Florida Onsite Sewage Nitrogen Reduction Strategies Study

Task B.7

B-HS5 Field System Monitoring Report No. 7

Progress Report

November 2014

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In association with:

AET

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Florida Onsite Sewage Nitrogen Reduction Strategies Study

TASK B.7
PROGRESS REPORT

B-HS5 Field System Monitoring Report No. 7

Prepared for:

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Division of Disease Control and Health Protection
Bureau of Environmental Health
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1.0 Background

Task B of the Florida Onsite Sewage Nitrogen Reduction Strategies Study (FOSNRS) includes performing field experiments to critically evaluate the performance of nitrogen removal technologies that were identified in FOSNRS Task A.9 and pilot tested in Task A.26. To meet this objective, full scale treatment systems are being installed at various residential sites in Florida and monitored over an extended timeframe under actual onsite conditions. The Task B Quality Assurance Project Plan (Task B.5) documents the objectives, monitoring framework, sample frequency and duration, and analytical methods to be used at the home sites. This report documents the seventh sample event of the passive nitrogen reduction system at home site B-HS5 in Seminole County, Florida.

2.0 Purpose

Operation of the B-HS5 system was initiated on July 9, 2013. This monitoring report documents data collected from the seventh B-HS5 monitoring and sampling event conducted on October 21, 2014 (Experimental Day 469). This monitoring event consisted of collecting flow measurements from the household water use meter, treatment system flow meters, recording electricity use, monitoring of field parameters, collection of water samples from four points in the treatment system, and chemical analyses of water samples by a NELAC certified laboratory.

3.0 Materials and Methods

3.1 Project Site

The B-HS5 field site is located in Seminole County, FL. The nitrogen reducing onsite treatment system for the single family residence was installed in June 2013. Design and construction details were presented previously in the Task B.6 document. Figure 1 is a system schematic showing the system components and layout of the installation. A flow schematic of the system is shown in Figure 2. The passive nitrogen reduction system (PNRS) consists of three process tanks that were added to the existing permitted

onsite system: a 1500 gallon plastic tank housing a Stage 1 unsaturated media filter; a 300 gallon concrete pump tank; and a 1,500 gallon two chamber concrete tank housing a Stage 2 saturated media biofilter. The existing 1,350 gallon concrete septic tank continues to provide primary treatment prior to the PNRS system. Based on measured average wastewater flow and tank volumes, there is over a ten day transit time through the treatment system prior to dispersal. The denitrified treated effluent is discharged into the soil via the existing drainfield which is a standard bed.

3.2 PNRS System Modification

The PNRS system was designed with two operational modes for Stage 1: single pass and recirculation. The Stage 1 biofilter was operated in single pass mode since system startup, but was switched to recirculation mode on April 25, 2014. In recirculation mode the pump tank discharge is split via two throttling gate valves to provide for recycling of a portion of the Stage 1 biofilter effluent to Stage 1 influent, with the balance of Stage 1 effluent proceeding to the Stage 2 biofilter.

The first single pass mode was initially tested, 100 percent of the Stage 1 effluent was discharged to the Stage 2 biofilter. Following the fourth sample event, the recirculation mode was initiated. In recirculation mode, a portion (3:1 target ratio) of the Stage 1 effluent was recirculated to the top of the Stage 1 biofilter and dispersed via five spray nozzles. The recirculated, nitrified effluent would have an opportunity to mix with incoming septic tank effluent discharged by the distribution box. In recirculation mode, the Stage 1 biofilter received both forward wastewater flow and recirculated Stage 1 effluent, and overall hydraulic loading on the Stage 1 biofilter is increased.

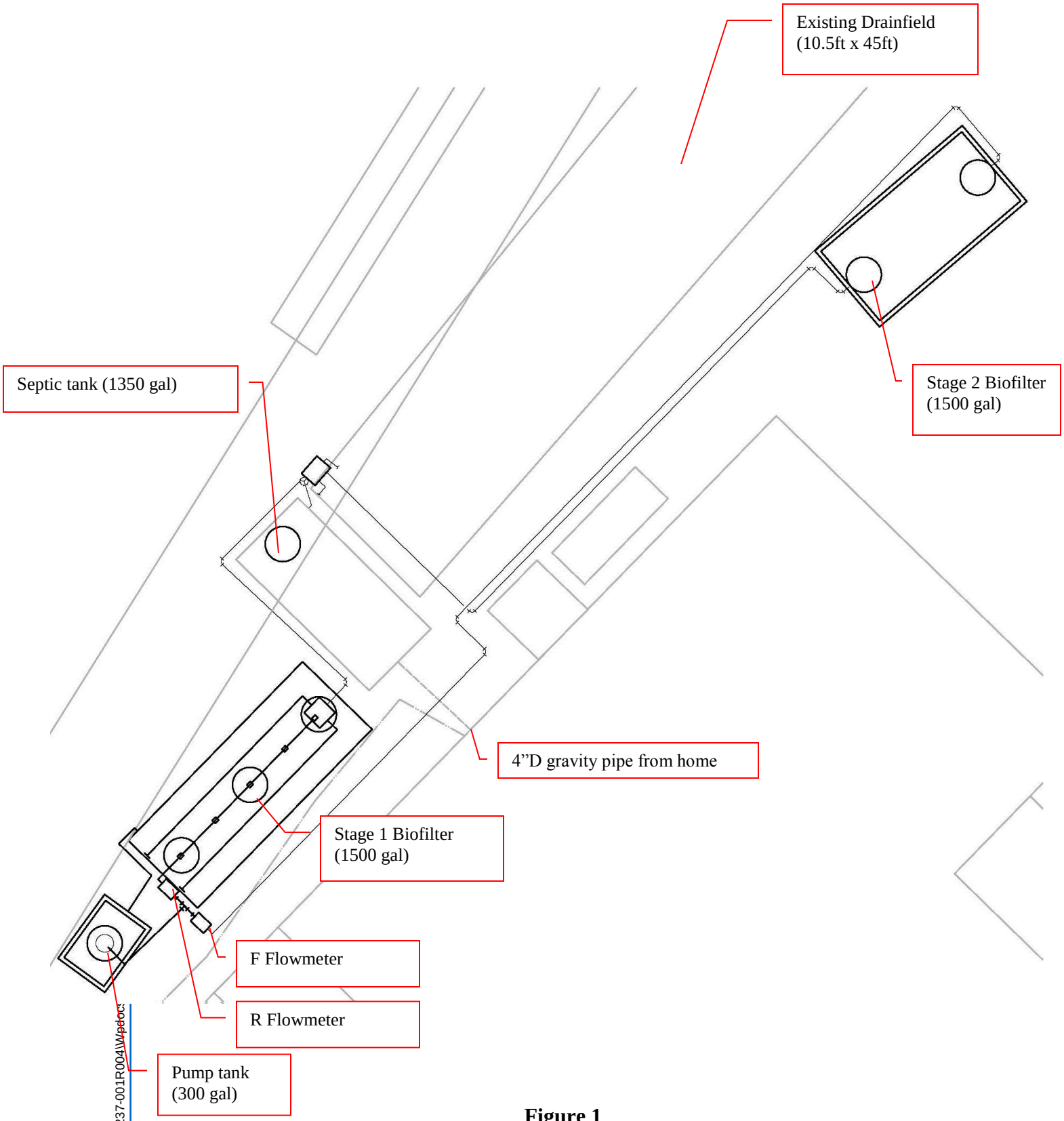

Figure 1
Plan View of B-HS5 System Layout

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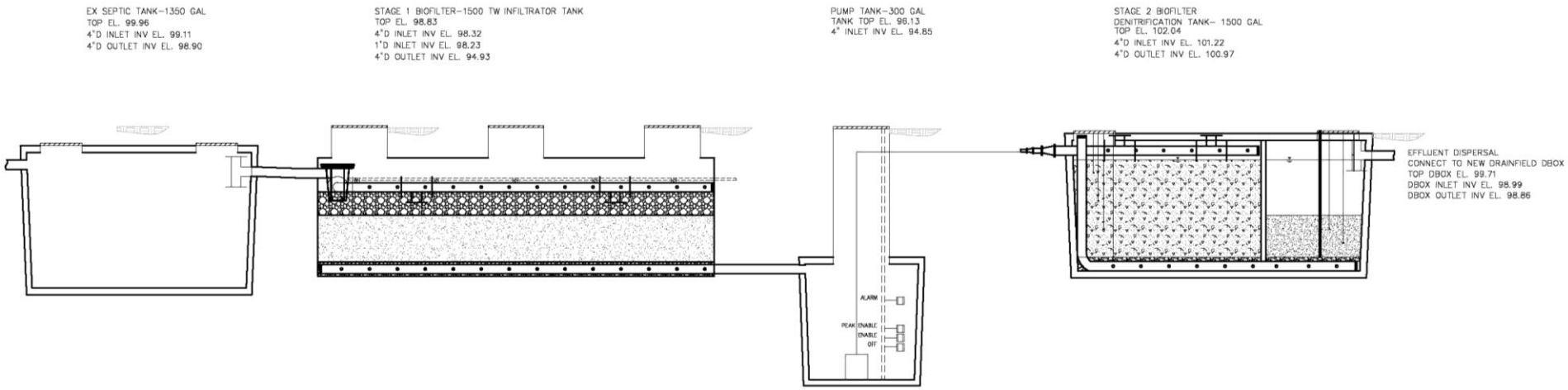

Figure 2
Flow Schematic of B-HS5 PNRS

3.3 Monitoring and Sample Locations and Identification

This monitoring event included sample collection from four points within the treatment system (Figure 3). Household wastewater enters the primary tank and exits as septic tank effluent (STE) through an effluent filter screen into the Stage 1 biofilter. The first monitoring point, B-HS5-STE, is the STE sampled approximately 1.5 feet below the surface of the primary tank prior to the effluent filter (Figure 4). Samples from monitoring point B-HS5-STE are representative of the whole household wastewater and represent the influent to the passive nitrogen reduction system.

