.8	2.8	2.8	0.01	20	20.0			
		MAX	26.6	8.6	270	6.9	974	550	1	2	22.8	2.8	2.8	0.01	20	20.0			
UNSAT-PS1	30" Polystyrene	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		MEAN	27.0		160	2.7	599	270	4	3.0	25.3	16	9.6	6.4	9.3	15.7			
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-			
		MIN	27.0	7.3	160	2.7	599	270	4	3.0	25.3	16	9.6	6.4	9.3	15.7			
		MAX	27.0	7.3	160	2.7	599	270	4	3.0	25.3	16	9.6	6.4	9.3	15.7			
Stage 2 Single Pass Upflow Biofilters Effluent																			
DENIT-SU4	80% Sulfur; 20% Sodium Sesqui.	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		MEAN	27.1		140	0.1	929	560	1	3.9	0.8	0.77	0.7	0.10	0.01	0.1	1.8	0.6	260
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		MIN	27.1	7.3	140	0.1	929	560	1	3.9	0.8	0.77	0.7	0.10	0.01	0.1	1.8	0.6	260
		MAX	27.1	7.3	140	0.1	929	560	1	3.9	0.8	0.77	0.7	0.10	0.01	0.1	1.8	0.6	260
DENIT-LS3	50% Lignocellulosic; 50% Sand	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		MEAN	28.1		200	0.1	695	370	2	12	2.0	2.0	1.1	0.95	0.01	1.0			
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-			
		MIN	28.1	7.7	200	0.1	695	370	2	12	2.0	2.0	1.1	0.95	0.01	1.0			
		MAX	28.1	7.7	200	0.1	695	370	2	12	2.0	2.0	1.1	0.95	0.01	1.0			
DENIT-SU3	80% Sulfur; 20% Oyster Shell	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		MEAN	27.6		170	0.1	1257	710	16	13	2.7	2.7	2.2	0.46	0.01	0.5	4.7	1.8	340
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		MIN	27.6	7.2	170	0.1	1257	710	16	13	2.7	2.7	2.2	0.46	0.01	0.5	4.7	1.8	340
		MAX	27.6	7.2	170	0.1	1257	710	16	13	2.7	2.7	2.2	0.46	0.01	0.5	4.7	1.8	340

Table 5 (con't)
Statistical Summary of Water Quality Data

Sample ID	Media Composition	Statistical Parameter	Temp (°C)	pH	Total Alkalinity (mg/L)	DO (mg/L)	Specific Conductance (µS)	TDS (mg/L)	TSS (mg/L)	$CBOD_5$ (mg/L)	TN (mg/L N)[1]	TKN (mg/L N)	Organic N (mg/L N)[2]	NH3-N (mg/L N)	NOx (mg/L N)	TIN (mg/L N)[3]	Sulfide (mg/L)	H_2S (mg/L)	SO_4 (mg/L)
DENIT-LS2	50% Lignocellulosic; 50% Expanded Clay	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		MEAN	27.2		370	0.1	998	510	9	5.5	2.8	1.4	1.2	0.23	1.4	1.6			
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-			
		MIN	27.2	8.1	370	0.1	998	510	9	5.5	2.8	1.4	1.2	0.23	1.4	1.6			
		MAX	27.2	8.1	370	0.1	998	510	9	5.5	2.8	1.4	1.2	0.23	1.4	1.6			
DENIT-LS4	30% Lignocellulosic; 70% Expanded Clay	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		MEAN	28.1		180	0.5	618	270	1	9.1	14.0	14	8.2	5.8	0.01	5.8			
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-			
		MIN	28.1	7.6	180	0.5	618	270	1	9.1	14.0	14	8.2	5.8	0.01	5.8			
		MAX	28.1	7.6	180	0.5	618	270	1	9.1	14.0	14	8.2	5.8	0.01	5.8			
Recirculation Tanks Effluent																			
RC1		n	1	1	1		1	1	1	1	1	1	1	1	1	1			
		MEAN	30.8		160		637	330	5	2.8	27.0	15	9.3	5.7	12	17.7			
		STD. DEV.	-		-		-	-	-	-	-	-	-	-	-	-			
		MIN	30.8	7.3	160		637	330	5	2.8	27.0	15	9.3	5.7	12	17.7			
		MAX	30.8	7.3	160		637	330	5	2.8	27.0	15	9.3	5.7	12	17.7			
RC2		n	1	1	1		1	1	1	1	1	1	1	1	1	1			
		MEAN	30.5		140		679	340	3	2	27.0	15	9.7	5.3	12	17.3			
		STD. DEV.	-		-		-	-	-	-	-	-	-	-	-	-			
		MIN	30.5	7.3	140		679	340	3	2	27.0	15	9.7	5.3	12	17.3			
		MAX	30.5	7.3	140		679	340	3	2	27.0	15	9.7	5.3	12	17.3			
RC3		n	1	1	1		1	1	1	1	1	1	1	1	1	1			
		MEAN	29.2		200		760	360	6	2	27.0	16	10.5	5.5	11	16.5			
		STD. DEV.	-		-		-	-	-	-	-	-	-	-	-	-			
		MIN	29.2	7.6	200		760	360	6	2	27.0	16	10.5	5.5	11	16.5			
		MAX	29.2	7.6	200		760	360	6	2	27.0	16	10.5	5.5	11	16.5			
RC4		n	1	1	1		1	1	1	1	1	1	1	1	1	1			
		MEAN	28.8		220		811	400	21	2.7	27.0	16	10.5	5.5	11	16.5			
		STD. DEV.	-		-		-	-	-	-	-	-	-	-	-	-			
		MIN	28.8	7.6	220		811	400	21	2.7	27.0	16	10.5	5.5	11	16.5			
		MAX	28.8	7.6	220		811	400	21	2.7	27.0	16	10.5	5.5	11	16.5			
Stage 1 Recirculating Biofilters Effluent																			
UNSAT-CL4	30" Clinoptilolite	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		MEAN	27.6		220	7.3	860	480	8	2	10.3	2.4	2.4	0.021	7.9	7.9			
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-			
		MIN	27.6	6.7	220	7.3	860	480	8	2	10.3	2.4	2.4	0.021	7.9	7.9			
		MAX	27.6	6.7	220	7.3	860	480	8	2	10.3	2.4	2.4	0.021	7.9	7.9			
UNSAT-CL2	15" Clinoptilolite	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		MEAN	27.1		200	6.7	781	440	3	2	17.1	2.1	2.1	0.01	15	15.0			
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-			
		MIN	27.1	7.9	200	6.7	781	440	3	2	17.1	2.1	2.1	0.01	15	15.0			
		MAX	27.1	7.9	200	6.7	781	440	3	2	17.1	2.1	2.1	0.01	15	15.0			
UNSAT-EC4	30" Expanded Clay	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		MEAN	27.4		160	7.2	661	350	1	2	18.9	1.9	1.9	0.01	17	17.0			
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-			
		MIN	27.4	7.3	160	7.2	661	350	1	2	18.9	1.9	1.9	0.01	17	17.0			
		MAX	27.4	7.3	160	7.2	661	350	1	2	18.9	1.9	1.9	0.01	17	17.0			

Table 5 (con't)
Statistical Summary of Water Quality Data

Sample ID	Media Composition	Statistical Parameter	Temp (°C)	pH	Total Alkalinity (mg/L)	DO (mg/L)	Specific Conductance (µS)	TDS (mg/L)	TSS (mg/L)	$CBOD_5$ (mg/L)	TN (mg/L N)[1]	TKN (mg/L N)	Organic N (mg/L N)[2]	NH3-N (mg/L N)	NOx (mg/L N)	TIN (mg/L N)[3]	Sulfide (mg/L)	H_2S (mg/L)	SO_4 (mg/L)
UNSAT-SA2	30" Sand	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		MEAN	26.7		110	7.0	604	330	1	2	19.2	2.2	2.2	0.01	17	17.0			
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-			
		MIN	26.7	6.0	110	7.0	604	330	1	2	19.2	2.2	2.2	0.01	17	17.0			
		MAX	26.7	6.0	110	7.0	604	330	1	2	19.2	2.2	2.2	0.01	17	17.0			
Denite Feed Tank (Tank 3)																			
DFT		n	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1
		MEAN	26.9		160		744	390	1	2	21.2	3.2	3.2	0.01	18	18.0	0.1	0.01	46
		STD. DEV.	-		-		-	-	-	-	-	-	-	-	-	-	-	-	-
		MIN	26.9	8.1	160		744	390	1	2	21.2	3.2	3.2	0.01	18	18.0	0.1	0.01	46
		MAX	26.9	8.1	160		744	390	1	2	21.2	3.2	3.2	0.01	18	18.0	0.1	0.01	46
Stage 2 Horizontal Biofilters Effluent																			
DENIT-SU1	80% Sulfur; 20% Oyster Shell	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		MEAN	27.5		200	0.5	1192	660	1	26	2.4	2.4	0.9	1.5	0.01	1.5	29	11	230
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		MIN	27.5	7.2	200	0.5	1192	660	1	26	2.4	2.4	0.9	1.5	0.01	1.5	29	11	230
		MAX	27.5	7.2	200	0.5	1192	660	1	26	2.4	2.4	0.9	1.5	0.01	1.5	29	11	230
DENIT-SU2	80% Sulfur; 20% Sodium Sesqui.	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		MEAN	27.9		260	1.2	1398	690	1	4.9	6.4	1.2	1.2	0.010	5.2	5.2	0.1	0.01	140
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		MIN	27.9	9.1	260	1.2	1398	690	1	4.9	6.4	1.2	1.2	0.010	5.2	5.2	0.1	0.01	140
		MAX	27.9	9.1	260	1.2	1398	690	1	4.9	6.4	1.2	1.2	0.010	5.2	5.2	0.1	0.01	140
DENIT-LS1	50% Lignocellulosic; 50% Expanded Clay	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		MEAN	27.3		250	0.5	738	370	1	56	1.5	1.5	0.7	0.76	0.039	0.8			
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-			
		MIN	27.3	7.5	250	0.5	738	370	1	56	1.5	1.5	0.7	0.76	0.039	0.8			
		MAX	27.3	7.5	250	0.5	738	370	1	56	1.5	1.5	0.7	0.76	0.039	0.8			
DENIT-GL1	12" Gravel; 60" Expanded Clay	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
		MEAN	27.8		220	1.5	794	380	1	39	6.6	1.9	0.9	1	4.7	5.7			
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-			
		MIN	27.8	8.0	220	1.5	794	380	1	39	6.6	1.9	0.9	1	4.7	5.7			
		MAX	27.8	8.0	220	1.5	794	380	1	39	6.6	1.9	0.9	1	4.7	5.7			
In-situ Simulator Biofilters Effluent																			
UNSAT-IS1 (STE)	12" Sand; 12" Mix (45% EC, 35% Ligno, 20% Sulfur)	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		MEAN	26.7		130	0.1	2438	1,600	113	7.8	0.432	0.41	0.365	0.045	0.022	0.07	0.1	0.01	1,100
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		MIN	26.7	6.4	130	0.1	2438	1,600	113	7.8	0.432	0.41	0.365	0.045	0.022	0.07	0.1	0.01	1,100
		MAX	26.7	6.4	130	0.1	2438	1,600	113	7.8	0.432	0.41	0.365	0.045	0.022	0.07	0.1	0.01	1,100
UNSAT-IS2 (NO_3)	12" Sand; 12" Mix (45% EC, 35% Ligno, 20% Sulfur)	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		MEAN	26.6		210	0.4	3506	3,000	108	13	0.63	0.62	0.510	0.11	0.01	0.12	0.1	0.01	1,800
		STD. DEV.	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		MIN	26.6	6.1	210	0.4	3506	3,000	108	13	0.63	0.62	0.510	0.11	0.01	0.12	0.1	0.01	1,800
		MAX	26.6	6.1	210	0.4	3506	3,000	108	13	0.63	0.62	0.510	0.11	0.01	0.12	0.1	0.01	1,800

Notes:

[1]Total Nitrogen (TN) is a calculated value equal to the sum of TKN and NO_x

[2]Organic Nitrogen (ON) is a calculated value equal to the difference of TKN and NH_3

[3]Total Inorganic Nitrogen (TIN) is a calculated value equal to the sum of NH_3 and NO_x

EC: expanded clay, CL: clinoptilolite, PS: polystyrene, SU: elemental sulfur, LS: lignocellulosic, GL: glycerol, OS: oyster shell, NS: sodium sesquicarbonate, GR: gravel

D.O. - Dissolved oxygen

5.0 PNRS II Sample Event No. 1: Summary and Recommendations

5.1 Summary

The completion of Sample Event 1 marks a significant milestone in the progression of PNRS II. In research and development projects of this type, the results of the first sampling event serve to confirm that the experimental systems are functioning as intended and provide the basis upon which to make system adjustments and modifications. The Sample Event No. 1 results indicate that the design and operating protocols established for PNRS II are essentially valid. A highly effective test platform for evaluation of passive biofiltration systems for nitrogen reduction has been established. Results of sample Event 1 indicate that:

- Delivered flowrates to all biofilters were generally within 10% of target;
- Eight out of nine Stage 1 unsaturated biofilters produced effluent NH_3-N less than 0.03 mg/L;
- Seven out of nine Stage 2 saturated biofilters produced effluent NO_x-N less than 1.5 mg/L;
- Effluent Total Nitrogen was less than 3.0 mg/L in four out of five of the directly coupled two-stage systems; and
- Vertically stacked biofilters (In-Situ Simulators) produced effluents with close to detection levels of both NH_3 and NO_x.

These results provide initial confirmation of the nitrogen reduction effectiveness of the PNRS II biofiltration systems and validate the ability of the GCREC pilot facility to provide a test platform for critical performance assessment. Where expected or desired PNRS II outcomes are not being achieved, they appear to be due to tractable issues that can be solved and are currently underway, as discussed in the following sections.

5.2 Recommendations

Careful observation of PNRS II systems and the results of Sample Event No. 1 were used to formulate recommendations for adjustments and modifications to the test systems and the GCREC pilot facility. A statement of the issue, description of the recommended adjustment or modification and its rationale, and expected outcomes are presented below. The recommendations listed below address the PNRS II performance issues that have been identified and each recommendation is believed to be capable of resolving the issue presented. All recommendations are based on the overriding PNRS II goal of providing functional specifications for modular biofiltration components for onsite nitrogen reducing treatment systems. The project team will continuously evaluate all PNRS II results including those resulting from the recommended modifications, and make further adaptations as needed.

5.2.1 Septic Tank Effluent (STE) Quality

The two important input factors to PNRS II biofilters are the composition of Septic Tank Effluent (STE) and the applied STE flowrates. It has been verified that target STE flowrates have been successfully achieved. Sample Event No. 1 revealed that GCREC Septic Tank Effluent exhibited low concentrations of key parameters when compared to typical residential STE. The PNRS II study is intended to evaluate systems that treat typical single residence STE and typical STE characteristics are desired. Examination of flow records of the existing GCREC treatment system indicated unexpectedly high flowrates. It was found upon further investigation that that condensate from the facility air conditioning (A/C) system was being drained into the wastewater system, ostensibly diluting the STE.

The A/C condensate from GCREC air conditioning units was rerouted in mid July and no longer discharges to the sewer. Additional STE sampling was conducted on July 21st to evaluate STE quality after removal of A/C condensate from the wastewater system. Samples were collected from existing GCREC septic tanks 1 and 2 as well as PNRS II STE storage Tank 1 and the STE feed to the Stage 1 biofilters. Results of these sample analyses will be used to make decisions on potential changes to improve influent wastewater characteristics to the PNRS II systems. Options include verifying that GCREC quality without A/C condensate is acceptable and using it as is or modifying the system by which STE is withdrawn from the GCREC wastewater system tank and pumped to the PNRS II dosing tank. The result of these efforts will be to provide influent STE to the PNRS II systems that reasonably approximates STE characteristics typical of single family residences.

5.2.2 Polystyrene Media Performance

The unsaturated single pass biofilter with polystyrene media (UNSAT-PS1) exhibited limited reduction of organic nitrogen and ammonia as well as a lower effluent dissolved oxygen than the other single pass Stage 1 unsaturated biofilters. Visual observations of the media surface suggested that the STE application system resulted in a majority of dosing in the central area of the horizontal cross section of media surface. Flow monitoring confirmed that water transported rapidly through the polystyrene media following an applied STE dose, unlike the other single pass Stage 1 biofilters. This not unexpected result can be attributed to the much larger media size of polystyrene media and its limited water retention characteristics versus other Stage 1 media. A capillary mat was installed in UNSAT-PS1 on July 16th, above the mesh bag, to improve flow distribution. Other options are also being considered, including a spray dosing system. The outcome of these efforts will be more uniform flow distribution to the surface of the polystyrene media and an improved evaluation of polystyrene performance capabilities in full scale applications.

5.2.3 Glycerol Denitrification Performance

The saturated horizontal denitrification biofilter with expanded clay media and glycerol as electron donor (DENIT-GL1) exhibited limited reduction of NO_x. Possible explanations include problems with the glycerol dosing system, slow establishment of glycerol utilizing, denitrifying microbial consortia within the biofilter, and sampling error. The glycerol feed system has been modified and DENIT-GL1 performance will be evaluated in Sample Event 2. Additionally, profiling will be conducted of NO_x species across the DENIT-GL1 biofilter, which will provide further insight into process efficacy. The outcome will be successful evaluation of the performance of the Stage 2 denitrification biofilter using glycerol as electron donor.