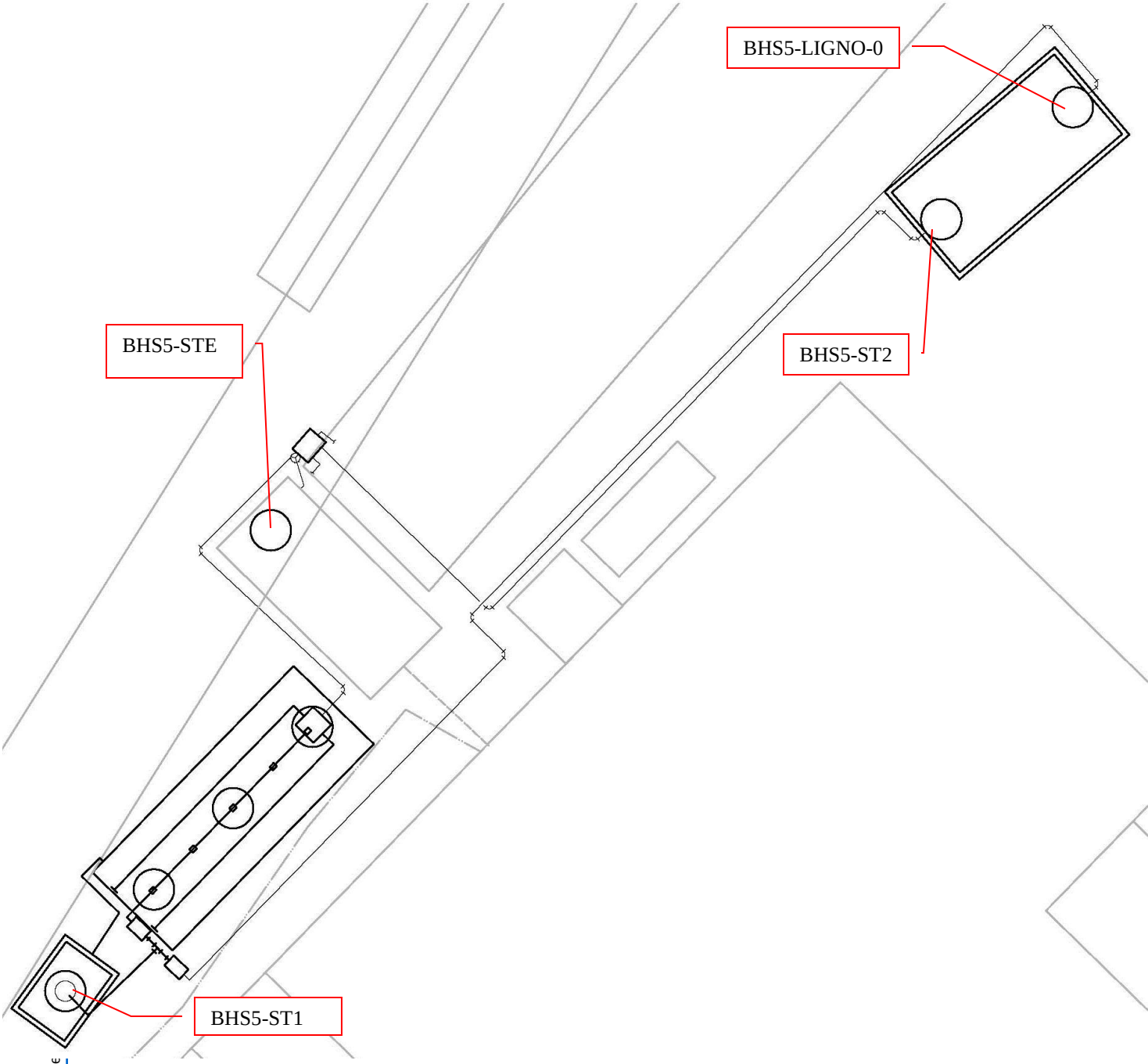

Figure 3
B-HS5 Sample and Monitoring Locations

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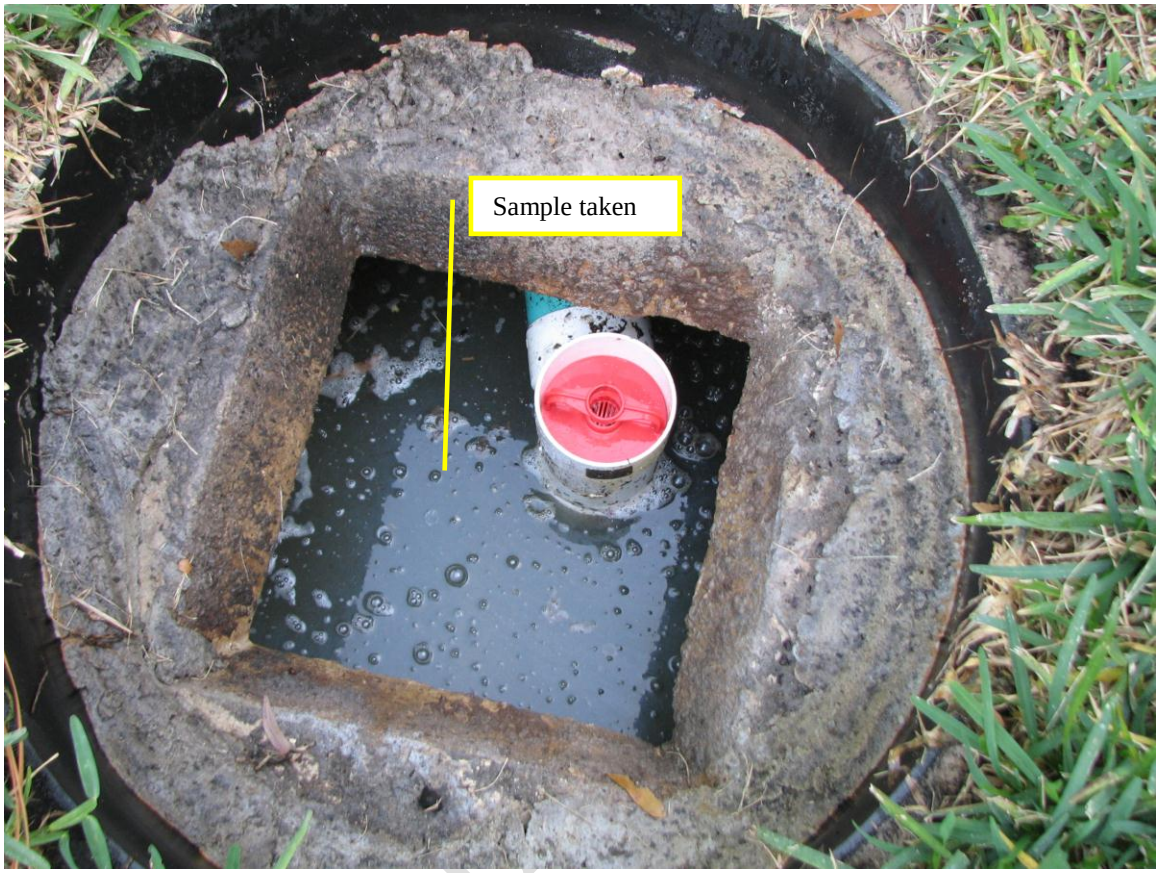


Figure 4
Primary Tank (B-HS5-STE sample)

The primary tank contents are discharged by gravity to a distribution box, located inside the Stage 1 biofilter, which splits the flow between three perforated distribution pipes that run along the top of the unsaturated Stage 1 biofilter media. In the Stage 1 biofilter, wastewater percolates downward through the unsaturated expanded clay media where nitrification occurs. The Stage 1 biofilter contains 12.8 inches of coarse expanded clay media (Riverlite™ 1/4; 1.1 to 4.8 mm) above 21 inches of finer expanded clay media (Riverlite™ 3/16; 0.6 to 2.4 mm). Stage 1 biofilter effluent flows into the pump tank by gravity. The second sampling point (B-HS5-ST1), is sampled approximately 1.5 feet below the surface of the pump tank representing the Stage 1 biofilter effluent (Figure 5).

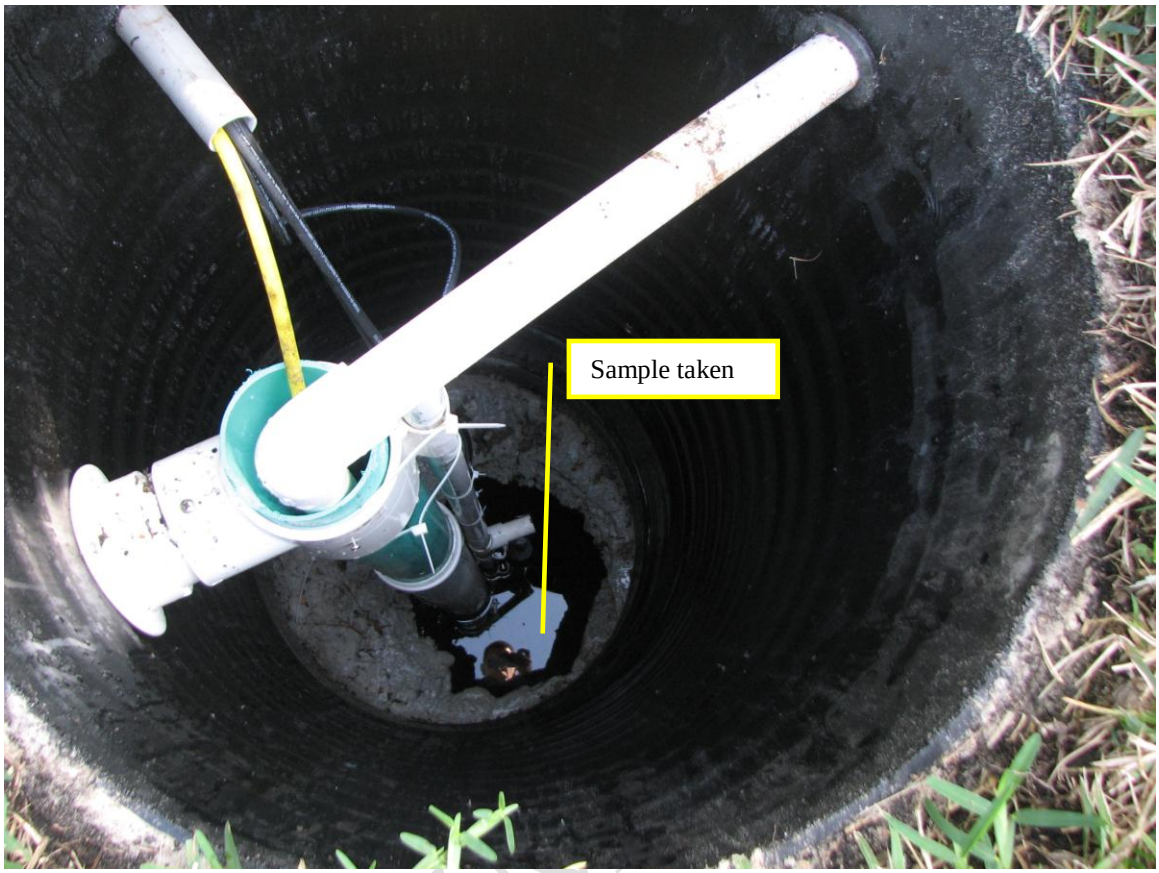


Figure 5
Stage 1 Effluent in Pump Tank (B-HS5-ST1 sample)

The pump tank discharge is split via two throttling gate valves which allow for optional recycling of a portion of the Stage 1 biofilter effluent with the balance proceeding to the Stage 2 biofilter. The system was designed with two operational modes. In the first mode, 100 percent of the Stage 1 effluent is discharged to the Stage 2 biofilter. Initial operation of B-HS5 was in the non-recirculation mode, which was in effect from system start-up through Experimental Day 290. The system was then switched to the second operating mode in which a portion of Stage 1 effluent is recirculated to the top of the Stage 1 biofilter and dispersed via five spray nozzles. The recirculated, nitrified effluent has an opportunity to mix with incoming septic tank effluent discharged by the distribution box. Recirculation back to the Stage 1 biofilter increases the overall hydraulic loading on the Stage 1 biofilter.

Effluent from the unsaturated (Stage 1) media tank enters the denitrification (Stage 2) biofilter at the top of the media in the first chamber (lignocellulosic media), flows downward through the media, moves laterally through the baffle wall to the bottom of the

second chamber, and upward through the media in the second chamber (elemental sulfur and oyster shell).

The first chamber of the Stage 2 biofilter contains 42-inches of lignocellulosic media as a supplemental carbon source for denitrification, a blended urban waste wood from Mother's Organics, Inc., Thonotosassa, FL. Stainless steel samplers are positioned at 12-inch increments for vertical profiling throughout the lignocellulosic media. The third primary sampling point is a stainless steel sampler positioned at the bottom of the lignocellulosic media (B-HS5-LIGNO-0) with tubing to the surface. The B-HS5-LIGNO-0 sample represents the lignocellulosic media effluent (Figure 6).

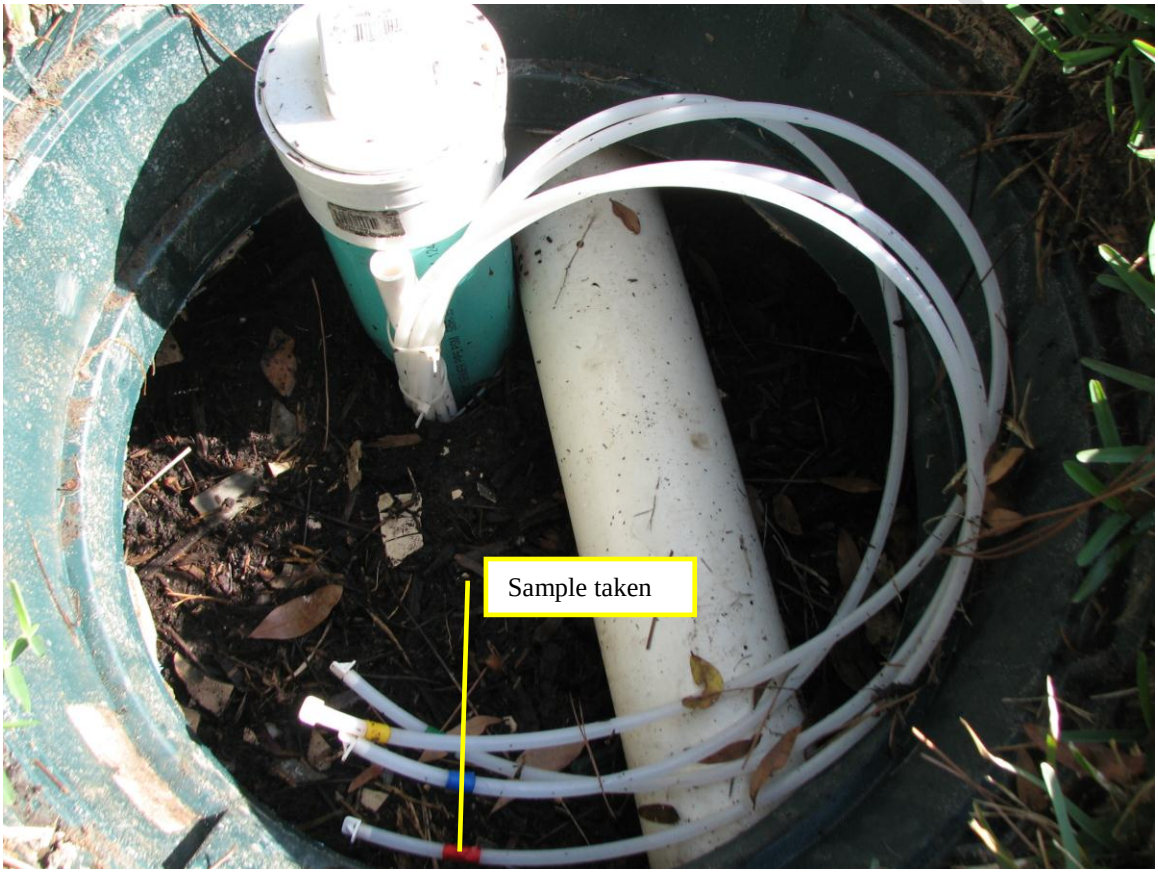


Figure 6
First chamber of Stage 2 biofilter (B-HS5-LIGNO-0" sample)

A collection pipe along the bottom transfers the first chamber (lignocellulosic media) effluent to the second chamber, which contains 18-inches of elemental sulfur mixed with

oyster shell media. The fourth primary sampling point, B-HS5-ST2, is the second chamber of the Stage 2 biofilter effluent which is sampled approximately 1 foot below the surface of the effluent baffle tee. This sample location is after passage through the sulfur media; it is the final effluent from the treatment system prior to being discharged to the soil infiltration system, or drainfield (Figure 7).

Figure 7
Second chamber of Stage 2 biofilter (B-HS5-ST2 sample)

3.4 Operational Monitoring

Start-up of the system occurred on July 9, 2013 (Experimental Day 0). The PNRS system has operated continually since that date. For this seventh formal sampling event, the water meter for the house and treatment system flow meters were read and recorded on October 21, 2014. The household water meter is located on the potable water line from the onsite well prior to entering the household plumbing. The water meter does not include the irrigation water use. Therefore, the water meter reading should be indicative of the wastewater flow to the system.

As previously discussed in Section 3.2, the pump tank discharge is split via two throttling gate valves which allow for a portion of the Stage 1 biofilter effluent to be sent back to the Stage 1 biofilter spray nozzles (for recirculation) with the rest proceeding to the Stage 2 biofilter. The treatment system flow meters (Figure 1) are located on the pump tank discharge lines following the flow split, and record the cumulative flow in gallons pumped from the pump chamber to the Stage 1 biofilter (R flowmeter) and Stage 2 biofilter (F flowmeter).

3.5 Energy Consumption

Energy consumption was monitored using an electrical meter installed between the main power box for the house and the control panel. The electrical meter records the cumulative power usage of the system in kilowatt-hours. The power usage of the system is primarily due to the single lift station pump installed within the pump tank, although a small amount of power is used by the control panel itself. There are no chemicals added to the system. However, the Stage 2 biofilter media (lignocellulosic and sulfur) are “reactive” media which will be consumed during operation. The Stage 2 biofilter was initially filled with 42 inches of lignocellulosic media and 18 inches of sulfur and oyster shell mixture media, which ostensibly will last for many years without replenishment or replacement.

3.6 Water Quality Sample Collection and Analyses

The seventh formal sample event was conducted on October 21, 2014 (Experimental Day 469). A full suite of influent, intermediate and effluent water quality samples were collected from the system for water quality analysis. Samples were collected at each of the four monitoring points described in Section 3.3: B-HS5-STE, B-HS5-ST1, B-HS5-LIGNO-0, and B-HS5-ST2. A peristaltic pump was used to collect samples and route them directly into analysis-specific containers after sufficient flushing of the tubing had occurred. Field parameters were then recorded.

Immediately subsequent to the regular samples for each primary monitoring point, additional sample was collected to be filtered at the laboratory (0.45 micron filter) for analysis of $CBOD_5$ and the nitrogen species to allow for comparison to the unfiltered sample water quality results. In addition, a field sample duplicate was taken. The field sample duplicate (B-HS5-ST1) was collected immediately subsequent to the regular samples.

The analysis-specific containers were supplied by the analytical laboratory and contained appropriate preservatives. The analysis-specific containers were labeled, placed in coolers and transported on ice to the analytical laboratories. 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. Chain of custody forms, provided in Appendix A, were used to document the transfer of samples from field personnel to the analytical laboratory.

Field parameters were measured using portable electronic probes and included temperature (Temp), dissolved oxygen (DO), oxidation-reduction potential (ORP), pH, and specific conductance. The field parameters were measured by placing the analytical probes in a container overflowing with sample water. The influent, intermediate, and effluent samples were analyzed by the laboratory for: total alkalinity, chemical oxygen demand (COD), total Kjeldahl nitrogen (TKN), ammonia nitrogen (NH_3-N), nitrate nitrogen (NO_3-N), nitrite nitrogen (NO_2-N), total phosphorus (TP), orthophosphate (Ortho P), total suspended solids (TSS), volatile suspended solids (VSS), total organic carbon (TOC), fecal coliform (fecal), and E.coli. The influent and sulfur media samples included sulfate, sulfide, and hydrogen sulfide (unionized). All analyses were performed by an independent and fully NELAC certified analytical laboratory (Southern Analytical Laboratory). Table 1 lists the analytical parameters, analytical methods, and detection limits for laboratory analyses.

Table 1
Analytical Parameters, Method of Analysis, and Detection Limits

Analytical Parameter	Method of Analysis	Method Detection Limit (mg/L)
Total Alkalinity as $CaCO_3$	SM 2320B	2 mg/L
Chemical Oxygen Demand (COD)	EPA 410.4	10 mg/L
Total Kjeldahl Nitrogen (TKN-N)	EPA 351.2	0.05 mg/L
Ammonia Nitrogen (NH_3-N)	EPA 350.1	0.005 mg/L
Nitrate Nitrogen (NO_3-N)	EPA 300.0	0.01 mg/L
Nitrite Nitrogen (NO_2-N)	EPA 300.0	0.01 mg/L
Nitrate+Nitrite Nitrogen (NOX-N)	EPA 300.0	0.02 mg/L
Total Phosphorus (TP)	SM 4500P-E	0.01 mg/L
Orthophosphate as P (Ortho P)	EPA 300.0	0.01 mg/L
Carbonaceous Biological Oxygen Demand ($CBOD_5$)	SM5210B	2 mg/L
Total Suspended Solids (TSS)	SM 2540D	1 mg/L
Volatile Suspended Solids (VSS)	EPA 160.4	1 mg/L
Total Organic Carbon (TOC)	SM5310B	0.06 mg/L
Sulfate	EPA 300.0	2.0 mg/L
Sulfide	SM 4500SF	0.10 mg/L
Hydrogen Sulfide (unionized)	SM 4550SF	0.01 mg/L
Fecal Coliform (fecal)	SM9222D	1 ct/100mL
E.coli	SM9223B	2 ct/100mL

4.0 Results and Discussion

4.1 Operational Monitoring

Table 2 provides a summary of the household water use since the water meter installation on February 12, 2013. The treatment system flow meter readings for the B-HS5 field site are summarized in Table 3. The operation and maintenance log which includes actions taken since start-up is provided in Appendix B. Summary tables of the Vericomm PLC recorded data are provided in Appendix C, Table C.1 and Table C.2. These include daily and cumulative pump runtime and system alarms that are used to check general pump operation and performance. From PNRS start-up through October 21, 2014, the average household water use was 130.9 gallons per day with periods of higher and lower flows (Table 2).

Table 2
Summary of Household Water Use Flowmeter

Date and Time Read	Cumulative Volume (gallons)	Average Daily Household Flow between readings, Q (gpd)	Average Daily Household Flow Since start-up, Q (gpd)
2/12/2013 10:30	166.0	INSTALLED	INSTALLED
2/21/2013 10:45	1,130.3	107.0	107.0
2/28/2013 11:45	2,323.9	169.5	134.4
3/7/2013 10:25	2,832.1	73.2	115.9
6/14/2013 13:00	13,460.9	107.2	108.9
6/25/2013 8:53	14,860.1	129.2	110.5
7/9/2013 15:20	PNRS start-up		
7/23/2013 8:31	17,659.4	100.0	
7/29/2013 11:10	18,769.2	181.6	181.6
8/15/2013 12:28	21,078.4	135.4	147.6
8/27/2013 9:15	22,427.8	113.7	136.1
9/27/2013 10:40	25,738.3	106.6	122.2
11/8/2013 10:30	31,992.8	148.9	132.6
11/27/2013 11:12	34,400.8	126.5	131.7
12/4/2013 14:34	35,292.8	124.9	131.3
12/23/2013 12:38	37,649.1	124.5	130.5
1/23/2014 10:00	42,526.6	157.9	135.1
1/31/2014 13:00	43,688.6	143.0	135.4
2/3/2014 8:40	43,688.6	0.0	133.5
2/4/2014 11:45	43,841.1	135.1	133.5
2/5/2014 9:45	43,928.5	95.3	133.3
2/6/2014 8:20	44,029.1	106.9	133.2
2/7/2014 10:30	44,175.2	134.0	133.2
2/12/2014 11:00	44,987.4	161.8	133.9
3/14/2014 9:50	48,684.9	123.5	132.6
4/11/2014 9:00	52,272.6	128.3	132.1
4/25/2014 10:05	54,087.0	128.9	131.9
4/29/2014 11:45	54,618.0	131.5	131.9
5/28/2014 10:00	59,552.4	170.6	135.5
6/11/2014 9:45	65,290.1	410.1	147.4
8/18/2014 11:00	69,750.1	65.5	133.2
9/19/2014 9:00	73,358.2	113.0	131.7
10/21/2014 12:21	77,223.0	120.3	130.9

Table 3
Summary of Treatment System Flowmeters

Date	Recirculation Pumped Flow, R Water Meter Reading	Recirculation Pumped Flow, R Water Meter Reading	Average Recirc Ratio	Stage 2 Biofilter Pumped Flow, Q Water Meter Reading	Average Daily Stage 2, Q between readings
	Cumulative Volume (gal)	Gallons/Day	R:Q	Cumulative Volume (gal)	Gallons/Day
7/5/2013 12:00	286.1	0.0	0.0		Installed
7/9/2013 15:20	286.1	0.0	0.0	167.5	Start-up
7/12/2013 14:13	286.1	0.0	0.0	207.4	13.5
7/17/2013 9:02	286.1	0.0	0.0	995.6	164.8
7/23/2013 8:31	286.1	0.0	0.0	1,642.9	108.3
7/29/2013 11:10	286.1	0.0	0.0	2,733.4	178.5
8/6/2013 8:51	286.1	0.0	0.0	3,894.7	146.9
8/15/2013 11:40	286.1	0.0	0.0	4,884.6	108.6
8/27/2013 9:15	286.1	0.0	0.0	6,135.4	105.1
9/27/2013 10:40	286.1	0.0	0.0	9,035.2	93.4
11/8/2013 10:30	286.1	0.0	0.0	14,347.7	126.5
11/27/2013 10:55	286.1	0.0	0.0	16,591.6	118.0
12/4/2013 13:45	286.1	0.0	0.0	17,474.0	124.0
12/23/2013 12:38	286.1	0.0	0.0	19,610.1	112.7
1/23/2014 10:00	286.1	0.0	0.0	24,359.1	153.7
1/31/2014 13:00	286.1	0.0	0.0	25,506.3	141.2
2/3/2014 8:40	286.1	0.0	0.0	25,551.0	15.9
2/4/2014 11:45	286.1	0.0	0.0	25,659.1	95.7
2/5/2014 9:45	286.1	0.0	0.0	25,737.2	85.3
2/6/2014 8:20	286.1	0.0	0.0	25,836.3	105.3
2/7/2014 10:30	286.1	0.0	0.0	25,952.1	106.2
2/12/2014 11:00	286.1	0.0	0.0	26,756.2	160.2
3/14/2014 9:50	286.1	0.0	0.0	30,148.2	113.3
4/11/2014 9:00	286.1	0.0	0.0	33,578.8	122.7
4/25/2014 10:50	286.1	0.0	0.0	35,326.6	124.2
Total average start-up to 4/25/14		0.0	0.0		121.3
Switched to recirculation mode of operation: Stage 1 sprayers					
4/25/2014 12:00	314.1	0.0		35,355.0	
4/29/2014 13:00	1,626.0	324.6	3.2:1	35,768.8	102.4
5/28/2014 10:22	13,966.4	427.1	3.4:1	39,443.6	127.2
7/11/2014 9:45	30,112.5	367.2	3.2:1	44,416.3	113.1
8/18/2014 11:00	43,938.8	363.4	3.2:1	48,763.1	114.2
9/19/2014 9:00	56,562.2	395.5	3.1:1	52,793.5	126.3

Table 3
Summary of Treatment System Flowmeters

Date	Recirculation Pumped Flow, R Water Meter Reading	Recirculation Pumped Flow, R Water Meter Reading	Average Recirc Ratio	Stage 2 Biofilter Pumped Flow, Q Water Meter Reading	Average Daily Stage 2, Q between readings
	Cumulative Volume (gal)	Gallons/Day	R:Q	Cumulative Volume (gal)	Gallons/Day
10/21/2014 12:20	69,070.3	389.2	3.0:1	56,912.7	128.2
Total average 4/25/2014 to 10/21/14		384.1	3.2:1		120.4

The two throttling gate valves control the fraction of Stage 1 effluent that is recirculated and the fraction sent to the Stage 2 biofilter. As previously discussed, the recirculation mode of operation was modified following the fourth sample event. The gate valves were set so that 3 parts went back to the Stage 1 sprayers and 1 part went to the Stage 2 tank (3:1 recycle ratio). The average recirculated pumped flow (to the Stage 1 biofilter), following the modification to the recirculation mode of operation, was 384.1 gallons per day, and the average forward flow to the Stage 2 biofilter was 120.4 gallons per day. Following the switch to the recirculation mode of operation, the average recirculation ratio was 3.2:1 (Table 3).

4.2 Energy Consumption

Energy consumption was monitored using an electrical meter installed between the main power box for the house and the control panel to record cumulative power usage of the pump in kilowatt-hours. The recorded electrical use for the system is summarized in Table 4.

Table 4
Summary of System Electrical Use

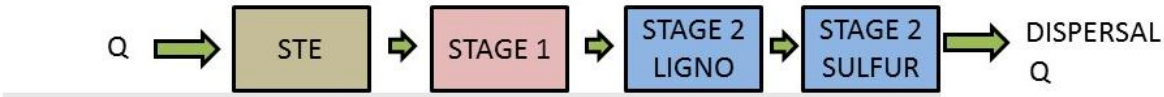
Date and Time Read	Electrical Meter Reading	Average Daily Electrical Use between readings	Average Electrical Use per Gallon Treated	Average Electrical Use Per 1,000 Gallons Treated
	Cumulative (kWh)	(kWh/day)	(kWh/gal)	(kWh/1000 gal)
7/5/2013 12:00		Installed		
7/9/2013 15:20	0.3	Start-up		
7/12/2013 14:13	0.4	0.03	0.0025	2.5063
7/17/2013 9:02	0.6	0.04	0.0003	0.2537
7/23/2013 8:32	0.8	0.03	0.0003	0.3089
7/29/2013 11:10	1.2	0.07	0.0004	0.3669
8/6/2013 8:51	1.5	0.04	0.0003	0.2583
8/15/2013 11:40	1.8	0.03	0.0003	0.3030
8/27/2013 9:15	2.2	0.03	0.0003	0.3198
9/27/2013 10:40	3.1	0.03	0.0003	0.3104
11/8/2013 10:30	4.8	0.04	0.0003	0.3200
11/27/2013 10:55	5.5	0.04	0.0003	0.3119
12/4/2013 13:45	5.8	0.04	0.0003	0.3400
12/23/2013 12:38	6.5	0.04	0.0003	0.3277
1/23/2014 10:00	8.0	0.05	0.0003	0.3159
1/31/2014 13:00	8.4	0.05	0.0003	0.3487
2/3/2014 8:40	8.4	0.00	0.0000	0.0000
2/12/2014 11:00	8.8	0.04	0.0002	0.2487
3/14/2014 9:50	9.9	0.04	0.0003	0.3243
4/11/2014 9:00	11.0	0.04	0.0003	0.3206
4/25/2014 10:50	11.6	0.04	0.0003	0.3433
Total average start-up to 4/25/14		0.04	0.0003	0.3214
Switched to recirculation mode of operation: Stage 1 sprayers				
4/25/2014 12:00	11.6			
4/29/2014 13:00	12.1	0.12	0.0012	1.2083
5/28/2014 10:22	16.5	0.15	0.0012	1.1973
7/11/2014 9:45	22.1	0.13	0.0011	1.1261
8/18/2014 11:00	27.1	0.13	0.0012	1.1503
9/19/2014 9:00	31.6	0.14	0.0011	1.1165
10/21/2014 12:20	36.2	0.14	0.0011	1.1167
Total average to 10/21/14		0.14	0.0011	1.1411

The total average electrical use prior to switching to the recirculation mode of operation (through April 25, 2014) was 0.04 kWh per day, and the corresponding average electrical use per 1,000 gallons treated was 0.3214 kWh. Following the switch from single

pass to recirculation mode, the average electrical use increased, as expected. Average electrical use after switching to the recirculation mode of operation was 0.14 kWh per day, and the average electrical use per 1,000 gallons treated increased to 1.1411 kWh.