5.2.4 Replace Alkalinity Supplement

Sulfur containing denitrification systems include media for alkalinity addition. Sodium sesquicarbonate was supplied as alkalinity supplement in one upflow denitrification biofilter (DENIT-SU4) and one horizontal denitrification biofilter (DENIT-SU-2). Experience with this material has indicated that it was capable of rapid dissolution and possibly re-precipitation, which could potentially limit long term alkalinity supply and hydraulic effectiveness of denitrification biofilters. Its use as an alkalinity supplement in full scale systems is questionable and sodium sesquicarbonate will be replaced with alternative alkalinity supplements. The media mixture in upflow denitrification biofilter DENIT-SU4 will be modified to include elemental sulfur, limestone, and expanded clay. The media mixture in horizontal denitrification biofilter (DENIT-SU-2) will also be modified to include

elemental sulfur, limestone, and expanded clay. The outcome will be replacement of the alkalinity supplement in DENIT-SU4 and DENIT-SU-2 and evaluation of the denitrification performance of the modified biofilters.

5.2.5 In-Situ Simulator Effluent Sulfate Concentration

In-Situ Simulators contain vertically stacked media layers intended to affect enhanced simultaneous nitrification and denitrification in a single pass vertical downflow system. The concept is to employ an upper unsaturated media layer for nitrification underlain by one or more layers containing denitrification media. The enhancement effect is due to the inclusion of electron donor (i.e. lignocellulosic material and/or elemental sulfur) into the unsaturated biofilter media in the lower layer. The In-Situ Simulators deployed in PNRS II employed a mixed media of expanded clay, lignocellulosic material and elemental sulfur in fully unsaturated condition. It was anticipated that deploying elemental sulfur under unsaturated conditions may result in greater sulfur oxidation to sulfate than if sulfur was contained in a saturated biofilter, however the sulfate level that would be reached by deploying sulfur in an unsaturated biofilter was unknown.

UNSAT-IS1 and UNSAT-IS2 both produced very low NH_3-N, NO_x-N and organic nitrogen concentrations in Sample Event No. 1, but sulfate levels were high. It is desired to explore the ability of single pass vertically stacked biofiltration systems to reduce Total Nitrogen while limiting effluent sulfate levels when elemental sulfur is included as a denitrification electron donor.

In an attempt to decrease sulfur oxidation in the lower layer, the discharge pipe of both In-Situ Simulators was modified on July 20th to saturate the lower 12" of the media bed. The denitrification media was fully encompassed within the saturated layer. Future monitoring will determine if this modification provides an improvement to the sulfate concentrations in the effluent from these systems, while maintaining adequate nitrogen reductions.

In addition, the overall PNRS II objective is to incorporate PNRS II results into the design of full scale testing at homeowner sites in FOSNRS Task B. The In-situ simulator results are critical for Task B activities and may delay Task B if not expedited. Due to the need to develop functional specifications for vertically stacked single pass biofiltration systems, it is recommended to deploy two additional vertically stacked biofilter systems to evaluate alternative media designs. The purpose of these is to evaluate media designs that achieve the potential benefit of enhancement of simultaneous nitrification / denitrification in unsaturated media and to minimize sulfate in the effluent. These will consist of small diameter biofilters with unsaturated media (sand), underlain by an unsaturated layer of expanded clay and lignocellulosic media, in turn underlain by a fully saturated

layer of elemental sulfur. These systems will be dosed at the same frequency (once per 4 hours) and average hydraulic loading rate (0.8 gal/ft^2-day) as the currently deployed UNSAT-IS1 and UNSAT-IS2. One will receive STE, and the second will receive nitrified effluent. Monitoring will be conducted of system effluent as well as intermediate nitrogen species within the biofilter below the unsaturated expanded clay/lignocellulosic layer and above the saturated sulfur layer. To monitor nitrogen species before contact with the elemental sulfur layer, an intermediary media layer of coarse sand/gravel may be installed above the sulfur layer and will be partially saturated. This would likely prevent upward communication from the sulfur layer and enable water samples to be collected from the saturated portion of the sand/gravel which represent the treatment effects of the unsaturated zone, without sulfur influence. In this manner, the effectiveness of the unsaturated system with only lignocellulosic electron donor and the added effect of underlying sulfur will be delineated.

The outcome of these efforts will be to specify the optimal media configuration to be employed in the In-Situ (mini-mound) systems, which will then be constructed at GCREC. In-Situ Simulator results from PNRS II are on the critical path. Modifications to the existing In-situ simulators and deployment of additional vertically stacked systems will provide the functional specifications required in order to proceed with construction of the In-Situ mini-mounds in a timely manner.

Appendix A: Operation & Maintenance Log

Table A.1
Operation and Maintenance Log

Date	Description
5/17/2010	Start-up
5/20/2010	Pump 1 not in Auto, LL float alarm, refilled Tank 1 to HIGH float
5/24/2010	First glycerol batch prepared (125 mL glycerol; 1875 mL DI water)
	1:15 dilution (125 mL glycerol, 1875 mL DI water)
5/26/2010	LL float alarm, refilled Tank 1 to HIGH float
6/1/2010	Replaced glycerol tubing
6/4/2010	LL float alarm, refilled Tank 1 to HIGH float, determined that LOW float is faulty
	Revised floats so that old Low Float is now High float
	Revised program installed so that only LOW Float turns on/off Pump 1
6/8/2010	Second glycerol batch prepared (125 mL glycerol; 1875 mL DI water)
6/18/2010	Pump 1 screen cleaned with hose
6/21/2010	Pump 5 and 11 Error Code 18, cleared alarm and restarted pumps
	Pump 8 was on "OFF", turned back to "AUTO"
6/22/2010	Pump 5 had turned off, turned back on at 9:32 am
6/28/2010	Pump 5 and 11 Error Code 18, cleared alarm and restarted pumps
	Replaced glycerol tubing, kink in top, added elbow
	Russ replaced existing GCREC mound Pump 2 ~ 11:00 am
7/2/2010	Pump 1 screen cleaned with hose
7/8/2010	Glycerol tubing had released to bottom of container, replaced with hard tubing all the way
	Tank 1 LOW Float revised magnet distance to shorten Pump 1 runtime
	Pump 1 screen cleaned with hose
7/12/2010	Pump 5 Error Code 18, cleared alarm and restarted pump
7/14/2010	UPS beeping, problem with receptacle, temporary fix with extension cord
7/15/2010	Electrician fixed receptacle
7/16/2010	Per Dr. Stanley all condensate flow diverted from septic system.
	Russ fixed existing GCREC Mound Pump 2 which had not been running
	Pump 5 and 11 Error Code 18, cleared alarm and restarted pumps

7/16/2010	Third glycerol batch prepared (125 mL glycerol; 1875 mL DI water)
	Capillary mat added to PS-1
7/19/2010	IS 1 changed discharge (rotated 180°) now 15 inches of saturation from bottom of tank
7/20/2010	IS 2 changed discharge (rotated 180°) now 15 inches of saturation from bottom of tank
	Removed PS1 capillary mat from inside mesh bag (ponding), replaced with new one on top of mesh
7/26/2010	Glycerol batch #4 (70 mL glycerol; 1930 mL DI water)
8/3/2010	Glycerol batch #5 (70 mL glycerol; 1930 mL DI water)
8/4/2010	Cleaned crosses in Stage 1 Recirculating Biofilters
	Added tees to outlet in RC1 and RC4 tanks to alleviate blockage build-up
	Replaced Hydrosplitter 1 & 2 tubing
	Replaced Stage 2 Horizontal tubing from Pump 11
	Cleaned Stage 2 Horizontal sample ports
	Lowered Pump 1 Low Float 2 wraps to decrease volume in tank(decrease residence time) to
	improve STE quality.

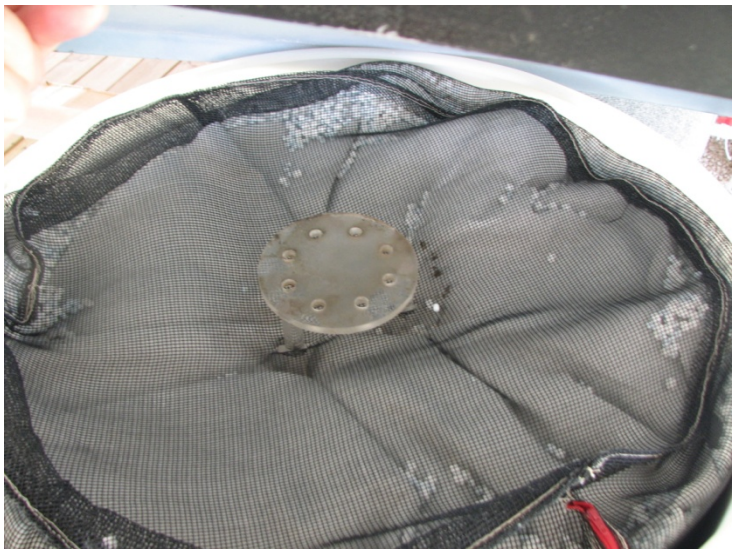

Figure A.1
Capillary Mat Installed above Polystyrene Media

Figure A.2
Revised In-situ Simulators Discharge Piping

Figure A.3
RC1 Outlet Tee

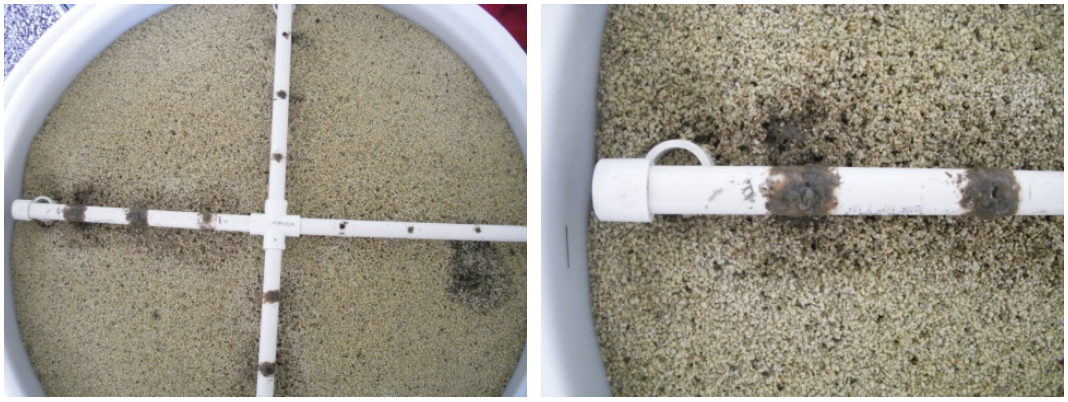

Figure A.4
UNSAT-CL4 before Cleaning

Figure A.5
UNSAT-CL4 after Cleaning

Appendix B: PLC Data Tables

Table B.1
PLC Recorded Daily Flows

Days Since Start-Up	Date	Pump 4 to Hydro 1	Pump 14 to Hydro 2	Pump 6 Recirc. System 1	Pump 7 Recirc. System 2	Pump 8 Recirc. System 3	Pump 9 Recirc. System 4
		(Gallons)	(Gallons)	(Gallons)	(Gallons)	(Gallons)	(Gallons)
0	5/17/2010	43	37	24	25	24	25
1	5/18/2010	76	67	44	47	44	44
2	5/19/2010	75	64	44	46	44	44
3	5/20/2010	68	61	42	44	42	43
4	5/21/2010	77	68	45	46	45	44
5	5/22/2010	77	67	45	47	44	45
6	5/23/2010	76	68	44	47	44	44
7	5/24/2010	75	65	45	48	44	45
8	5/25/2010	64	56	39	41	38	39
9	5/26/2010	51	43	28	30	28	28
10	5/27/2010	77	67	45	47	44	44
11	5/28/2010	77	68	45	47	44	45
12	5/29/2010	77	69	44	47	44	45
13	5/30/2010	76	66	45	47	44	44
14	5/31/2010	74	65	45	48	44	45
15	6/1/2010	69	61	41	43	41	41
16	6/2/2010	77	67	45	48	45	45
17	6/3/2010	75	67	45	47	44	44
18	6/4/2010	77	65	44	47	42	44
19	6/5/2010	76	67	45	47	45	45
20	6/6/2010	77	68	45	47	44	44
21	6/7/2010	77	68	44	47	45	45
22	6/8/2010	76	68	45	48	44	45
23	6/9/2010	77	68	45	47	45	44
24	6/10/2010	76	67	45	47	45	45

Days Since Start-Up	Date	Pump 4 to Hydro 1	Pump 14 to Hydro 2	Pump 6 Recirc. System 1	Pump 7 Recirc. System 2	Pump 8 Recirc. System 3	Pump 9 Recirc. System 4
		(Gallons)	(Gallons)	(Gallons)	(Gallons)	(Gallons)	(Gallons)
25	6/11/2010	77	68	45	48	45	45
26	6/12/2010	76	68	44	47	44	44
27	6/13/2010	76	68	45	47	45	45
28	6/14/2010	76	72	45	48	45	45
29	6/15/2010	76	73	45	47	45	44
30	6/16/2010	77	71	45	48	45	45
31	6/17/2010	75	71	44	47	34	45
32	6/18/2010	76	71	45	47	0	44
33	6/19/2010	76	72	44	48	0	45
34	6/20/2010	75	71	45	47	0	44
35	6/21/2010	73	69	42	45	12	43
36	6/22/2010	75	71	45	47	45	45
37	6/23/2010	76	72	44	48	45	44
38	6/24/2010	75	72	45	48	44	45
39	6/25/2010	75	72	45	47	45	45
40	6/26/2010	76	71	44	48	45	44
41	6/27/2010	75	72	45	47	44	45
42	6/28/2010	75	71	44	48	44	43
43	6/29/2010	75	71	44	47	44	45
44	6/30/2010	74	71	44	48	44	44
45	7/1/2010	71	68	44	47	44	45
46	7/2/2010	76	68	44	47	44	44
47	7/3/2010	75	69	44	48	44	44
48	7/4/2010	75	69	44	47	44	45
49	7/5/2010	75	68	44	47	45	44
50	7/6/2010	76	69	44	48	44	44
51	7/7/2010	75	68	44	47	44	45
52	7/8/2010	76	69	44	48	44	44
53	7/9/2010	76	70	44	47	44	45
54	7/10/2010	76	69	45	48	45	45
55	7/11/2010	76	68	44	48	44	44
56	7/12/2010	76	69	44	47	44	45

Days Since Start-Up	Date	Pump 4 to Hydro 1	Pump 14 to Hydro 2	Pump 6 Recirc. System 1	Pump 7 Recirc. System 2	Pump 8 Recirc. System 3	Pump 9 Recirc. System 4
		(Gallons)	(Gallons)	(Gallons)	(Gallons)	(Gallons)	(Gallons)
57	7/13/2010	76	69	44	48	45	44
58	7/14/2010	78	71	43	46	43	43
59	7/15/2010	75	69	44	48	45	44
60	7/16/2010	76	70	44	48	44	45
61	7/17/2010	75	69	45	47	45	44
62	7/18/2010	76	69	44	48	45	45
63	7/19/2010	76	69	44	48	45	44
64	7/20/2010	75	68	45	48	44	45
65	7/21/2010	76	74	44	47	45	44
66	7/22/2010	75	69	44	48	45	45
67	7/23/2010	75	69	45	48	44	45
68	7/24/2010	75	68	44	48	44	44
69	7/25/2010	74	69	44	48	44	45
70	7/26/2010	75	68	45	48	44	45
71	7/27/2010	75	68	44	48	44	44
72	7/28/2010	74	68	45	48	44	45
73	7/29/2010	74	68	45	48	45	44
74	7/30/2010	74	67	44	47	44	45
75	7/31/2010	75	68	45	48	44	44
76	8/1/2010	74	68	45	46	45	45
77	8/2/2010	74	68	44	48	44	44

Table B.2
PLC Recorded Daily Runtimes

Days Since Start-Up	Date	STE Pump 1 to Tank 1	Pump 4 to Hydro 1	Pump 14 to Hydro 2	Pump 6 Recirc. System 1	Pump 7 Recirc. System 2	Pump 8 Recirc. System 3	Pump 9 Recirc. System 4
		(minutes)	(minutes)	(minutes)	(minutes)	(minutes)	(minutes)	(minutes)
0	5/17/2010	0	7	6	4	4	4	4
1	5/18/2010	0	13	11	6	7	6	6
2	5/19/2010	0	13	10	7	6	6	6
3	5/20/2010	16	11	11	6	7	6	6
4	5/21/2010	0	13	11	6	7	7	7
5	5/22/2010	8	13	10	7	6	6	6
6	5/23/2010	0	13	11	6	7	7	7
7	5/24/2010	0	12	11	6	7	6	6
8	5/25/2010	0	12	9	6	6	6	6
9	5/26/2010	17	8	7	4	4	4	4
10	5/27/2010	0	13	11	6	7	6	6
11	5/28/2010	18	13	11	7	7	6	6
12	5/29/2010	0	12	10	6	6	7	7
13	5/30/2010	719	13	11	6	7	6	6
14	5/31/2010	1440	13	11	7	7	6	6
15	6/1/2010	543	12	10	6	6	6	6
16	6/2/2010	2	12	11	6	7	7	7
17	6/3/2010	0	13	10	6	7	6	6
18	6/4/2010	13	13	11	7	7	6	6
19	6/5/2010	6	13	11	6	6	7	7
20	6/6/2010	5	12	11	6	7	6	6
21	6/7/2010	5	13	10	7	7	7	7
22	6/8/2010	0	13	11	6	7	6	6
23	6/9/2010	6	13	11	7	7	6	6
24	6/10/2010	5	13	11	6	6	7	7
25	6/11/2010	7	12	11	6	7	6	6
26	6/12/2010	6	13	10	7	7	7	7
27	6/13/2010	6	13	11	6	7	6	6
28	6/14/2010	7	13	11	7	6	6	6
29	6/15/2010	7	13	11	6	7	7	7
30	6/16/2010	659	12	11	6	7	6	6