4.3 Water Quality

Water quality analytical results for Sample Event No. 7 are listed in Table 5. Key results are graphically displayed in Figure 8. A summary of the water quality data collected to date for the test system is presented in Table 6. The laboratory report containing the raw analytical data is included in Appendix A. The following discussion summarizes the water quality analytical results. The performance of the various system components was compared by considering the changes through treatment of nitrogen species (TKN, NH_3-N, and NO_X-N), as well as supporting water quality parameters.



	STE	STAGE 1	STAGE 2 LIGNO	STAGE 2 SULFUR
$CBOD_5$ mg/L	90	7	7	33
TKN mg N/L	77	4.2	2.7	1.9
NH_3 mg N/L	76	0.17	Non-detect	1.2
NO_x mg N/L	0.07	58	29	0.04
TN mg N/L	77	62	32	1.9
Sulfate mg/L	18	28	27	330
Fecal Coliform (Ct/100mL)	140,000	204	43	80

Figure 8
Graphical Representation of Nitrogen Results
Sample Event No. 7, October 21, 2014 (Experimental Day 469)

Septic Tank Effluent (STE) Quality: The water quality characteristics of STE collected in Sample Event 7 were within the typical range generally expected for domestic STE. The measured STE total nitrogen (TN) concentration was 77 mg/L, which is within the high end of the range that has been typically reported for Florida single family residence STE.

Stage 1 Effluent (ST1): The Stage 1 effluent NH_3-N level was 0.17 mg/L with a DO level at 4.9 mg/L (Table 5). The Stage 1 effluent TSS and $CBOD_5$ concentrations 1 mg/L and 7 mg/L, respectively. The Stage 1 biofilter showed nearly complete nitrification with an

effluent NH_3-N concentration of 0.17 mg/L and TKN of 4.2 mg/L. The Stage 1 effluent NO_x-N was 58.1 mg/L. The Stage 1 effluent TN was 62.3 mg/L, a 19 percent reduction in nitrogen.

Stage 2 Biofilter Effluent (LIGNO-0" and ST2): The Stage 2 system produced a highly reducing environment and achieved essentially complete NO_x-N reduction. Effluent NO_x-N from the Stage 2 biofilter monitoring point was 0.04 mg/L. The low NO_x-N was accompanied by a measured 0.05 mg/L DO and -302 mV ORP. The lignocellulosic media effluent NO_x-N was 29.3 mg/L. Final total nitrogen (TN) in the treatment system effluent was 1.94 mg/L, a 97.5 percent reduction in nitrogen relative to the STE. The Stage 2 biofilter lignocellulosic media effluent and sulfur media effluent $CBOD_5$ were 7 and 33 mg/L, respectively. The Stage 2 effluent sulfate concentration was 330 mg/L.

Table 5
Water Quality Analytical Results

Sample ID	Sample Date/Time	Temp (°C)	pH	Specific Conductance (uS/cm)	DO (mg/L)	ORP (mV)	Total Alkalinity (mg/L)	TSS (mg/L)	VSS (mg/L)	$CBOD_5$ (mg/L)	COD (mg/L)	TN (mg/L N)[1]	TKN (mg/L N)	Organic N (mg/L N)[2]	NH_3-N (mg/L N)	NO_3-N (mg/L N)	NO_2-N (mg/L N)	NOx (mg/L N)	TIN (mg/L N)[3]	TP (mg/L)	Ortho P (mg/L P)	Sulfate (mg/L)	Hydrogen Sulfide (mg/L)	Sulfide (mg/L)	Fecal (Ct/100 mL)	E-coli (Ct/100 mL)	TOC (mg/L)
BHS5-STE	10/21/2014 11:40	26	7.3	1215	0.02	-292.4	430	43	43	90	150	77.07	77	1.0	76	0.02	0.05	0.07	76.07	8.5	6.5	18	0.48	1.4	140,000	120,000	36
BHS5-STE-FILTERED	10/21/2014 11:40	26	7.3	1215	0.02	-292.4				51		64.02	64	7.0	57	0.01	0.01	0.02	57.02								
BHS5-ST1	10/21/2014 11:10	23.4	6.98	1137	4.9	55.1	170	1	1	7	14	62.25	4.2	4.0	0.17	58	0.05	58.05	58.22	2.5	1.9	28	0.01	0.1	204	190	3.4
BHS5-ST1-DUP	10/21/2014 11:20	23.4	6.98	1137	4.9	55.1	170	1	1	7	10	62.55	3.5	3.3	0.19	59	0.05	59.05	59.24	2.4	2	28	0.01	0.1	217	200	3.7
BHS5-ST1-FILTERED	10/21/2014 11:10	23.4	6.98	1137	4.9	55.1				2		62.85	2.8	2.6	0.18	60	0.05	60.05	60.23								
BHS5-LIGNO-0	10/21/2014 10:40	26.1	6.78	1074	0.03	-209.3	270	1	1	7	18	32.00	2.7	2.7	0.009	29	0.3	29.30	29.31	2	1.6	27	0.24	0.4	43	28	5
BHS5-LIGNO-0-FILTERED	10/21/2014 10:40	26.1	6.78	1074	0.03	-209.3				2		33.28	4	3.9	0.068	29	0.28	29.28	29.35								
BHS5-ST2	10/21/2014 10:20	25.3	6.66	1302	0.05	-302.4	200	2	2	33	50	1.94	1.9	0.7	1.2	0.02	0.02	0.04	1.24	1.6	1.4	330	1.3	2	80	74	5.8
BHS5-ST2-FILTERED	10/21/2014 10:20	25.3	6.66	1302	0.05	-302.4				19		1.66	1.6	1.2	0.44	0.05	0.01	0.06	0.50			350					
BHS5-EB	10/21/2014 12:30	24.6	6.75	1.2	8.01	105.8	2	1	1	2	10	0.08	0.05	0.04	0.009	0.02	0.01	0.03	0.04	0.01	0.012	0.2	0.01	0.1	1	2	0.2

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.

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 6
Summary of Water Quality Data

Sample ID	Statistics	Temp (°C)	pH	Specific Conductance (uS/cm)	DO (mg/L)	ORP (mV)	Total Alkalinity (mg/L)	TSS (mg/L)	VSS (mg/L)	$CBOD_5$ (mg/L)	COD (mg/L)	TN (mg/L N)[1]	TKN (mg/L N)	Organic N (mg/L N)[2]	NH_3-N (mg/L N)	NO_3-N (mg/L N)	NO_2-N (mg/L N)	NOx (mg/L N)	TIN (mg/L N)[3]	TP (mg/L)	Ortho P (mg/L P)	Sulfate (mg/L)	Hydrogen Sulfide (mg/L)	Sulfide (mg/L)	Fecal (Ct/100 mL)	E-coli (Ct/100 mL)	TOC (mg/L)
STE	n	13	13	13	13	13	11	13	11	13	11	13	13	12	13	13	13	13	13	11	11	13	13	13	11	11	11
	MEAN	23.97	7.24	1198.54	0.06	-285.28	411.82	38.62	33.55	79.69	148.91	72.57	72.54	13.23	60.33	0.02	0.01	0.03	60.36	7.42	5.27	5.29	3.34	7.88	48,129	8,759	38
	STD. DEV.	3.78		68.00	0.03	39.44	20.89	13.02	13.68	22.67	65.98	9.03	9.03	16.29	19.76	0.02	0.01	0.02	19.77	1.87	0.80	5.26	1.65	2.77			10
	MIN	19.10	6.99	1048.00	0.01	-341.90	370.00	22.00	12.00	32.00	37.00	61.02	61.00	1.00	0.26	0.01	0.01	0.02	0.28	5.30	3.70	1.30	0.48	1.40	3,100	1,700	20
	MAX	28.90	7.63	1305.00	0.11	-226.80	440.00	60.00	56.00	120.00	270.00	89.02	89.00	60.74	79.00	0.08	0.05	0.08	79.02	12.00	6.50	18.00	6.90	12.00	160,000	120,000	51
Stage 1	n	13	13	13	13	13	11	11	11	11	11	13	13	13	13	12	12	13	13	11	11	9	8	8	11	11	11
	MEAN	23.64	6.87	1155.23	2.81	6.69	202.73	1.91	1.73	8.64	14.91	51.72	6.18	3.31	2.87	44.00	0.38	45.54	48.41	2.47	1.70	29.56	0.20	0.35	1,068	104	6
	STD. DEV.	3.22		72.42	1.13	94.49	18.49	1.04	1.10	5.22	7.41	8.39	2.54	1.44	2.70	7.48	0.50	8.47	7.95	0.40	0.23	5.32	0.27	0.37			2
	MIN	20.11	6.65	1057.00	1.64	-127.90	170.00	1.00	1.00	2.00	10.00	37.60	3.60	1.60	0.12	33.00	0.01	34.00	34.39	2.00	1.30	21.00	0.01	0.10	82	2	3
	MAX	28.20	7.18	1249.00	4.90	134.50	230.00	4.00	4.00	18.00	33.00	65.70	10.00	6.50	7.50	58.00	1.80	61.00	61.14	3.10	1.90	37.00	0.79	1.20	8,100	3,600	12
Stage 2 Ligno	n	13	13	13	13	13	11	13	11	13	11	13	13	13	13	12	12	13	13	11	11	10	9	9	11	11	11
	MEAN	24.06	6.63	1080.00	0.56	-98.09	344.55	5.15	2.91	12.31	37.18	13.16	3.06	2.27	0.79	7.14	0.89	10.10	10.88	1.28	0.73	25.40	0.18	0.31	234	24	12
	STD. DEV.	4.27		71.38	0.67	93.21	56.28	6.14	1.87	9.33	36.52	12.28	2.19	1.26	1.38	10.99	0.79	12.63	12.12	0.53	0.45	3.44	0.24	0.29			6
	MIN	18.40	6.25	946.00	0.03	-230.80	260.00	1.00	1.00	2.00	12.00	2.70	0.88	0.00	0.01	0.01	0.01	0.02	0.42	0.51	0.13	18.00	0.01	0.10	43	2	5
	MAX	30.20	7.38	1182.00	2.50	63.10	410.00	24.00	6.00	38.00	140.00	36.80	8.30	4.32	4.60	30.00	2.00	35.00	35.07	2.10	1.60	30.00	0.63	0.81	1,000	740	29
Stage 2 Sulfur	n	13	13	13	13	13	11	11	11	11	11	13	13	13	13	13	13	13	13	11	11	13	13	13	11	11	11
	MEAN	23.38	6.71	1212.15	0.15	-259.91	353.64	2.36	2.36	11.18	34.00	2.73	2.68	1.36	1.32	0.03	0.01	0.04	1.36	1.14	0.71	117.92	7.46	11.09	25	8	11
	STD. DEV.	4.54		215.01	0.10	51.28	71.03	1.29	1.29	9.21	8.10	2.67	2.68	1.00	1.77	0.04	0.00	0.04	1.76	0.33	0.33	87.28	11.99	17.18			5
	MIN	18.30	6.41	991.00	0.03	-357.00	200.00	1.00	1.00	2.00	23.00	1.12	1.00	0.65	0.16	0.01	0.01	0.02	0.18	0.42	0.18	29.00	0.25	0.40	1	2	6
	MAX	30.40	7.04	1781.00	0.38	-195.40	480.00	5.00	5.00	33.00	50.00	10.02	10.00	4.20	5.80	0.17	0.02	0.18	5.82	1.60	1.40	330.00	45.00	64.00	1,000	74	25
Tap	n	3	3	3	3	3	1	1	1	1	1	3	3	3	3	3	3	3	3	1	1	3	1	1	1	1	1
	MEAN	26.47	7.28	448.00	3.94	98.53	130.00	1.00	1.00	2.00	10.00	0.32	0.10	0.07	0.03	0.22	0.01	0.22	0.25	0.06	0.03	12.67	2.60	4.10	1	2	3
	STD. DEV.	3.01		15.72	2.22	173.67						0.18	0.01	0.03	0.02	0.18	0.00	0.18	0.19			0.58					
	MIN	23.60	6.73	431.00	2.31	-65.30	130.00	1.00	1.00	2.00	10.00	0.12	0.09	0.04	0.01	0.01	0.01	0.02	0.03	0.06	0.03	12.00	2.60	4.10	1	2	3
	MAX	29.60	7.60	462.00	6.47	280.60	130.00	1.00	1.00	2.00	10.00	0.44	0.11	0.09	0.05	0.33	0.01	0.33	0.37	0.06	0.03	13.00	2.60	4.10	1	2	3

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.

[4]Fecal coliform and pH values are reported as geometric mean.

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.

Sample held beyond the acceptable holding time

5.0 B-HS5 Sample Event No. 7: Summary and Recommendations

5.1 Summary

The results of the seventh sampling event indicate that the system is operating well and no adjustments are recommended at this time. The Sample Event No. 7 results indicate that:

- Septic tank effluent (STE) quality is characteristic of typical household STE quality. The total nitrogen concentration of 77 mg/L is within the high end of the range of values typically reported for Florida single family residence STE.
- The Stage 1 biofilter converted most of the ammonia N to oxidized nitrogen; effluent contained 4.2 mg/L TKN, of which 0.17 mg/L was ammonia.
- The Stage 2 biofilter effluent NO_x-N was 0.04 mg N/L.
- The total nitrogen concentration in the final effluent from the total treatment system was 1.94 mg/L, an approximately 97.5% reduction from STE.
- Stage 1 recirculation mode resulted in generally similar treatment performance as single pass, with some evidence of higher TKN and NH_3-N reductions.