Days Since Start-Up	Date	STE Pump 1 to Tank 1	Pump 4 to Hydro 1	Pump 14 to Hydro 2	Pump 6 Recirc. System 1	Pump 7 Recirc. System 2	Pump 8 Recirc. System 3	Pump 9 Recirc. System 4
		(minutes)	(minutes)	(minutes)	(minutes)	(minutes)	(minutes)	(minutes)
31	6/17/2010	973	13	11	7	7	5	6
32	6/18/2010	6	13	10	6	7	0	7
33	6/19/2010	6	13	11	6	6	0	6
34	6/20/2010	5	12	11	7	7	0	7
35	6/21/2010	5	13	11	6	7	2	6
36	6/22/2010	5	13	10	7	7	6	6
37	6/23/2010	6	13	11	6	7	7	7
38	6/24/2010	5	13	11	6	6	6	6
39	6/25/2010	0	12	11	7	7	7	7
40	6/26/2010	5	13	11	6	7	6	6
41	6/27/2010	6	13	10	7	7	6	6
42	6/28/2010	5	13	11	6	6	7	7
43	6/29/2010	6	13	11	6	7	6	6
44	6/30/2010	6	12	11	7	7	6	6
45	7/1/2010	6	13	10	6	7	7	7
46	7/2/2010	121	13	11	6	7	6	6
47	7/3/2010	6	13	11	7	6	7	7
48	7/4/2010	5	12	11	6	7	6	6
49	7/5/2010	5	13	11	7	7	6	6
50	7/6/2010	0	13	10	6	7	7	7
51	7/7/2010	6	13	11	6	6	6	6
52	7/8/2010	11	13	11	7	7	6	6
53	7/9/2010	5	12	11	6	7	7	7
54	7/10/2010	4	13	10	7	7	6	6
55	7/11/2010	5	13	11	6	7	7	7
56	7/12/2010	5	13	11	6	6	6	6
57	7/13/2010	5	12	11	7	7	6	6
58	7/14/2010	4	13	11	6	7	7	7
59	7/15/2010	5	13	10	6	7	6	6
60	7/16/2010	4	13	11	7	7	7	7
61	7/17/2010	5	13	11	6	6	6	6
62	7/18/2010	9	12	11	7	7	6	6

Days Since Start-Up	Date	STE Pump 1 to Tank 1	Pump 4 to Hydro 1	Pump 14 to Hydro 2	Pump 6 Recirc. System 1	Pump 7 Recirc. System 2	Pump 8 Recirc. System 3	Pump 9 Recirc. System 4
		(minutes)	(minutes)	(minutes)	(minutes)	(minutes)	(minutes)	(minutes)
63	7/19/2010	5	13	11	6	7	7	7
64	7/20/2010	5	13	10	6	7	6	6
65	7/21/2010	4	13	12	7	6	6	6
66	7/22/2010	5	12	11	6	7	7	7
67	7/23/2010	4	13	10	7	7	6	6
68	7/24/2010	5	13	11	6	7	7	7
69	7/25/2010	5	13	11	6	7	6	6
70	7/26/2010	4	13	11	7	6	6	6
71	7/27/2010	5	12	11	6	7	7	7
72	7/28/2010	4	13	10	6	7	6	6
73	7/29/2010	5	13	11	7	7	7	7
74	7/30/2010	5	13	11	6	6	6	6
75	7/31/2010	4	13	11	7	7	6	6
76	8/1/2010	5	12	10	6	7	7	7
77	8/2/2010	4	13	11	6	7	6	6

Appendix C: Flow Cycle Tests

Table C.1
Stage 1 Single Pass Biofilters Flow Cycle

Time minutes	Stage 1 Single Pass Biofilters Effluent									
	PS1	CL3	CL1	EC3	EC1	PS1	CL3	CL1	EC3	EC1
	30 in.	30 in.	15 in.	30 in.	15 in.	30 in.	30 in.	15 in.	30 in.	15 in.
	Incremental Volume (ml)					Cumulative Volume (ml)				
	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10
0.00	-	-	-	-	-	0	0	0	0	0
5.00	1,446	181	227	222	140	1,446	181	227	222	140
10.00	275	148	469	199	199	1,721	329	696	421	339
15.17	122	148	373	195	268	1,843	477	1,069	616	607
20.00	65	176	260	179	265	1,908	653	1,329	795	872
25.00	47	238	215	188	239	1,955	891	1,544	983	1,111
30.00	35	270	170	195	229	1,990	1,161	1,714	1,178	1,340
35.00	27	267	142	201	191	2,016	1,428	1,856	1,379	1,531
40.00	25	249	122	208	180	2,041	1,677	1,978	1,587	1,711
45.00	18	225	110	210	161	2,059	1,902	2,088	1,797	1,872
50.00	15	203	100	210	138	2,074	2,105	2,188	2,007	2,010
55.00	13	182	89	210	109	2,087	2,287	2,277	2,217	2,119
60.00	13	170	83	208	130	2,100	2,457	2,360	2,425	2,249

Table C.2
Stage 2 Single Pass Biofilters Flow Cycle Incremental Volume

Time minutes	Stage 2 Single Pass Upflow Biofilters Effluent									
	LS4	LS2	SU3	LS3	SU4	LS4	LS2	SU3	LS3	SU4
	24 in.	24 in.	24 in.	24 in.	24 in.	24 in.	24 in.	24 in.	24 in.	24 in.
	Incremental Volume (ml)					Cumulative Volume (ml)				
	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10
0.00	-	-	-		-	0	0	0	0	0
5.00	645	165	90	172	125	645	165	90	172	125
10.00	633	155	268	230	140	1,278	320	358	402	265
15.00	280	148	368	187	160	1,558	468	726	589	425
20.00	170	151	338	193	203	1,728	619	1,064	782	628
25.00	109	183	255	180	205	1,837	802	1,319	962	833
30.00	79	230	208	190	230	1,916	1,032	1,527	1,152	1,063
35.00	50	249	112	189	216	1,966	1,281	1,639	1,341	1,279
40.00	35	259	105	202	201	2,001	1,540	1,744	1,543	1,480
45.28	33	250	140	219	195	2,034	1,790	1,884	1,762	1,675
50.00	26	209	108	192	159	2,060	1,999	1,992	1,954	1,834
55.00	20	200	104	205	160	2,080	2,199	2,096	2,159	1,994
60.00	21	192	100	200	140	2,101	2,391	2,196	2,359	2,134

Table C.3
Stage 1 Recirculating Biofilters Flow Cycle Incremental Volume

Time minutes	Stage 1 Recirculating Biofilters Effluent							
	SA2	EC4	CL2	CL4	SA2	EC4	CL2	CL4
	30 in.	30 in.	15 in.	30 in.	30 in.	30 in.	15 in.	30 in.
	Incremental volume (ml)				Cumulative volume (ml)			
	7/28/10	7/28/10	7/13/10	7/13/10	7/28/10	7/28/10	7/13/10	7/13/10
0.00	-	-	-	-	0	0	0	0
5.00	420	422	1,075	361	420	422	1,075	361
10.00	390	398	3,000	617	810	820	4,075	978
15.00	739	794	1,575	1,512	1,549	1,614	5,650	2,490
20.00	1,320	1,400	955	1,401	2,869	3,014	6,605	3,891
25.00	1,240	1,328	658	1,148	4,109	4,342	7,263	5,039
30.00	1,097	1,150	485	948	5,206	5,492	7,748	5,987
35.00	905	962	378	789	6,111	6,454	8,126	6,776
40.00	780	839	310	667	6,891	7,293	8,436	7,443
45.00	708	708	258	576	7,599	8,001	8,694	8,019
50.00	590	620	230	522	8,189	8,621	8,924	8,541
55.00	525	542	182	428	8,714	9,163	9,106	8,969
60.00	467	490	171	402	9,181	9,653	9,277	9,371

Table C.4
Stage 2 Horizontal Biofilters Flow Cycle Incremental Volume

Time minutes	Stage 2 Horizontal Biofilters Effluent							
	GL1	LS1	SU2	SU1	GL1	LS1	SU2	SU1
	72 in.	72 in.	72 in.	72 in.	72 in.	72 in.	72 in.	72 in.
	Incremental Volume (ml)				Cumulative Volume (ml)			
	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10	7/28/10
0.00	-	-	-	-	0	0	0	0
5.00	235	258	269	280	235	258	269	280
10.00	11	11	5	4	246	269	274	284
15.08	4	2	2	2	250	271	276	286
20.00	4	2	2	2	254	273	278	288
25.00	5	2	2	3	259	275	281	290
30.00	5	1	2	3	264	276	282	293
35.00	5	2	2	2	269	278	284	295
40.08	6	3	2	2	274	281	287	297
45.37	6	3	3	3	280	284	290	300
50.00	5	2	1	2	285	285	291	302
55.00	6	4	3	3	290	290	293	305
60.00	4	1	2	2	295	291	295	307

Appendix D: Laboratory Report

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SOUTHERN ANALYTICAL LABORATORIES, INC.
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July 8, 2010
Project No: 102787

Laboratory Report

Project Name **PNRS II Wastewater System Analyses**

Parameters	Units	Results	Method	Detection Limit	Date/Time Analyzed	Date/Time Prep	Analyst
Sample Description		**GC-STE-T1**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.01**					
Date/Time Collected		**07/01/10 14:00**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	210	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	20	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	22	SM 5210 B	2	07/07/10 13:30	07/02/10 09:30	KTC
Nitrate-Nitrite (as N)	mg/l	0.023 I	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	240	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	35	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	23	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV
Sample Description		**GC-RC1**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.02**					
Date/Time Collected		**07/01/10 14:10**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	160	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	5.7	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	2.8	SM 5210 B	2	07/07/10 13:30	07/02/10 09:30	KTC
Nitrate-Nitrite (as N)	mg/l	12	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	330	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	15	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	5	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV

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July 8, 2010
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Laboratory Report

Project Name **PNRS II Wastewater System Analyses**

Parameters	Units	Results	Method	Detection Limit	Date/Time Analyzed	Date/Time Prep	Analyst
Sample Description		**GC-RC2**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.03**					
Date/Time Collected		**07/01/10 13:45**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	140	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	5.3	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	2 U	SM 5210 B	2	07/07/10 13:30	07/02/10 09:30	KTC
Nitrate-Nitrite (as N)	mg/l	12	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	340	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	15	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	3	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV
Sample Description		**GC-RC3**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.04**					
Date/Time Collected		**07/01/10 12:50**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	200	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	5.5	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	2 U	SM 5210 B	2	07/07/10 13:30	07/02/10 09:30	KTC
Nitrate-Nitrite (as N)	mg/l	11	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	360	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	16	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	6	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV

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July 8, 2010
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Laboratory Report

Project Name **PNRS II Wastewater System Analyses**

Parameters	Units	Results	Method	Detection Limit	Date/Time Analyzed	Date/Time Prep	Analyst
Sample Description		**GC-RC4**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.05**					
Date/Time Collected		**07/01/10 12:40**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	220	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	5.5	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	2.7	SM 5210 B	2	07/07/10 13:30	07/02/10 09:30	KTC
Nitrate-Nitrite (as N)	mg/l	11	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	400	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	16	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	21	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV
Sample Description		**GC-IS1**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.06**					
Date/Time Collected		**07/01/10 14:35**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	130	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	0.045	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	7.8	SM 5210 B	2	07/07/10 13:30	07/02/10 09:30	KTC
Hydrogen Sulfide (Unionized)	mg/l	0.01 U	SM 4500S F	0.01	07/05/10 10:15		KTC
Sulfide	mg/l	0.1 U	SM 4500S F	0.1	07/05/10 10:15		KTC
Nitrate-Nitrite (as N)	mg/l	0.022 I	EPA 353.2	0.01	07/02/10 13:46		SMB
Sulfate	mg/l	1,100	EPA 300.0	0.2	07/06/10 18:16		MEJ
Total Dissolved Solids	mg/l	1,600	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	0.41	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	113	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV

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July 8, 2010
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Laboratory Report

Project Name **PNRS II Wastewater System Analyses**

Parameters	Units	Results	Method	Detection Limit	Date/Time Analyzed	Date/Time Prep	Analyst
Sample Description		**GC-IS2**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.07**					
Date/Time Collected		**07/01/10 14:35**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	210	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	0.11	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	13	SM 5210 B	2	07/07/10 13:30	07/02/10 09:30	KTC
Hydrogen Sulfide (Unionized)	mg/l	0.01 U	SM 4500S F	0.01	07/05/10 10:15		KTC
Sulfide	mg/l	0.1 U	SM 4500S F	0.1	07/05/10 10:15		KTC
Nitrate-Nitrite (as N)	mg/l	0.01 U	EPA 353.2	0.01	07/02/10 13:46		SMB
Sulfate	mg/l	1,800	EPA 300.0	0.2	07/06/10 18:33		MEJ
Total Dissolved Solids	mg/l	3,000	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	0.62	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	108	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV
Sample Description		**GC-EC1**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.08**					
Date/Time Collected		**07/01/10 13:45**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	110	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	0.01 U	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	2 U	SM 5210 B	2	07/07/10 13:30	07/02/10 09:30	KTC
Hydrogen Sulfide (Unionized)	mg/l	0.06	SM 4500S F	0.01	07/05/10 10:15		KTC
Sulfide	mg/l	0.17 I	SM 4500S F	0.1	07/05/10 10:15		KTC
Nitrate-Nitrite (as N)	mg/l	19	EPA 353.2	0.01	07/02/10 13:46		SMB
Sulfate	mg/l	46	EPA 300.0	0.2	07/02/10 19:10		MEJ
Total Dissolved Solids	mg/l	350	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	2.2	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	1 U	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV

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Laboratory Report

Project Name **PNRS II Wastewater System Analyses**

Parameters	Units	Results	Method	Detection Limit	Date/Time Analyzed	Date/Time Prep	Analyst
Sample Description		**GC-SA2**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.09**					
Date/Time Collected		**07/01/10 12:25**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	110	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	0.01 U	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	2 U	SM 5210 B	2	07/07/10 13:30	07/02/10 09:30	KTC
Nitrate-Nitrite (as N)	mg/l	17	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	330	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	2.2	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	1 U	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV
Sample Description		**GC-EC3**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.10**					
Date/Time Collected		**07/01/10 13:40**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	84	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	0.01 U	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	2 U	SM 5210 B	2	07/07/10 13:30	07/02/10 09:30	KTC
Nitrate-Nitrite (as N)	mg/l	19	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	410	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	2.2	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	2	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV

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Parameters	Units	Results	Method	Detection Limit	Date/Time Analyzed	Date/Time Prep	Analyst
Sample Description		**GC-EC4**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.11**					
Date/Time Collected		**07/01/10 11:50**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	160	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	0.01 U	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	2 U	SM 5210 B	2	07/07/10 13:30	07/02/10 10:30	KTC
Nitrate-Nitrite (as N)	mg/l	17	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	350	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	1.9	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	1 U	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV
Sample Description		**GC-CL1**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.12**					
Date/Time Collected		**07/01/10 13:30**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	230	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	0.01 U	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	2 U	SM 5210 B	2	07/07/10 13:30	07/02/10 10:30	KTC
Hydrogen Sulfide (Unionized)	mg/l	0.01 U	SM 4500S F	0.01	07/05/10 10:15		KTC
Sulfide	mg/l	0.1 U	SM 4500S F	0.1	07/05/10 10:15		KTC
Nitrate-Nitrite (as N)	mg/l	18	EPA 353.2	0.01	07/02/10 13:46		SMB
Sulfate	mg/l	37	EPA 300.0	0.2	07/02/10 19:27		MEJ
Total Dissolved Solids	mg/l	470	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	2.7	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	7	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV

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Laboratory Report

Project Name **PNRS II Wastewater System Analyses**

Parameters	Units	Results	Method	Detection Limit	Date/Time Analyzed	Date/Time Prep	Analyst
Sample Description		**GC-CL2**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.13**					
Date/Time Collected		**07/01/10 11:20**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	200	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	0.01 U	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	2 U	SM 5210 B	2	07/07/10 13:30	07/02/10 10:30	KTC
Nitrate-Nitrite (as N)	mg/l	15	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	440	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	2.1	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	3	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV
Sample Description		**GC-CL3**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.14**					
Date/Time Collected		**07/01/10 13:20**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	270	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	0.01 U	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	2 U	SM 5210 B	2	07/07/10 13:30	07/02/10 10:30	KTC
Nitrate-Nitrite (as N)	mg/l	20	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	550	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	2.8	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	1	SM 2540D	1	07/06/10 15:00	07/02/10 09:30	MJV

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110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 fax 813-855-2218

Hazen and Sawyer, PC
10002 Princess Palm Avenue
Suite 200
Tampa, FL 33619-

July 8, 2010
Project No: 102787

Laboratory Report

Project Name **PNRS II Wastewater System Analyses**

Parameters	Units	Results	Method	Detection Limit	Date/Time Analyzed	Date/Time Prep	Analyst
Sample Description		**GC-CL4**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.15**					
Date/Time Collected		**07/01/10 11:15**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	220	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	0.021 I	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	2 U	SM 5210 B	2	07/07/10 13:30	07/02/10 10:30	KTC
Nitrate-Nitrite (as N)	mg/l	7.9	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	480	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	2.4	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	8	SM 2540D	1	07/06/10 15:15	07/02/10 10:30	MJV
Sample Description		**GC-PS1**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.16**					
Date/Time Collected		**07/01/10 13:15**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	160	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	6.4	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	3.0	SM 5210 B	2	07/07/10 13:30	07/02/10 10:30	KTC
Nitrate-Nitrite (as N)	mg/l	9.3	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	270	SM 2540C	10	07/07/10 13:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	16	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	4	SM 2540D	1	07/06/10 15:15	07/02/10 10:30	MJV

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July 8, 2010
Project No: 102787