Appendix A: Laboratory Report

SOUTHERN ANALYTICAL LABORATORIES, INC.
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10002 Princess Palm Ave, Suite 200
Tampa, FL 33619

November 11, 2014
Work Order: 1410748

Laboratory Report

Project Name **B-HS5 SE#11**

Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		**BHS5-STE**						
Matrix		**Wastewater**						
SAL Sample Number		**1410748-01**						
Date/Time Collected		**10/21/14 11:40**						
Collected by		**Josefin Hirst**						
Date/Time Received		**10/21/14 14:55**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.48	SM 4550SF	0.04	0.01	10/28/14 15:46	10/28/14 15:48	1
Ammonia as N	mg/L	76	EPA 350.1	0.040	0.009		10/22/14 17:00	1
Carbonaceous BOD	mg/L	90	SM 5210B	2	2	10/22/14 11:53	10/27/14 13:17	1
Chemical Oxygen Demand	mg/L	150	EPA 410.4	25	10	10/30/14 12:16	10/30/14 14:30	1
Nitrate+Nitrite (N)	mg/L	0.04	EPA 353.2	0.04	0.01		10/23/14 12:46	1
Nitrite (as N)	mg/L	0.05	SM 4500NO2-B	0.04	0.01		10/22/14 11:17	1
Orthophosphate as P	mg/L	6.5	SM 4500P-E	0.20	0.060		10/22/14 11:12	5
Phosphorous - Total as P	mg/L	8.5	SM 4500P-E	0.040	0.010	10/22/14 08:19	10/22/14 14:54	1
Sulfate	mg/L	18	EPA 300.0	6.0	2.0		10/29/14 18:49	10
Sulfide	mg/L	1.4	SM 4500SF	0.40	0.10		10/28/14 16:22	1
Total Alkalinity	mg/L	430	SM 2320B	8.0	2.0		10/27/14 13:08	1
Total Kjeldahl Nitrogen	mg/L	77	EPA 351.2	0.20	0.05	10/22/14 08:19	10/22/14 14:54	1
Total Organic Carbon	mg/L	36	SM 5310B	10	0.60		10/23/14 08:58	10
Total Suspended Solids	mg/L	43	SM 2540D	1	1	10/22/14 12:58	10/23/14 16:40	1
Volatile Suspended Solids	mg/L	43	EPA 160.4	1	1	10/22/14 12:58	10/23/14 16:40	1
Nitrate (as N)	mg/L	0.02 U	EPA 353.2	0.08	0.02		10/23/14 12:46	1
Microbiology								
E. Coli	MPN/100 mL	120,000	SM 9223B	2.0	2.0	10/21/14 16:28	10/22/14 10:48	1
Fecal Coliforms	CFU/100 ml	140,000	SM 9222D	1	1	10/21/14 16:14	10/22/14 14:16	1
Sample Description		**BHS5-STE-FILTERED**						
Matrix		**Wastewater**						
SAL Sample Number		**1410748-02**						
Date/Time Collected		**10/21/14 11:40**						
Collected by		**Josefin Hirst**						
Date/Time Received		**10/21/14 14:55**						
Inorganic, Dissolved								
Ammonia as N	mg/L	57	EPA 350.1	3.6	0.85		10/31/14 11:46	90
Carbonaceous BOD	mg/L	51	SM 5210B	2	2	10/22/14 11:52	10/27/14 13:24	1
Nitrate (as N)	mg/L	0.01 U	EPA 353.2	0.04	0.01		10/24/14 12:46	1
Nitrite (as N)	mg/L	0.01 U	SM 4500NO2-B	0.04	0.01		10/22/14 11:17	1
Total Kjeldahl Nitrogen	mg/L	64	EPA 351.2	0.20	0.050	10/22/14 08:22	10/22/14 15:10	1
Nitrate+Nitrite (N)	mg/L	0.01 U	EPA 353.2	0.04	0.01		10/24/14 12:46	1
Lab filtration for diss. analytes							10/24/14 11:06	

Florida Certification Number: E84129
NELAP Accredited

Francis I. Daniels, Laboratory Director
Leslie C. Boardman, Q.A. Manager

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November 11, 2014
Work Order: 1410748

Laboratory Report

Project Name **B-HS5 SE#11**

Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		**BHS5-ST1**						
Matrix		**Wastewater**						
SAL Sample Number		**1410748-03**						
Date/Time Collected		**10/21/14 11:10**						
Collected by		**Josefin Hirst**						
Date/Time Received		**10/21/14 14:55**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.01 U	SM 4550SF	0.04	0.01	10/28/14 15:46	10/28/14 15:48	1
Ammonia as N	mg/L	0.17	EPA 350.1	0.040	0.009		10/22/14 17:00	1
Carbonaceous BOD	mg/L	7	SM 5210B	2	2	10/22/14 11:53	10/27/14 13:17	1
Chemical Oxygen Demand	mg/L	14 I	EPA 410.4	25	10	10/30/14 12:16	10/30/14 14:30	1
Nitrate+Nitrite (N)	mg/L	59	EPA 353.2	0.96	0.24		10/23/14 14:16	24
Nitrite (as N)	mg/L	0.05	SM 4500NO2-B	0.04	0.01		10/22/14 11:18	1
Orthophosphate as P	mg/L	1.9	SM 4500P-E	0.040	0.012		10/22/14 10:56	1
Phosphorous - Total as P	mg/L	2.5	SM 4500P-E	0.040	0.010	10/22/14 08:19	10/22/14 14:54	1
Sulfate	mg/L	28	EPA 300.0	6.0	2.0		10/29/14 19:03	10
Sulfide	mg/L	0.10 U	SM 4500SF	0.40	0.10		10/28/14 16:22	1
Total Alkalinity	mg/L	170	SM 2320B	8.0	2.0		10/27/14 13:15	1
Total Kjeldahl Nitrogen	mg/L	4.2	EPA 351.2	0.20	0.05	10/22/14 08:19	10/22/14 14:54	1
Total Organic Carbon	mg/L	3.4	SM 5310B	1.0	0.060		10/23/14 08:58	1
Total Suspended Solids	mg/L	1	SM 2540D	1	1	10/22/14 12:58	10/23/14 16:40	1
Volatile Suspended Solids	mg/L	1 U	EPA 160.4	1	1	10/22/14 12:58	10/23/14 16:40	1
Nitrate (as N)	mg/L	58	EPA 353.2	1.0	0.25		10/23/14 14:16	24
Microbiology								
E. Coli	MPN/100 mL	190	SM 9223B	2.0	2.0	10/21/14 16:28	10/22/14 10:48	1
Fecal Coliforms	CFU/100 ml	204	SM 9222D	1	1	10/21/14 16:14	10/22/14 14:16	1

Sample Description		**BHS5-ST1-DUP**						
Matrix		**Wastewater**						
SAL Sample Number		**1410748-04**						
Date/Time Collected		**10/21/14 11:20**						
Collected by		**Josefin Hirst**						
Date/Time Received		**10/21/14 14:55**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.01 U	SM 4550SF	0.04	0.01	10/28/14 15:46	10/28/14 15:48	1
Ammonia as N	mg/L	0.19	EPA 350.1	0.040	0.009		10/22/14 17:00	1
Carbonaceous BOD	mg/L	7	SM 5210B	2	2	10/22/14 11:53	10/27/14 13:17	1
Chemical Oxygen Demand	mg/L	10 I	EPA 410.4	25	10	10/30/14 12:16	10/30/14 14:30	1
Nitrate+Nitrite (N)	mg/L	59	EPA 353.2	0.96	0.24		10/23/14 14:17	24
Nitrite (as N)	mg/L	0.05	SM 4500NO2-B	0.04	0.01		10/22/14 11:18	1
Orthophosphate as P	mg/L	2.0	SM 4500P-E	0.040	0.012		10/22/14 10:57	1
Phosphorous - Total as P	mg/L	2.4	SM 4500P-E	0.040	0.010	10/22/14 08:19	10/22/14 14:54	1

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November 11, 2014
Work Order: 1410748

Laboratory Report

Project Name **B-HS5 SE#11**

Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		**BHS5-ST1-DUP**						
Matrix		**Wastewater**						
SAL Sample Number		**1410748-04**						
Date/Time Collected		**10/21/14 11:20**						
Collected by		**Josefin Hirst**						
Date/Time Received		**10/21/14 14:55**						
Sulfate	mg/L	28	EPA 300.0	6.0	2.0		10/29/14 19:16	10
Sulfide	mg/L	0.10 U	SM 4500SF	0.40	0.10		10/28/14 16:22	1
Total Alkalinity	mg/L	170	SM 2320B	8.0	2.0		10/27/14 13:21	1
Total Kjeldahl Nitrogen	mg/L	3.5	EPA 351.2	0.20	0.05	10/22/14 08:19	10/22/14 14:54	1
Total Organic Carbon	mg/L	3.7	SM 5310B	1.0	0.060		10/23/14 08:58	1
Total Suspended Solids	mg/L	1 U	SM 2540D	1	1	10/22/14 12:58	10/23/14 16:40	1
Volatile Suspended Solids	mg/L	1 U	EPA 160.4	1	1	10/22/14 12:58	10/23/14 16:40	1
Nitrate (as N)	mg/L	59	EPA 353.2	1.0	0.25		10/23/14 14:17	24
Microbiology								
E. Coli	MPN/100 mL	200	SM 9223B	2.0	2.0	10/21/14 16:28	10/22/14 10:48	1
Fecal Coliforms	CFU/100 ml	217	SM 9222D	1	1	10/21/14 16:14	10/22/14 14:16	1
Sample Description		**BHS5-ST1-FILTERED**						
Matrix		**Wastewater**						
SAL Sample Number		**1410748-05**						
Date/Time Collected		**10/21/14 11:10**						
Collected by		**Josefin Hirst**						
Date/Time Received		**10/21/14 14:55**						
Inorganic, Dissolved								
Ammonia as N	mg/L	0.18	EPA 350.1	0.040	0.009		10/31/14 10:38	1
Carbonaceous BOD	mg/L	2 U	SM 5210B	2	2	10/22/14 11:52	10/27/14 13:24	1
Nitrate (as N)	mg/L	60	EPA 353.2	4.8	1.2		10/24/14 15:22	120
Nitrite (as N)	mg/L	0.05	SM 4500NO2-B	0.04	0.01		10/22/14 11:19	1
Total Kjeldahl Nitrogen	mg/L	2.8	EPA 351.2	0.20	0.050	10/22/14 08:22	10/22/14 15:10	1
Nitrate+Nitrite (N)	mg/L	60	EPA 353.2	4.8	1.2		10/24/14 15:22	120
Lab filtration for diss. analytes							10/24/14 11:06	
Sample Description		**BHS5-LIGNO-0**						
Matrix		**Wastewater**						
SAL Sample Number		**1410748-06**						
Date/Time Collected		**10/21/14 10:40**						
Collected by		**Josefin Hirst**						
Date/Time Received		**10/21/14 14:55**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.24	SM 4550SF	0.04	0.01	10/28/14 15:46	10/28/14 15:48	1
Ammonia as N	mg/L	0.009 U	EPA 350.1	0.040	0.009		10/22/14 17:00	1

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November 11, 2014
Work Order: 1410748

Laboratory Report

Project Name **B-HS5 SE#11**

Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		**BHS5-LIGNO-0**						
Matrix		**Wastewater**						
SAL Sample Number		**1410748-06**						
Date/Time Collected		**10/21/14 10:40**						
Collected by		**Josefin Hirst**						
Date/Time Received		**10/21/14 14:55**						
Carbonaceous BOD	mg/L	7	SM 5210B	2	2	10/22/14 11:53	10/27/14 13:17	1
Chemical Oxygen Demand	mg/L	18 I	EPA 410.4	25	10	10/30/14 12:16	10/30/14 14:30	1
Nitrate+Nitrite (N)	mg/L	30	EPA 353.2	0.96	0.24		10/23/14 14:18	24
Nitrite (as N)	mg/L	0.30 I	SM 4500NO2-B	0.40	0.10		10/22/14 11:37	10
Orthophosphate as P	mg/L	1.6	SM 4500P-E	0.040	0.012		10/22/14 10:58	1
Phosphorous - Total as P	mg/L	2.0	SM 4500P-E	0.040	0.010	10/22/14 08:19	10/22/14 14:54	1
Sulfate	mg/L	27	EPA 300.0	6.0	2.0		10/29/14 19:30	10
Sulfide	mg/L	0.40	SM 4500SF	0.40	0.10		10/28/14 16:22	1
Total Alkalinity	mg/L	270	SM 2320B	8.0	2.0		10/27/14 13:29	1
Total Kjeldahl Nitrogen	mg/L	2.7	EPA 351.2	0.20	0.05	10/22/14 08:19	10/22/14 14:54	1
Total Organic Carbon	mg/L	5.0	SM 5310B	1.0	0.060		10/23/14 08:58	1
Total Suspended Solids	mg/L	1	SM 2540D	1	1	10/22/14 12:58	10/23/14 16:40	1
Volatile Suspended Solids	mg/L	1 U	EPA 160.4	1	1	10/22/14 12:58	10/23/14 16:40	1
Nitrate (as N)	mg/L	29	EPA 353.2	1.4	0.34		10/23/14 14:18	24
Microbiology								
E. Coli	MPN/100 mL	28	SM 9223B	2.0	2.0	10/21/14 16:28	10/22/14 10:48	1
Fecal Coliforms	CFU/100 ml	43	SM 9222D	1	1	10/21/14 16:14	10/22/14 14:16	1

Sample Description		**BHS5-LIGNO-0-FILTERED**						
Matrix		**Wastewater**						
SAL Sample Number		**1410748-07**						
Date/Time Collected		**10/21/14 10:40**						
Collected by		**Josefin Hirst**						
Date/Time Received		**10/21/14 14:55**						
Inorganic, Dissolved								
Ammonia as N	mg/L	0.068	EPA 350.1	0.040	0.009		10/31/14 10:40	1
Carbonaceous BOD	mg/L	2 U	SM 5210B	2	2	10/22/14 11:52	10/27/14 13:24	1
Nitrate (as N)	mg/L	29	EPA 353.2	0.96	0.24		10/24/14 14:17	24
Nitrite (as N)	mg/L	0.28 I	SM 4500NO2-B	0.40	0.10		10/22/14 11:38	10
Total Kjeldahl Nitrogen	mg/L	4.0	EPA 351.2	0.20	0.050	10/22/14 08:22	10/22/14 15:10	1
Nitrate+Nitrite (N)	mg/L	29	EPA 353.2	0.96	0.24		10/24/14 14:17	24
Lab filtration for diss. analytes							10/24/14 11:06	

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November 11, 2014
Work Order: 1410748