Laboratory Report

Project Name **PNRS II Wastewater System Analyses**

Parameters	Units	Results	Method	Detection Limit	Date/Time Analyzed	Date/Time Prep	Analyst
Sample Description		**GC-SU1**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.17**					
Date/Time Collected		**07/01/10 14:20**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	200	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	1.5	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	26	SM 5210 B	2	07/07/10 13:30	07/02/10 10:30	KTC
Hydrogen Sulfide (Unionized)	mg/l	11	SM 4500S F	0.01	07/05/10 10:15		KTC
Sulfide	mg/l	29	SM 4500S F	0.1	07/05/10 10:15		KTC
Nitrate-Nitrite (as N)	mg/l	0.01 U	EPA 353.2	0.01	07/02/10 13:46		SMB
Sulfate	mg/l	230	EPA 300.0	0.2	07/02/10 19:44		MEJ
Total Dissolved Solids	mg/l	660	SM 2540C	10	07/07/10 13:00	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	2.4	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	1 U	SM 2540D	1	07/06/10 15:15	07/02/10 10:30	MJV
Sample Description		**GC-SU2**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.18**					
Date/Time Collected		**07/01/10 14:25**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	260	SM 2320B	2	07/02/10 15:00		KTC
Ammonia Nitrogen	mg/l N	0.01 U	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	4.9	SM 5210 B	2	07/07/10 13:30	07/02/10 10:30	KTC
Hydrogen Sulfide (Unionized)	mg/l	0.01 U	SM 4500S F	0.01	07/08/10 13:30		KTC
Sulfide	mg/l	0.1 U	SM 4500S F	0.1	07/08/10 13:30		KTC
Nitrate-Nitrite (as N)	mg/l	5.2	EPA 353.2	0.01	07/02/10 13:46		SMB
Sulfate	mg/l	140	EPA 300.0	0.2	07/02/10 20:01		MEJ
Total Dissolved Solids	mg/l	690	SM 2540C	10	07/07/10 14:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	1.2	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	1 U	SM 2540D	1	07/06/10 15:15	07/02/10 10:30	MJV

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July 8, 2010
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Laboratory Report

Project Name **PNRS II Wastewater System Analyses**

Parameters	Units	Results	Method	Detection Limit	Date/Time Analyzed	Date/Time Prep	Analyst
Sample Description		**GC-SU3**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.19**					
Date/Time Collected		**07/01/10 10:10**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	170	SM 2320B	2	07/05/10 13:30		KTC
Ammonia Nitrogen	mg/l N	0.46	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	13	SM 5210 B	2	07/07/10 13:30	07/02/10 12:30	KTC
Hydrogen Sulfide (Unionized)	mg/l	1.8	SM 4500S F	0.01	07/05/10 10:15		KTC
Sulfide	mg/l	4.7	SM 4500S F	0.1	07/05/10 10:15		KTC
Nitrate-Nitrite (as N)	mg/l	0.01 U	EPA 353.2	0.01	07/02/10 13:46		SMB
Sulfate	mg/l	340	EPA 300.0	0.2	07/02/10 20:18		MEJ
Total Dissolved Solids	mg/l	710	SM 2540C	10	07/07/10 14:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	2.7	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	16	SM 2540D	1	07/06/10 15:15	07/02/10 10:30	MJV
Sample Description		**GC-SU4**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.20**					
Date/Time Collected		**07/01/10 10:40**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	140	SM 2320B	2	07/05/10 13:30		KTC
Ammonia Nitrogen	mg/l N	0.10	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	3.9	SM 5210 B	2	07/07/10 13:30	07/02/10 12:30	KTC
Hydrogen Sulfide (Unionized)	mg/l	0.6	SM 4500S F	0.01	07/05/10 10:15		KTC
Sulfide	mg/l	1.8	SM 4500S F	0.1	07/05/10 10:15		KTC
Nitrate-Nitrite (as N)	mg/l	0.01 U	EPA 353.2	0.01	07/02/10 13:46		SMB
Sulfate	mg/l	260	EPA 300.0	0.2	07/02/10 20:35		MEJ
Total Dissolved Solids	mg/l	560	SM 2540C	10	07/07/10 14:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	0.77	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	1 U	SM 2540D	1	07/06/10 15:15	07/02/10 10:30	MJV

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July 8, 2010
Project No: 102787

Laboratory Report

Project Name **PNRS II Wastewater System Analyses**

Parameters	Units	Results	Method	Detection Limit	Date/Time Analyzed	Date/Time Prep	Analyst
Sample Description		**GC-LS1**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.21**					
Date/Time Collected		**07/01/10 13:05**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	250	SM 2320B	2	07/05/10 13:30		KTC
Ammonia Nitrogen	mg/l N	0.76	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	56	SM 5210 B	2	07/07/10 13:30	07/02/10 12:30	KTC
Nitrate-Nitrite (as N)	mg/l	0.039 I	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	370	SM 2540C	10	07/07/10 14:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	1.5	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	1 U	SM 2540D	1	07/06/10 15:15	07/02/10 10:30	MJV
Sample Description		**GC-LS2**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.22**					
Date/Time Collected		**07/01/10 10:00**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	370	SM 2320B	2	07/05/10 13:30		KTC
Ammonia Nitrogen	mg/l N	0.23	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	5.5	SM 5210 B	2	07/07/10 13:30	07/02/10 12:30	KTC
Nitrate-Nitrite (as N)	mg/l	1.4	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	510	SM 2540C	10	07/07/10 14:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	1.4	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	9	SM 2540D	1	07/06/10 15:15	07/02/10 10:30	MJV

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July 8, 2010
Project No: 102787

Laboratory Report

Project Name **PNRS II Wastewater System Analyses**

Parameters	Units	Results	Method	Detection Limit	Date/Time Analyzed	Date/Time Prep	Analyst
Sample Description		**GC-LS3**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.23**					
Date/Time Collected		**07/01/10 10:30**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	200	SM 2320B	2	07/05/10 13:30		KTC
Ammonia Nitrogen	mg/l N	0.95	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	12	SM 5210 B	2	07/07/10 13:30	07/02/10 12:30	KTC
Nitrate-Nitrite (as N)	mg/l	0.01 U	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	370	SM 2540C	10	07/07/10 14:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	2.0	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	2	SM 2540D	1	07/06/10 15:15	07/02/10 10:30	MJV
Sample Description		**GC-LS4**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.24**					
Date/Time Collected		**07/01/10 09:45**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	180	SM 2320B	2	07/05/10 13:30		KTC
Ammonia Nitrogen	mg/l N	5.8	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	9.1	SM 5210 B	2	07/07/10 13:30	07/02/10 12:30	KTC
Nitrate-Nitrite (as N)	mg/l	0.01 U	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	270	SM 2540C	10	07/07/10 14:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	14	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	1	SM 2540D	1	07/06/10 15:15	07/02/10 10:30	MJV

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July 8, 2010
Project No: 102787

Laboratory Report

Project Name **PNRS II Wastewater System Analyses**

Parameters	Units	Results	Method	Detection Limit	Date/Time Analyzed	Date/Time Prep	Analyst
Sample Description		**GC-GL1**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.25**					
Date/Time Collected		**07/01/10 12:08**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	220	SM 2320B	2	07/05/10 13:30		KTC
Ammonia Nitrogen	mg/l N	0.96	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	39	SM 5210 B	2	07/07/10 13:30	07/02/10 12:30	KTC
Nitrate-Nitrite (as N)	mg/l	4.7	EPA 353.2	0.01	07/02/10 13:46		SMB
Total Dissolved Solids	mg/l	380	SM 2540C	10	07/07/10 14:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	1.9	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	1 U	SM 2540D	1	07/06/10 15:15	07/02/10 10:30	MJV
Sample Description		**GC-DFT**					
Matrix		**Wastewater**					
SAL Sample Number		**102787.26**					
Date/Time Collected		**07/01/10 12:15**					
Date/Time Received		**07/01/10 16:00**					
Inorganics							
Total Alkalinity as CaCO3	mg/l	160	SM 2320B	2	07/05/10 13:30		KTC
Ammonia Nitrogen	mg/l N	0.01 U	EPA 350.1	0.01	07/02/10 09:00		SMB
Carbonaceous BOD	mg/l	2 U	SM 5210 B	2	07/07/10 13:30	07/02/10 12:30	KTC
Hydrogen Sulfide (Unionized)	mg/l	0.01 U	SM 4500S F	0.01	07/05/10 10:15		KTC
Sulfide	mg/l	0.1 U	SM 4500S F	0.1	07/05/10 10:15		KTC
Nitrate-Nitrite (as N)	mg/l	18	EPA 353.2	0.01	07/02/10 13:46		SMB
Sulfate	mg/l	46	EPA 300.0	0.2	07/02/10 20:52		MEJ
Total Dissolved Solids	mg/l	390	SM 2540C	10	07/07/10 14:30	07/02/10 12:00	MJV
Total Kjeldahl Nitrogen	mg/l N	3.2	EPA 351.2	0.05	07/06/10 09:30	07/02/10 08:25	MEJ
Total Suspended Solids	mg/l	1 U	SM 2540D	1	07/06/10 15:15	07/02/10 10:30	MJV

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July 8, 2010
Project No: 102787

Laboratory Report

Project Name **PNRS II Wastewater System Analyses**

Footnotes

#	Questions regarding this report should be directed to Client Services at 813-855-1844.
*	Test results presented in this report meet all the requirements of the NELAC standards. Test results within this report relate only to these samples.
**	A statement of estimated uncertainty of test results is available upon request.
***	For methods marked with ***, all QC criteria have been met for this method which is equivalent to a SAL certified method.
I	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U	Analyte was undetected. Indicated concentration is method detection limit.