Laboratory Report

Project Name **B-HS5 SE#11**

Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		**BHS5-ST2**						
Matrix		**Wastewater**						
SAL Sample Number		**1410748-08**						
Date/Time Collected		**10/21/14 10:20**						
Collected by		**Josefin Hirst**						
Date/Time Received		**10/21/14 14:55**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	1.3	SM 4550SF	0.04	0.01	10/28/14 15:46	10/28/14 15:48	1
Ammonia as N	mg/L	1.2	EPA 350.1	0.040	0.009		10/22/14 17:00	1
Carbonaceous BOD	mg/L	33	SM 5210B	2	2	10/22/14 11:53	10/27/14 13:17	1
Chemical Oxygen Demand	mg/L	50	EPA 410.4	25	10	10/30/14 12:16	10/30/14 14:30	1
Nitrate+Nitrite (N)	mg/L	0.03 I	EPA 353.2	0.04	0.01		10/23/14 13:03	1
Nitrite (as N)	mg/L	0.02 I	SM 4500NO2-B	0.04	0.01		10/22/14 11:21	1
Orthophosphate as P	mg/L	1.4	SM 4500P-E	0.040	0.012		10/22/14 10:58	1
Phosphorous - Total as P	mg/L	1.6	SM 4500P-E	0.040	0.010	10/22/14 08:19	10/22/14 14:54	1
Sulfate	mg/L	330	EPA 300.0	6.0	2.0		10/29/14 19:43	10
Sulfide	mg/L	2.0	SM 4500SF	0.40	0.10		10/28/14 16:22	1
Total Alkalinity	mg/L	200	SM 2320B	8.0	2.0		10/27/14 13:37	1
Total Kjeldahl Nitrogen	mg/L	1.9	EPA 351.2	0.20	0.05	10/22/14 08:19	10/22/14 14:54	1
Total Organic Carbon	mg/L	5.8	SM 5310B	1.0	0.060		10/23/14 08:58	1
Total Suspended Solids	mg/L	2	SM 2540D	1	1	10/22/14 12:58	10/23/14 16:40	1
Volatile Suspended Solids	mg/L	2	EPA 160.4	1	1	10/22/14 12:58	10/23/14 16:40	1
Nitrate (as N)	mg/L	0.02 U	EPA 353.2	0.08	0.02		10/23/14 13:03	1
Microbiology								
E. Coli	MPN/100 mL	74	SM 9223B	2.0	2.0	10/21/14 16:28	10/22/14 10:48	1
Fecal Coliforms	CFU/100 ml	80	SM 9222D	1	1	10/21/14 16:14	10/22/14 14:16	1
Sample Description		**BHS5-ST2-FILTERED**						
Matrix		**Wastewater**						
SAL Sample Number		**1410748-09**						
Date/Time Collected		**10/21/14 10:20**						
Collected by		**Josefin Hirst**						
Date/Time Received		**10/21/14 14:55**						
Inorganics								
Sulfate	mg/L	350	EPA 300.0	6.0	2.0		10/29/14 19:57	10
Inorganic, Dissolved								
Ammonia as N	mg/L	0.44	EPA 350.1	0.040	0.009		10/31/14 10:41	1
Carbonaceous BOD	mg/L	19	SM 5210B	2	2	10/22/14 11:52	10/27/14 13:24	1
Nitrate (as N)	mg/L	0.05	EPA 353.2	0.04	0.01		10/24/14 12:54	1
Nitrite (as N)	mg/L	0.01 U	SM 4500NO2-B	0.04	0.01		10/22/14 11:22	1
Total Kjeldahl Nitrogen	mg/L	1.6	EPA 351.2	0.20	0.050	10/22/14 08:22	10/22/14 15:10	1

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November 11, 2014
Work Order: 1410748

Laboratory Report

Project Name **B-HS5 SE#11**

Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		**BHS5-ST2-FILTERED**						
Matrix		**Wastewater**						
SAL Sample Number		**1410748-09**						
Date/Time Collected		**10/21/14 10:20**						
Collected by		**Josefin Hirst**						
Date/Time Received		**10/21/14 14:55**						
Nitrate+Nitrite (N)	mg/L	0.05	EPA 353.2	0.04	0.01		10/24/14 12:54	1
Lab filtration for diss. analytes							10/24/14 11:06	
Sample Description		**BHS5-EB**						
Matrix		**Reagent Water**						
SAL Sample Number		**1410748-10**						
Date/Time Collected		**10/21/14 12:30**						
Collected by		**Josefin Hirst**						
Date/Time Received		**10/21/14 14:55**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.01 U	SM 4550SF	0.04	0.01	10/28/14 15:46	10/28/14 15:48	1
Ammonia as N	mg/L	0.009 U	EPA 350.1	0.040	0.009		10/22/14 17:00	1
Carbonaceous BOD	mg/L	2 U	SM 5210B	2	2	10/22/14 11:53	10/27/14 13:17	1
Chemical Oxygen Demand	mg/L	10 U	EPA 410.4	25	10	10/30/14 12:16	10/30/14 14:30	1
Nitrate+Nitrite (N)	mg/L	0.02 I	EPA 353.2	0.04	0.01		10/23/14 13:05	1
Nitrite (as N)	mg/L	0.01 U	SM 4500NO2-B	0.04	0.01		10/22/14 11:22	1
Orthophosphate as P	mg/L	0.012 U	SM 4500P-E	0.040	0.012		10/22/14 10:59	1
Phosphorous - Total as P	mg/L	0.010 U	SM 4500P-E	0.040	0.010	10/22/14 08:19	10/22/14 14:54	1
Sulfate	mg/L	0.20 U	EPA 300.0	0.60	0.20		10/29/14 20:10	1
Sulfide	mg/L	0.10 U	SM 4500SF	0.40	0.10		10/28/14 16:22	1
Total Alkalinity	mg/L	2.0 U	SM 2320B	8.0	2.0		10/27/14 13:45	1
Total Kjeldahl Nitrogen	mg/L	0.05 U	EPA 351.2	0.20	0.05	10/22/14 08:19	10/22/14 14:54	1
Total Organic Carbon	mg/L	0.20 I	SM 5310B	1.0	0.060		10/23/14 08:58	1
Total Suspended Solids	mg/L	1 U	SM 2540D	1	1	10/22/14 12:58	10/23/14 16:40	1
Volatile Suspended Solids	mg/L	1 U	EPA 160.4	1	1	10/22/14 12:58	10/23/14 16:40	1
Nitrate (as N)	mg/L	0.02 I	EPA 353.2	0.08	0.02		10/23/14 13:05	1
Microbiology								
E. Coli	MPN/100 mL	2.0 U	SM 9223B	2.0	2.0	10/21/14 16:28	10/22/14 10:48	1
Fecal Coliforms	CFU/100 ml	1 U	SM 9222D	1	1	10/21/14 16:14	10/22/14 14:16	1

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November 11, 2014
Work Order: 1410748

Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ42204 - Digestion for TP and TKN										
Blank (BJ42204-BLK1)					Prepared & Analyzed: 10/22/14 14:54					
Phosphorous - Total as P	0.010 U	0.040	0.010	mg/L						
Total Kjeldahl Nitrogen	0.05 U	0.20	0.05	mg/L						
LCS (BJ42204-BS1)					Prepared & Analyzed: 10/22/14 14:54					
Total Kjeldahl Nitrogen	0.999	0.20	0.05	mg/L	1.0		100	90-110		
Phosphorous - Total as P	1.07	0.040	0.010	mg/L	1.0		107	90-110		
Matrix Spike (BJ42204-MS1)		**Source: 1410748-10**			Prepared & Analyzed: 10/22/14 14:54					
Total Kjeldahl Nitrogen	0.990	0.20	0.05	mg/L	1.0	ND	99	90-110		
Phosphorous - Total as P	1.09	0.040	0.010	mg/L	1.0	ND	109	90-110		
Matrix Spike (BJ42204-MS2)		**Source: 1411383-07**			Prepared & Analyzed: 10/22/14 14:54					
Phosphorous - Total as P	1.19	0.040	0.010	mg/L	1.0	0.163	103	90-110		
Total Kjeldahl Nitrogen	1.73	0.20	0.05	mg/L	1.0	0.645	109	90-110		
Matrix Spike Dup (BJ42204-MSD1)		**Source: 1410748-10**			Prepared & Analyzed: 10/22/14 14:54					
Phosphorous - Total as P	1.10	0.040	0.010	mg/L	1.0	ND	110	90-110	0.9	25
Total Kjeldahl Nitrogen	0.991	0.20	0.05	mg/L	1.0	ND	99	90-110	0.1	20
Matrix Spike Dup (BJ42204-MSD2)		**Source: 1411383-07**			Prepared & Analyzed: 10/22/14 14:54					
Phosphorous - Total as P	1.19	0.040	0.010	mg/L	1.0	0.163	103	90-110	0.2	25
Total Kjeldahl Nitrogen	1.73	0.20	0.05	mg/L	1.0	0.645	109	90-110	0.2	20
Batch BJ42209 - Ortho phosphorus SM4500P-E by seal										
Blank (BJ42209-BLK1)					Prepared & Analyzed: 10/22/14 10:50					
Orthophosphate as P	0.012 U	0.040	0.012	mg/L						

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November 11, 2014
Work Order: 1410748

Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ42209 - Ortho phosphorus SM4500P-E by seal										
LCS (BJ42209-BS1)					Prepared & Analyzed: 10/22/14 10:52					
Orthophosphate as P	0.824	0.040	0.012	mg/L	0.80		103	90-110		
Matrix Spike (BJ42209-MS1)		**Source: 1410748-10**			Prepared & Analyzed: 10/22/14 10:53					
Orthophosphate as P	0.985	0.040	0.012	mg/L	1.0	ND	99	90-110		
Matrix Spike Dup (BJ42209-MSD1)		**Source: 1410748-10**			Prepared & Analyzed: 10/22/14 10:54					
Orthophosphate as P	1.03	0.040	0.012	mg/L	1.0	ND	103	90-110	4	20
Batch BJ42211 - Ammonia by SEAL										
Blank (BJ42211-BLK1)					Prepared & Analyzed: 10/22/14 17:00					
Ammonia as N	0.009 U	0.040	0.009	mg/L						
LCS (BJ42211-BS1)					Prepared & Analyzed: 10/22/14 17:00					
Ammonia as N	0.47	0.040	0.009	mg/L	0.50		95	90-110		
Matrix Spike (BJ42211-MS1)		**Source: 1410748-03**			Prepared & Analyzed: 10/22/14 17:00					
Ammonia as N	0.64	0.040	0.009	mg/L	0.50	0.17	93	90-110		
Matrix Spike Dup (BJ42211-MSD1)		**Source: 1410748-03**			Prepared & Analyzed: 10/22/14 17:00					
Ammonia as N	0.63	0.040	0.009	mg/L	0.50	0.17	92	90-110	1	10
Batch BJ42214 - TOC prep										
Blank (BJ42214-BLK1)					Prepared & Analyzed: 10/23/14 08:58					
Total Organic Carbon	0.060 U	1.0	0.060	mg/L						

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November 11, 2014
Work Order: 1410748

Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ42214 - TOC prep										
LCS (BJ42214-BS1)					Prepared & Analyzed: 10/23/14 08:58					
Total Organic Carbon	9.31	1.0	0.060	mg/L	10		93	90-110		
Matrix Spike (BJ42214-MS1)		**Source: 1410748-03**			Prepared & Analyzed: 10/23/14 08:58					
Total Organic Carbon	12.8	1.0	0.060	mg/L	10	3.36	95	85-115		
Matrix Spike Dup (BJ42214-MSD1)		**Source: 1410748-03**			Prepared & Analyzed: 10/23/14 08:58					
Total Organic Carbon	13.2	1.0	0.060	mg/L	10	3.36	98	85-115	2	10
Batch BJ42219 - Nitrite SM 4500NO2-B by seal										
Blank (BJ42219-BLK1)					Prepared & Analyzed: 10/22/14 11:14					
Nitrite (as N)	0.01 U	0.04	0.01	mg/L						
LCS (BJ42219-BS1)					Prepared & Analyzed: 10/22/14 11:14					
Nitrite (as N)	0.0800	0.04	0.01	mg/L	0.080		100	90-110		
Matrix Spike (BJ42219-MS1)		**Source: 1410748-01**			Prepared & Analyzed: 10/22/14 11:15					
Nitrite (as N)	0.0718 J2	0.04	0.01	mg/L	0.10	0.0451	27	77-119		
Matrix Spike (BJ42219-MS2)		**Source: 1411385-02**			Prepared & Analyzed: 10/22/14 11:16					
Nitrite (as N)	0.0274 I,J2	0.04	0.01	mg/L	0.10	ND	27	77-119		
Matrix Spike Dup (BJ42219-MSD1)		**Source: 1410748-01**			Prepared & Analyzed: 10/22/14 11:15					
Nitrite (as N)	0.0711 J2	0.04	0.01	mg/L	0.10	0.0451	26	77-119	1	20
Matrix Spike Dup (BJ42219-MSD2)		**Source: 1411385-02**			Prepared & Analyzed: 10/22/14 11:16					
Nitrite (as N)	0.0285 I,J2	0.04	0.01	mg/L	0.10	ND	28	77-119	4	20

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November 11, 2014
Work Order: 1410748

Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ42227 - BOD										
Blank (BJ42227-BLK1)					Prepared: 10/22/14 Analyzed: 10/27/14 13:17					
Carbonaceous BOD	2 U	2	2	mg/L						
LCS (BJ42227-BS1)					Prepared: 10/22/14 Analyzed: 10/27/14 13:17					
Carbonaceous BOD	224	2	2	mg/L	200		112	85-115		
LCS Dup (BJ42227-BSD1)					Prepared: 10/22/14 Analyzed: 10/27/14 13:17					
Carbonaceous BOD	227	2	2	mg/L	200		113	85-115	1	200
Duplicate (BJ42227-DUP1)		**Source: 1411383-01**			Prepared: 10/22/14 Analyzed: 10/27/14 13:17					
Carbonaceous BOD	250	2	2	mg/L		240			3	25
Batch BJ42229 - TSS prep										
Blank (BJ42229-BLK1)					Prepared: 10/22/14 Analyzed: 10/23/14 16:40					
Volatile Suspended Solids	1 U	1		mg/L						
Total Suspended Solids	1 U	1	1	mg/L						
LCS (BJ42229-BS1)					Prepared: 10/22/14 Analyzed: 10/23/14 16:40					
Total Suspended Solids	50.2	1	1	mg/L	50		100	85-115		
Duplicate (BJ42229-DUP1)		**Source: 1411308-01**			Prepared: 10/22/14 Analyzed: 10/23/14 16:40					
Volatile Suspended Solids	2,380	1		mg/L		2620			9	20
Total Suspended Solids	2,780	1	1	mg/L		3000			7	30
Batch BJ42316 - Nitrate 353.2 by seal										
Blank (BJ42316-BLK1)					Prepared & Analyzed: 10/23/14 12:38					
Nitrate+Nitrite (N)	0.01 U	0.04	0.01	mg/L						

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November 11, 2014
Work Order: 1410748

Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ42316 - Nitrate 353.2 by seal										
LCS (BJ42316-BS1)					Prepared & Analyzed: 10/23/14 12:40					
Nitrate+Nitrite (N)	0.800	0.04	0.01	mg/L	0.80		100	90-110		
Matrix Spike (BJ42316-MS1)		**Source: 1410748-01**			Prepared & Analyzed: 10/23/14 12:42					
Nitrate+Nitrite (N)	1.02	0.04	0.01	mg/L	1.0	0.0430	98	90-110		
Matrix Spike (BJ42316-MS2)		**Source: 1410919-14**			Prepared & Analyzed: 10/23/14 12:59					
Nitrate+Nitrite (N)	0.995	0.04	0.01	mg/L	1.0	ND	100	90-110		
Matrix Spike Dup (BJ42316-MSD1)		**Source: 1410748-01**			Prepared & Analyzed: 10/23/14 12:44					
Nitrate+Nitrite (N)	1.03	0.04	0.01	mg/L	1.0	0.0430	99	90-110	0.8	20
Matrix Spike Dup (BJ42316-MSD2)		**Source: 1410919-14**			Prepared & Analyzed: 10/23/14 13:01					
Nitrate+Nitrite (N)	0.980	0.04	0.01	mg/L	1.0	ND	98	90-110	2	20
Batch BJ42439 - alkalinity										
Blank (BJ42439-BLK1)					Prepared & Analyzed: 10/27/14 11:24					
Total Alkalinity	2.0 U	8.0	2.0	mg/L						
Blank (BJ42439-BLK2)					Prepared & Analyzed: 10/27/14 11:27					
Total Alkalinity	2.0 U	8.0	2.0	mg/L						
LCS (BJ42439-BS1)					Prepared & Analyzed: 10/27/14 11:36					
Total Alkalinity	130	8.0	2.0	mg/L	120		107	90-110		
LCS (BJ42439-BS2)					Prepared & Analyzed: 10/27/14 11:42					
Total Alkalinity	140	8.0	2.0	mg/L	120		109	90-110		

Hazen and Sawyer
10002 Princess Palm Ave, Suite 200
Tampa, FL 33619

November 11, 2014
Work Order: 1410748

Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ42439 - alkalinity										
Matrix Spike (BJ42439-MS1)		**Source: 1410747-10**			Prepared & Analyzed: 10/27/14 12:52					
Total Alkalinity	130	8.0	2.0	mg/L	120	2.9	103	80-120		
Matrix Spike (BJ42439-MS2)		**Source: 1410752-27**			Prepared & Analyzed: 10/27/14 15:20					
Total Alkalinity	140	8.0	2.0	mg/L	120	ND	110	80-120		
Matrix Spike Dup (BJ42439-MSD1)		**Source: 1410747-10**			Prepared & Analyzed: 10/27/14 12:57					
Total Alkalinity	140	8.0	2.0	mg/L	120	2.9	106	80-120	3	26
Matrix Spike Dup (BJ42439-MSD2)		**Source: 1410752-27**			Prepared & Analyzed: 10/27/14 15:26					
Total Alkalinity	140	8.0	2.0	mg/L	120	ND	110	80-120	0.5	26
Batch BJ42825 - Sulfide prep										
Blank (BJ42825-BLK1)					Prepared & Analyzed: 10/28/14 16:22					
Sulfide	0.10 U	0.40	0.10	mg/L						
Blank (BJ42825-BLK2)					Prepared & Analyzed: 10/28/14 16:22					
Sulfide	0.10 U	0.40	0.10	mg/L						
LCS (BJ42825-BS1)					Prepared & Analyzed: 10/28/14 16:22					
Sulfide	5.21	0.40	0.10	mg/L	5.0		104	85-115		
LCS (BJ42825-BS2)					Prepared & Analyzed: 10/28/14 16:22					
Sulfide	5.21	0.40	0.10	mg/L	5.0		104	85-115		
Matrix Spike (BJ42825-MS1)		**Source: 1410747-10**			Prepared & Analyzed: 10/28/14 16:22					
Sulfide	5.21	0.40	0.10	mg/L	5.0	ND	104	85-115		

Hazen and Sawyer
10002 Princess Palm Ave, Suite 200
Tampa, FL 33619

November 11, 2014
Work Order: 1410748

Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ42825 - Sulfide prep										
Matrix Spike (BJ42825-MS2)		**Source: 1410748-10**			Prepared & Analyzed: 10/28/14 16:22					
Sulfide	5.21	0.40	0.10	mg/L	5.0	ND	104	85-115		
Matrix Spike Dup (BJ42825-MSD1)		**Source: 1410747-10**			Prepared & Analyzed: 10/28/14 16:22					
Sulfide	5.01	0.40	0.10	mg/L	5.0	ND	100	85-115	4	14
Matrix Spike Dup (BJ42825-MSD2)		**Source: 1410748-10**			Prepared & Analyzed: 10/28/14 16:22					
Sulfide	4.81	0.40	0.10	mg/L	5.0	ND	96	85-115	8	14
Batch BJ42925 - Ion Chromatography 300.0 Prep										
Blank (BJ42925-BLK1)					Prepared & Analyzed: 10/29/14 17:14					
Sulfate	0.20 U	0.60	0.20	mg/L						
Surrogate: Dichloroacetate	*0.814*			*mg/L*	*1.0*		*81*	*78-120*		
LCS (BJ42925-BS1)					Prepared & Analyzed: 10/29/14 17:27					
Sulfate	9.13	0.60	0.20	mg/L	9.0		101	85-115		
Surrogate: Dichloroacetate	*0.981*			*mg/L*	*1.0*		*98*	*78-120*		
LCS (BJ42925-BS2)					Prepared & Analyzed: 10/29/14 17:55					
Sulfate	9.25	0.60	0.20	mg/L	9.0		103	85-115		
Surrogate: Dichloroacetate	*1.03*			*mg/L*	*1.0*		*103*	*78-120*		
LCS (BJ42925-BS3)					Prepared & Analyzed: 10/29/14 18:08					
Sulfate	9.24	0.60	0.20	mg/L	9.0		103	85-115		
Surrogate: Dichloroacetate	*1.01*			*mg/L*	*1.0*		*101*	*78-120*		
LCS (BJ42925-BS4)					Prepared & Analyzed: 10/29/14 18:22					
Sulfate	9.24	0.60	0.20	mg/L	9.0		103	85-115		
Surrogate: Dichloroacetate	*0.988*			*mg/L*	*1.0*		*99*	*78-120*		

Hazen and Sawyer
10002 Princess Palm Ave, Suite 200
Tampa, FL 33619

November 11, 2014
Work Order: 1410748

Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ42925 - Ion Chromatography 300.0 Prep										
LCS (BJ42925-BS5)					Prepared & Analyzed: 10/29/14 18:36					
Sulfate	9.21	0.60	0.20	mg/L	9.0		102	85-115		
Surrogate: Dichloroacetate	*1.03*			*mg/L*	*1.0*		*103*	*78-120*		
LCS Dup (BJ42925-BSD1)					Prepared & Analyzed: 10/29/14 17:41					
Sulfate	9.08	0.60	0.20	mg/L	9.0		101	85-115	0.5	200
Surrogate: Dichloroacetate	*1.02*			*mg/L*	*1.0*		*102*	*78-120*		
Matrix Spike (BJ42925-MS1)		**Source: 1411389-02**			Prepared & Analyzed: 10/29/14 21:32					
Sulfate	10,900	600	200	mg/L	9000	1820	100	85-115		
Surrogate: Dichloroacetate	*1.01*			*mg/L*	*1.0*		*101*	*78-120*		
Matrix Spike (BJ42925-MS2)		**Source: 1410747-06**			Prepared & Analyzed: 10/30/14 12:23					
Sulfate	109	6.0	2.0	mg/L	90	20.4	98	85-115		
Surrogate: Dichloroacetate	*1.10*			*mg/L*	*1.0*		*110*	*78-120*		
Batch BJ43022 - COD prep										
Blank (BJ43022-BLK1)					Prepared & Analyzed: 10/30/14 14:30					
Chemical Oxygen Demand	10 U	25	10	mg/L						
Blank (BJ43022-BLK2)					Prepared & Analyzed: 10/30/14 14:30					
Chemical Oxygen Demand	10 U	25	10	mg/L						
LCS (BJ43022-BS1)					Prepared & Analyzed: 10/30/14 14:30					
Chemical Oxygen Demand	47	25	10	mg/L	50		94	90-110		
LCS (BJ43022-BS2)					Prepared & Analyzed: 10/30/14 14:30					
Chemical Oxygen Demand	45	25	10	mg/L	50		90	90-110		

Hazen and Sawyer
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Tampa, FL 33619

November 11, 2014
Work Order: 1410748

Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ43022 - COD prep										
Matrix Spike (BJ43022-MS1)		**Source: 1410747-10**			Prepared & Analyzed: 10/30/14 14:30					
Chemical Oxygen Demand	50	25	10	mg/L	50	ND	100	85-115		
Matrix Spike (BJ43022-MS2)		**Source: 1410748-10**			Prepared & Analyzed: 10/30/14 14:30					
Chemical Oxygen Demand	54	25	10	mg/L	50	ND	108	85-115		
Matrix Spike Dup (BJ43022-MSD1)		**Source: 1410747-10**			Prepared & Analyzed: 10/30/14 14:30					
Chemical Oxygen Demand	52	25	10	mg/L	50	ND	104	85-115	4	32
Matrix Spike Dup (BJ43022-MSD2)		**Source: 1410748-10**			Prepared & Analyzed: 10/30/14 14:30					
Chemical Oxygen Demand	50	25	10	mg/L	50	ND	100	85-115	8	32

Hazen and Sawyer
10002 Princess Palm Ave, Suite 200
Tampa, FL 33619

November 11, 2014
Work Order: 1410748

Inorganic, Dissolved - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ42205 - Digestion for TP and TKN										
Blank (BJ42205-BLK1)					Prepared & Analyzed: 10/22/14 15:10					
Total Kjeldahl Nitrogen	0.050 U	0.20	0.050	mg/L						
LCS (BJ42205-BS1)					Prepared & Analyzed: 10/22/14 15:10					
Total Kjeldahl Nitrogen	0.989	0.20	0.050	mg/L	1.0		99	90-110		
Matrix Spike (BJ42205-MS1)		**Source: 1410748-09**			Prepared & Analyzed: 10/22/14 15:10					
Total Kjeldahl Nitrogen	2.55	0.20	0.050	mg/L	1.0	1.61	94	90-110		
Matrix Spike Dup (BJ42205-MSD1)		**Source: 1410748-09**			Prepared & Analyzed: 10/22/14 15:10					
Total Kjeldahl Nitrogen	2.62	0.20	0.050	mg/L	1.0	1.61	101	90-110	2	20
Batch BJ42219 - Nitrite SM 4500NO2-B by seal										
Blank (BJ42219-BLK1)					Prepared & Analyzed: 10/22/14 11:14					
Nitrite (as N)	0.01 U	0.04	0.01	mg/L						
LCS (BJ42219-BS1)					Prepared & Analyzed: 10/22/14 11:14					
Nitrite (as N)	0.0800	0.04	0.01	mg/L	0.080		100	90-110		
Matrix Spike (BJ42219-MS1)		**Source: 1410748-01**			Prepared & Analyzed: 10/22/14 11:15					
Nitrite (as N)	0.0718 J2	0.04	0.01	mg/L	0.10	0.0451	27	77-119		
Matrix Spike (BJ42219-MS2)		**Source: 1411385-02**			Prepared & Analyzed: 10/22/14 11:16					
Nitrite (as N)	0.0274 I,J2	0.04	0.01	mg/L	0.10	ND	27	77-119		
Matrix Spike Dup (BJ42219-MSD1)		**Source: 1410748-01**			Prepared & Analyzed: 10/22/14 11:15					
Nitrite (as N)	0.0711 J2	0.04	0.01	mg/L	0.10	0.0451	26	77-119	1	20

Hazen and Sawyer
10002 Princess Palm Ave, Suite 200
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November 11, 2014
Work Order: 1410748

Inorganic, Dissolved - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ42219 - Nitrite SM 4500NO2-B by seal										
Matrix Spike Dup (BJ42219-MSD2)		**Source: 1411385-02**			Prepared & Analyzed: 10/22/14 11:16					
Nitrite (as N)	0.0285 I,J2	0.04	0.01	mg/L	0.10	ND	28	77-119	4	20
Batch BJ42226 - BOD Dissolved										
Blank (BJ42226-BLK1)					Prepared: 10/22/14 Analyzed: 10/27/14 13:24					
Carbonaceous BOD	2 U	2	2	mg/L						
LCS (BJ42226-BS1)					Prepared: 10/22/14 Analyzed: 10/27/14 13:24					
Carbonaceous BOD	227	2	2	mg/L	200		113	85-115		
LCS Dup (BJ42226-BSD1)					Prepared: 10/22/14 Analyzed: 10/27/14 13:24					
Carbonaceous BOD	224	2	2	mg/L	200		112	85-115	1	200
Duplicate (BJ42226-DUP1)		**Source: 1410748-02**			Prepared: 10/22/14 Analyzed: 10/27/14 13:24					
Carbonaceous BOD	49	2	2	mg/L		51			4	25
Batch BJ42416 - Nitrate 353.2 by seal										
Blank (BJ42416-BLK1)					Prepared & Analyzed: 10/24/14 12:08					
Nitrate+Nitrite (N)	0.01 U	0.04	0.01	mg/L						
LCS (BJ42416-BS1)					Prepared & Analyzed: 10/24/14 12:10					
Nitrate+Nitrite (N)	0.797	0.04	0.01	mg/L	0.80		100	90-110		
Matrix Spike (BJ42416-MS1)		**Source: 1410747-03**			Prepared & Analyzed: 10/24/14 15:17					
Nitrate+Nitrite (N)	49.2 L2	4.8	1.2	mg/L	1.0	55.0	NR	80-120		