SOUTHERN ANALYTICAL LABORATORIES, INC.

110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 fax 813-855-2218

SAL Project No. 102787

Client Name	Contact / Phone:
Hazan and Sawyer	Josephin Edeback-Hirst 813-630-4498
Project Name / Location	jedeback@hazanandsawyer.com
PNRS II Wastewater System Analyses	
Samplers: (Signature)	

Matrix Codes: DW-Drinking Water WW-Wastewater SW-SurfaceWater SL-Sludge SO-Soil GW-Groundwater SA-Saline Water O-Other R-Reagent Water

SAL Use Only Sample No.	Sample Description	Date	Time	Matrix	Composite	Grab	1LP, Cool Alkalinity, CBOD, TSS, TDS	1LP, Cool Alkalinity, CBOD, TSS, TDS, SO4	1LP, Zn Acetate/NaOH Hydrogen Sulfide	250 ml P, H_2SO_4 TKN, NH_3, NOx	Field pH	Field Temp	Field Cond		No. of Containers (Total per each location)
							PARAMETER / CONTAINER DESCRIPTION								
01	GC-STE-T1	7/1/10	2:00pm	WW		X	1			1	6.91	31.3	649		2
02	GC-RC1	7/1/10	2:10pm	WW		X	1			1	7.28	30.8	637		2
03	GC-RC2	7/1/10	1:45pm	WW		X	1			1	7.27	30.5	679		2
04	GC-RC3	7/1/10	12:50pm	WW		X	1			1	7.61	29.2	760		2
05	GC-RC4	7/1/10	12:40pm	WW		X	1			1	7.61	28.8	811		2
06	GC-IS1	7/1/10	2:35pm	WW		X		1	1	1	6.39	30.1	2438		3
07	GC-IS2	7/1/10	2:35pm	WW		X		1	1	1	6.14	30.8	3506		3
08	GC-EC1	7/1/10	1:45pm	WW		X		1	1	1	7.25	29.5	617		3
09	GC-SA2	7/1/10	12:25pm	WW		X	1			1	6.04	27.7	604		2
10	GC-EC3	7/1/10	1:40pm	WW		X	1			1	7.34	28.8	712		2
11	GC-EC4	7/1/10	11:50am	WW		X	1			1	7.28	28.2	661		2
12	GC-CL1	7/1/10	1:30pm	WW		X		1	1	1	8.3	30.0	857		3

Containers Prepared/ Relinquished:	Date/Time: 1300 06-29-10	Received: Josephin Hirst	Date/Time: 6/30 8:45am
Relinquished: Josephin Hirst	Date/Time: 7/1/10 2:45pm	Received: Noel Dumit	Date/Time: 7/1/10 2:45
Relinquished: x Noel Dumit	Date/Time: 1600 7-1-10	Received: K Mudmark	Date/Time: 1600 7-1-10
Relinquished:	Date/Time:	Received:	Date/Time:
Relinquished:	Date/Time:	Received:	Date/Time:

Seal intact?	Y N N/A	**Instructions / Remarks**
Samples intact upon arrival?	Y N N/A	
Received on ice? Temp 4°	Y N N/A	7-2-10
Proper preservatives indicated?	Y N N/A	
Rec'd within holding time?	Y N N/A	
Volatiles rec'd w/out headspace	Y N N/A	
Proper containers used?	Y N N/A	

Chain of Custody.xls
Rev.Date 11/19/01

Chain of Custody

SOUTHERN ANALYTICAL LABORATORIES, INC.

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SAL Project No. 102787

Client Name	Contact / Phone:
Hazan and Sawyer	Josephin Edeback-Hirst 813-630-4498
Project Name / Location	jedeback@hazanandsawyer.com
PNRS II Wastewater System Analyses	
Samplers: (Signature)	

Matrix Codes: DW-Drinking Water WW-Wastewater SW-SurfaceWater SL-Sludge SO-Soil GW-Groundwater SA-Saline Water O-Other R-Reagent Water

SAL Use Only Sample No.	Sample Description	Date	Time	Matrix	Composite	Grab	PARAMETER / CONTAINER DESCRIPTION: 1LP, Cool Alkalinity, CBOD, TSS, TDS	1LP, Cool Alkalinity, CBOD, TSS, TDS, SO4	1LP, Zn Acetate/NaOH Hydrogen Sulfide	250 ml P, H_2SO_4 TKN, NH_3, NOx	Field pH	Field Temp (°C)	Field Cond (mS)		No. of Containers (Total per each location)
13	GC-CL2	7/1/10	11:20am	WW		X	1			1	7.85	28.1	781		2
14	GC-CL3	7/1/10	1:20pm	WW		X	1			1	8.64	28.7	974		2
15	GC-CL4	7/1/10	11:15am	WW		X	1			1	6.72	27.9	860		2
16	GC-PS1	7/1/10	1:15pm	WW		X	1			1	7.28	28.8	599		2
17	GC-SU1	7/1/10	2:30pm	WW		X		1	1	1	7.15	31.8	1192		3
18	GC-SU2	7/1/10	2:25pm	WW		X		1	1	1	9.08	31.4	1398		3
19	GC-SU3	7/1/10	10:10am	WW		X		1	1	1	7.17	27.0	1257		3
20	GC-SU4	7/1/10	10:40am	WW		X		1	1	1	7.30	27.1	929		3
21	GC-LS1	7/1/10	1:05pm	WW		X	1			1	7.51	31.3	738		2
22	GC-LS2	7/1/10	10:00am	WW		X	1			1	8.14	27.1	9.14		2
23	GC-LS3 7.70pH; 695uS; 27.4°C	7/1/10	10:30am	WW		X	1			1	~~8.05~~	~~27.5~~	~~829~~		2
24	GC-LS4 7.62pH; 618uS; 27.3°C	7/1/10	9:45am	WW		X	1			1	~~7.78~~ 7.62	~~27.7~~ 27.6	~~618~~ 582		2

Containers Prepared/ Relinquished:	Date/Time:	Received:	Date/Time:
	1300 06/29/10	Josephin Hirst	6/30 8:45am
Relinquished: Josephin Hirst	Date/Time: 7/1/10 2:45pm	Received: Noel Quant	Date/Time: 7/1/10 2:45
Relinquished: Noel Quant	Date/Time: 1600 7-1-10	Received: K Mudmuch	Date/Time: 1600 7-1-10
Relinquished:	Date/Time:	Received:	Date/Time:
Relinquished:	Date/Time:	Received:	Date/Time:

Seal intact?	Y N N/A
Samples intact upon arrival?	Y N N/A
Received on ice? Temp____	Y N N/A
Proper preservatives indicated?	Y N N/A
Rec'd within holding time?	Y N N/A
Volatiles rec'd w/out headspace	Y N N/A
Proper containers used?	Y N N/A

Instructions / Remarks

Chain of Custody

SOUTHERN ANALYTICAL LABORATORIES, INC.
110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 fax 813-855-2218

SAL Project No. 102787

Client Name	Contact / Phone:
Hazan and Sawyer	Josephin Edeback-Hirst 813-630-4498
Project Name / Location	jedeback@hazanandsawyer.com
PNRS II Wastewater System Analyses	
Samplers: (Signature)	

Matrix Codes: DW-Drinking Water WW-Wastewater SW-SurfaceWater SL-Sludge SO-Soil GW-Groundwater SA-Saline Water O-Other R-Reagent Water

SAL Use Only Sample No.	Sample Description	Date	Time	Matrix	Composite	Grab	PARAMETER / CONTAINER DESCRIPTION: 1LP, Cool Alkalinity, CBOD, TSS, TDS	1LP, Cool Alkalinity, CBOD, TSS, TDS, SO4	1LP, Zn Acetate/NaOH Hydrogen Sulfide	250 ml P, H_2SO_4 TKN, NH_3, NOx	Field pH	Field Temp	Field Cond		No. of Containers (Total per each location)
25	GC-GL1	7/1/10	12:08pm	WW		X	1			1	7.96	30.1	794		2
26	GC-DFT	7/1/10	12:15pm	WW		X		1	1	1	8.06	29.9	744		3

Containers Prepared/ Relinquished:	Date/Time: 1300 06-29-10	Received: Josephin Hirst	Date/Time: 6/30 8:45 am
Relinquished: Josephin Hirst	Date/Time: 7/1 2:45pm	Received: Noel Hunt	Date/Time: 7/1/10 2:45
Relinquished: Noel Hunt	Date/Time: 1600 7-1-10	Received: K Mudmark	Date/Time: 1600 7-1-10
Relinquished:	Date/Time:	Received:	Date/Time:
Relinquished:	Date/Time:	Received:	Date/Time:

Seal intact? Y N N/A
Samples intact upon arrival? Y N N/A
Received on ice? Temp_____ Y N N/A
Proper preservatives indicated? Y N N/A
Rec'd within holding time? Y N N/A
Volatiles rec'd w/out headspace Y N N/A
Proper containers used? Y N N/A

Instructions / Remarks

Chain of Custody.xls
Rev.Date 11/19/01

Chain of Custody