Hazen and Sawyer
10002 Princess Palm Ave, Suite 200
Tampa, FL 33619

November 11, 2014
Work Order: 1410748

Inorganic, Dissolved - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ42416 - Nitrate 353.2 by seal										
Matrix Spike (BJ42416-MS2)		**Source: 1410747-06**			Prepared & Analyzed: 10/24/14 14:11					
Nitrate+Nitrite (N)	12.6 L2	0.96	0.24	mg/L	1.0	12.8	NR	80-120		
Matrix Spike Dup (BJ42416-MSD1)		**Source: 1410747-03**			Prepared & Analyzed: 10/24/14 15:18					
Nitrate+Nitrite (N)	50.5 L2	4.8	1.2	mg/L	1.0	55.0	NR	80-120	3	20
Matrix Spike Dup (BJ42416-MSD2)		**Source: 1410747-06**			Prepared & Analyzed: 10/24/14 14:12					
Nitrate+Nitrite (N)	12.4 L2	0.96	0.24	mg/L	1.0	12.8	NR	80-120	1	20
Batch BJ42924 - Ammonia by SEAL										
Blank (BJ42924-BLK1)					Prepared & Analyzed: 10/31/14 10:16					
Ammonia as N	0.009 U	0.040	0.009	mg/L						
LCS (BJ42924-BS1)					Prepared & Analyzed: 10/31/14 10:17					
Ammonia as N	0.47	0.040	0.009	mg/L	0.50		93	90-110		
Matrix Spike (BJ42924-MS1)		**Source: 1410919-08**			Prepared & Analyzed: 10/31/14 10:19					
Ammonia as N	0.47 J2	0.040	0.009	mg/L	0.50	ND	94	90-110		
Matrix Spike (BJ42924-MS2)		**Source: 1410919-13**			Prepared & Analyzed: 10/31/14 10:31					
Ammonia as N	0.51	0.040	0.009	mg/L	0.50	0.018	98	90-110		
Matrix Spike Dup (BJ42924-MSD1)		**Source: 1410919-08**			Prepared & Analyzed: 10/31/14 10:21					
Ammonia as N	0.44 J2	0.040	0.009	mg/L	0.50	ND	88	90-110	7	10
Matrix Spike Dup (BJ42924-MSD2)		**Source: 1410919-13**			Prepared & Analyzed: 10/31/14 13:58					
Ammonia as N	0.51	0.040	0.009	mg/L	0.50	0.018	98	90-110	0.4	10

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10002 Princess Palm Ave, Suite 200
Tampa, FL 33619

November 11, 2014
Work Order: 1410748

Microbiology - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ42137 - FC-MF										
Blank (BJ42137-BLK1)					Prepared: 10/21/14 Analyzed: 10/22/14 14:16					
Fecal Coliforms	1 U	1	1	CFU/100 ml						
Duplicate (BJ42137-DUP1)		**Source: 1410748-10**			Prepared: 10/21/14 Analyzed: 10/22/14 14:16					
Fecal Coliforms	1 U	1	1	CFU/100 ml		ND				200

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Hazen and Sawyer
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November 11, 2014
Work Order: 1410748

* Qualifiers, Notes and Definitions

Results followed by a "U" indicate that the sample was analyzed but the compound was not detected. Results followed by "I" indicate that the reported value is between the laboratory method detection limts and the laboratory practical quantitation limit.

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.

Test results in this report meet all the requirements of the NELAC standards. Any applicable qualifiers are shown below.

L2 Analyte level in sample invalidated Matrix Spike.
J2 Quality control value for accuracy was outside control limits.

Questions regarding this report should be directed to :

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Kathryn@southernanalyticallabs.com

SOUTHERN ANALYTICAL LABORATORIES, INC.
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SAL Project No. 1410748

Client Name: Hazan and Sawyer

Contact / Phone: Josefin Hirst 813-630-4498

Project Name / Location: BHS5 SE#11

Samplers: (Signature) [signature]

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

PARAMETER / CONTAINER DESCRIPTION

SAL Use Only Sample No.	Sample Description	Date	Time	Matrix	Composite	Grab	125mLP, $Na_2S_2O_3$ FC-MF, FC-QT	500mLP, Cool Total Alkalinity, TSS, VSS, CBOD, NOx, OP, SO_4	125mLP, H_2SO_4 COD, TKN, NH_3, TP	500mLP, NaOH & Zn Acetate H_2S	40mLaV, HCl TOC	500mLP, Cool Lab Filtered (CBOD, TKN, NH_3, NOx)	500mLP, Cool Lab Filtered (CBOD, TKN, NH_3, NOx, SO_4)		pH	Temperature	Conductivity	DO
01	BHS5-STE	10/21/14	11:40	WW		X	4	2	1	1	2				7.30	26.0	1215	0.02
02	BHS5-STE-FILTERED		11:40	WW		X						1			7.30	26.0	1215	0.02
03	BHS5-ST1		11:10	WW		X	4	2	1	1	2				6.98	23.4	1137	4.90
04	BHS5-ST1-DUP		11:20	WW		X	4	2	1	1	2				6.98	23.4	1137	4.90
05	BHS5-ST1-FILTERED		11:10	WW		X						1			6.98	23.4	1137	4.90
06	BHS5-LIGNO-0		10:40	WW		X	4	2	1	1	2				6.78	26.1	1074	0.03
07	BHS5-LIGNO-0-FILTERED		10:40	WW		X						1			6.78	26.1	1074	0.03
08	BHS5-ST2		10:20	WW		X	4	2	1	1	2				6.66	25.3	1302	0.05
09	BHS5-ST2-FILTERED		10:20	WW		X							1		6.66	25.3	1302	0.05
10	BHS5-EB		12:20	R		X	4	2	1	1	2							

Containers Prepared/ Relinquished	Date/Time: 1100 100614	Received: [signature]	Date/Time: 1240 100814
Relinquished: [signature]	Date/Time: 1245 10/21/14	Received: [signature]	Date/Time: 1245 10-21-14
Relinquished: [signature]	Date/Time: 258 10-21-14	Received: [signature]	Date/Time: 1455 10-21-14
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 1410748

Appendix B: Operation & Maintenance Log

Table B.1
Operation and Maintenance Log

Date	Description
6/24/2013	Construction - Stage 1 and Stage 2 tanks installed
6/25/2013	Construction - Drainfield distribution box installed and all pipework
7/9/2013	System Start-up
	Bull run valve switched from drainfield to Stage 1 biofilter
7/17/2013	System check
7/23/2013	Construction - sod installation
7/29/2013	Preliminary sample event No. 1
8/6/2013	Site visit. System ok.
	Need to add soil around low side of pump tank riser
8/15/2013	Preliminary sample event No. 2
9/27/2013	Sample Event No. 1
11/8/2013	Site visit. System ok.
11/27/2013	Site visit. System ok.
12/4/2013	Sample Event No. 2
12/23/2013	Site visit. System ok.
1/23/2014	Site visit. System ok.
1/31/2014	Site visit. System ok.
2/3/2014	Sample Event No. 3
2/4/2014	Sample Event No. 4
2/5/2014	Sample Event No. 5
2/6/2014	Sample Event No. 6
2/7/2014	Sample Event No. 7
2/12/2014	Site visit. System ok.
3/14/2014	Site visit. System ok.
4/11/2014	Sample Event No. 8
4/25/2014	Site visit. System ok.
	Revised mode of operation to recirculation to the Stage 1 biofilter sprayers.
	Set recirc ratio to 3:1.
	Installed Stage 1 biofilter piezometer for water level monitoring.

Table B.1 (con't)
Operation and Maintenance Log

4/29/2014	Site visit. System ok.
5/28/2014	Sample Event No. 9 (formal No. 5)
5/29/2014	Collected samples for product composition testing.
7/11/2014	Site visit. System ok.
	First and second sprayers in Stage 1 biofilter not spinning on dose. Fixed.
7/29/2014	Site visit. System ok.
	Cleaned STE effluent screen.
8/18/2014	Sample Event No. 10 (formal No. 6)
	Middle sprayer in Stage 1 biofilter not spinning on dose. Fixed.
9/19/2014	Site visit. System ok.
	Cleaned STE effluent screen.
10/21/2014	Sample Event No. 11 (formal No. 7)
	Cleaned STE effluent screen.

Appendix C: Vericomm PLC Data

Table C.1
Vericomm Data August 23, 2014 through October 21, 2014

System Status		10/21/14 10:04	9/19/14 9:06	8/23/14 3:10
Point	Description	Value	Value	Value
1	Alarm Status	OK	OK	OK
2	Alert Status	OK	OK	OK
3	System Mode	Normal	Normal	Normal
5	Timer Mode	Off	Off	Off
6	Active Off Time	60.0 Minutes	60.0 Minutes	60.0 Minutes
7	Active On Time	2.1 Minutes	2.1 Minutes	2.1 Minutes
9	Pump Mode	Off	Off	Off
10	Pump Status	Off	Off	Off
Settings				
Point	Description	Value	Value	Value
17	Off Cycle Time	60.0 Minutes	60.0 Minutes	60.0 Minutes
18	On Cycle Time	2.1 Minutes	2.1 Minutes	2.1 Minutes
19	Override Off Cycle Time	30.0 Minutes	30.0 Minutes	30.0 Minutes
20	Override On Cycle Time	0.7 Minutes	0.7 Minutes	0.7 Minutes
21	Minimum Override Cycles	3.0 Cycles	3.0 Cycles	3.0 Cycles
23	Override Cycle Limit per Day	7.0 Cycles	7.0 Cycles	7.0 Cycles
24	Time Limit per Day	26.0 Minutes	26.0 Minutes	26.0 Minutes
25	High Level Pump Test	2.0 Minutes	2.0 Minutes	2.0 Minutes
28	Alarm Update Interval	120.0 Minutes	120.0 Minutes	120.0 Minutes
29	Page Delay	960.0 Minutes	960.0 Minutes	960.0 Minutes
30	Page Interval	30.0 Minutes	30.0 Minutes	30.0 Minutes
31	Local Alarm Delay	1140.0 Minutes	1140.0 Minutes	1140.0 Minutes
32	Local Reactivate Delay	120.0 Minutes	120.0 Minutes	120.0 Minutes
Troubleshooting				
Point	Description	Value	Value	Value
33	Top Float Status	OK	OK	OK
34	Middle Float Status	OK	OK	OK
35	Bottom Float Status	OK	OK	OK
37	Contactor Status	OK	OK	OK
38	Pump Status	OK	OK	OK
40	Filter Status	OK	OK	OK
41	Tank Status	OK	OK	OK
43	Power Status	OK	OK	OK
Flow Data (at the time of Vericomm call-in)				
Point	Description	Value	Value	Value
49	Pump Run Time Today	6.0 Minutes	6.2 Minutes	2.0 Minutes
50	Override Cycles Today	0	0	0
51	Pump Cycles Today	6.0 Cycles	6.0 Cycles	2.0 Cycles
52	Average Run Time per Cycle Today	1.0 Minutes	1.0 Minutes	1.0 Minutes
54	Brownouts Today	0	0	0

Table C.1 (continued)
Vericomm Data August 23, 2014 through October 21, 2014

		10/21/14 10:04	9/19/14 9:06	8/23/14 3:10
30-Day History Data				
Point	Description	Value	Value	Value
65	30 Day Average Run Time per Day	16.1 Minutes	16.9 Minutes	14.7 Minutes
66	30 Day Average Override Cycles per Day	0.2 Cycles	0.0 Cycles	0.0 Cycles
67	30 Day Average Cycles per Day	14.6 Cycles	15.2 Cycles	13.1 Cycles
68	30 Day Average Run Time per Cycle	1.1 Minutes	1.1 Minutes	1.1 Minutes
71	30 Day Total Pump Run Time	482.1 Minutes	506.5 Minutes	440.5 Minutes
72	30 Day Total Override Cycles	7.0 Cycles	0.0 Cycles	0.0 Cycles
73	30 Day Total Cycles	437.0 Cycles	457.0 Cycles	394.0 Cycles
76	30 Day Total Brownouts	0	2	1
Totalized Pump Data				
Point	Description	Value	Value	Value
82	Pump Total Run Time	69.7 Hours	60.8 Hours	53.1 Hours
83	Pump Total Cycles	4443.0 Cycles	3969.0 Cycles	3553.0 Cycles
Miscellaneous				
Point	Description	Value	Value	Value
145	Pump On Auto	Off	Off	Off
147	Pump Test Today	Off	Off	Off
148	Pump Check Enable	Off	Off	Off
149	Total Override Cycles	0	0	0
150	High Level Condition	Off	Off	Off
151	Leak Check Enable	Off	Off	Off
152	Brownout State	Off	Off	Off
153	Test Mode	Off	Off	Off
Alarm Points				
Point	Description	Value	Value	Value
161	General Alarm	Off	Off	Off
162	New Alarm	Off	Off	Off
163	Update Central Enable	On	On	On
167	Page Alarm Start	Off	Off	Off
168	Pager Signal	Off	Off	Off
169	Local Alarm Start	Off	Off	Off
170	Local Alarm Silence	Off	Off	Off
Inputs & Outputs				
Point	Description	Value	Value	Value
177	High Level/Override Timer Float Input	Off	Off	Off
178	Timer Float Input	Off	Off	Off
179	Redundant Off Float & Low Level Alarm Input	On	On	On
181	Push To Silence Input	Off	Off	Off
182	Auxiliary Contact Input	Off	Off	Off
186	Pump Output	Off	Off	Off
188	Alarm Light Output	Off	Off	Off
189	Audible Alarm Output	Off	Off	Off