Florida Department of Health
Onsite Nitrogen Reduction Strategies Study

Contract CORCL

TASK B.6

Installation Report for Passive Nitrogen Reduction System B-HS5

June 2013

Task B of the Florida Onsite Nitrogen Reduction Strategies Study (FOSNRS) includes performing field experiments to critically evaluate the performance of nitrogen removal technologies that were identified and pilot tested in FOSNRS Task A. To meet this objective, full scale treatment systems will be installed at various residential sites in Florida, operated on septic tank effluent under actual onsite conditions, and monitored over an extended timeframe. 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 installation of a passive nitrogen reduction system at a home site in Seminole County, Florida (B-HS5).

System Overview

The B-HS5 system was installed in Seminole County, Florida in June 2013. It consists of three additional tanks to the existing permitted system: 1500 gallon plastic tank Stage 1 unsaturated media filter; 300 gallon concrete pump tank; and 1,500 gallon two chamber concrete Stage 2 saturated media biofilter. Figure 1 is a site schematic showing the system components and layout of the installation. The complete as-built system drawings are included in the attached Appendix A.

Household wastewater enters the existing 1,350 gallon primary tank and exits as septic tank effluent through an effluent screen. The septic tank effluent contents are discharged by gravity to a distribution box, located inside the Stage 1 biofilter, which splits the flow between two perforated distribution pipes along the top of the unsaturated Stage 1 biofilter media. The Stage 1 biofilter contains 12.8 inches of coarse expanded clay media (Riverlite^{TM} 1/4; 1.1 to 4.8 mm) above 21 inches of finer expanded clay media (Riverlite^{TM} 3/16; 0.6 to 2.4 mm). Wastewater percolates downward through the expanded clay media where nitrification occurs. Stage 1 biofilter effluent then flows into the pump tank (which contains the pump and float switches). 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 for recirculation with the rest proceeding to the Stage 2 biofilter. The system was designed with two modes of operation. The first option (which will initially be tested) is to have 100 percent of the Stage 1 effluent discharge to the Stage 2 biofilter. The second option is to have the recirculated effluent return to the top of the Stage 1 biofilter, dispersed by five spray nozzles. The recirculated effluent would have an opportunity to mix with incoming septic tank effluent discharged by the distribution box. Recirculation back to the Stage 1 biofilter increases the hydraulic loading on the Stage 1 biofilter. Effluent from the unsaturated (Stage 1) media tank enters the denitrification (Stage 2) biofilter into a standing water column lying above 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 Stage 2 biofilter contains 42-inches of lignocellulosic media in the first chamber. A collection pipe along the bottom transfers the effluent to the second chamber which contains 18-inches of elemental sulfur mixed with oyster shell media. The Stage 2 biofilter effluent discharges near the top of the tank; therefore denitrification occurs in the saturated environment. The denitrified treated effluent is discharged into the soil via the existing drainfield which is a standard bed. A flow schematic of the system is shown on Figure 2.

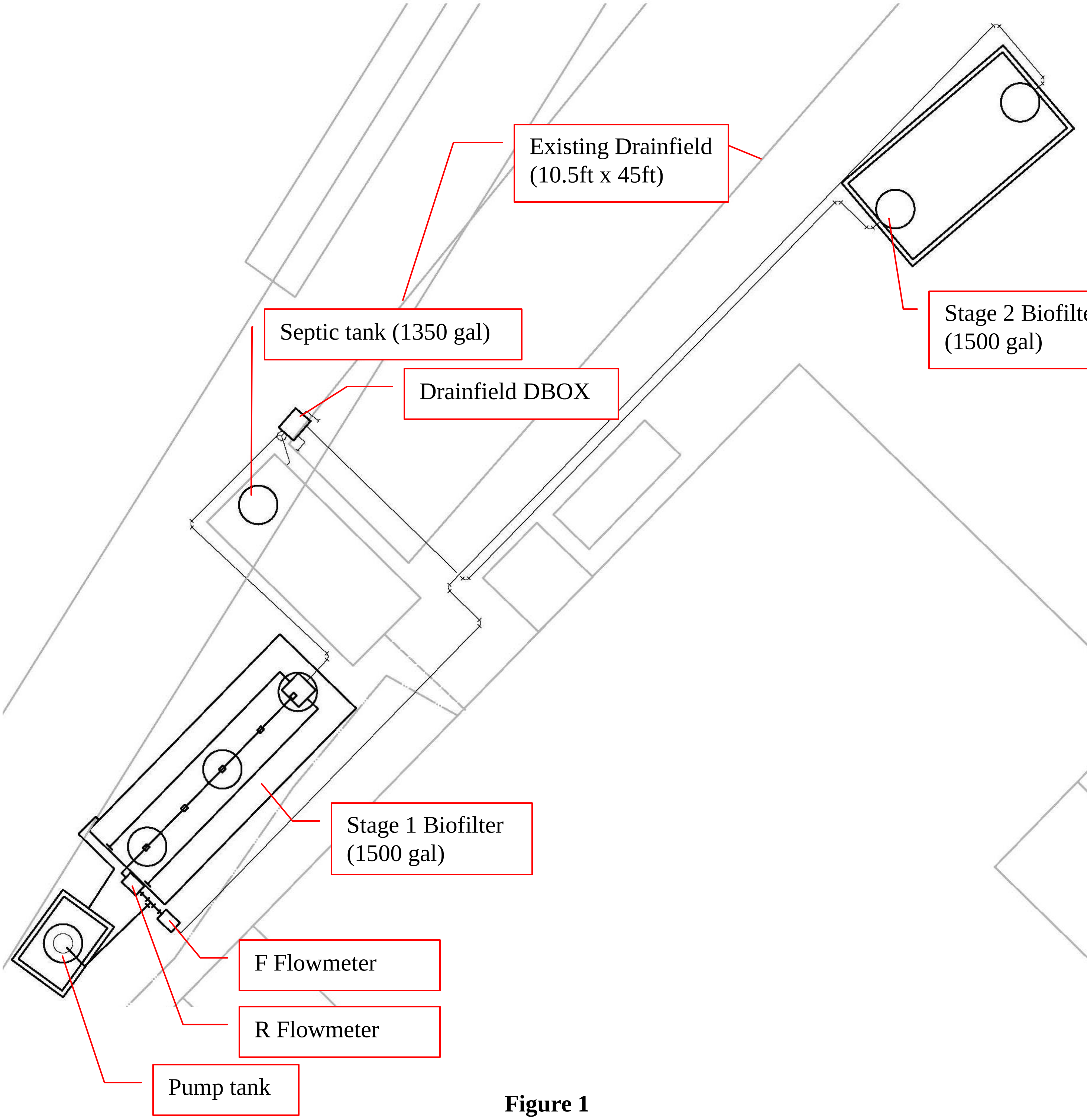

Figure 1
Schematic of B-HS5 PNRS installed in Seminole county

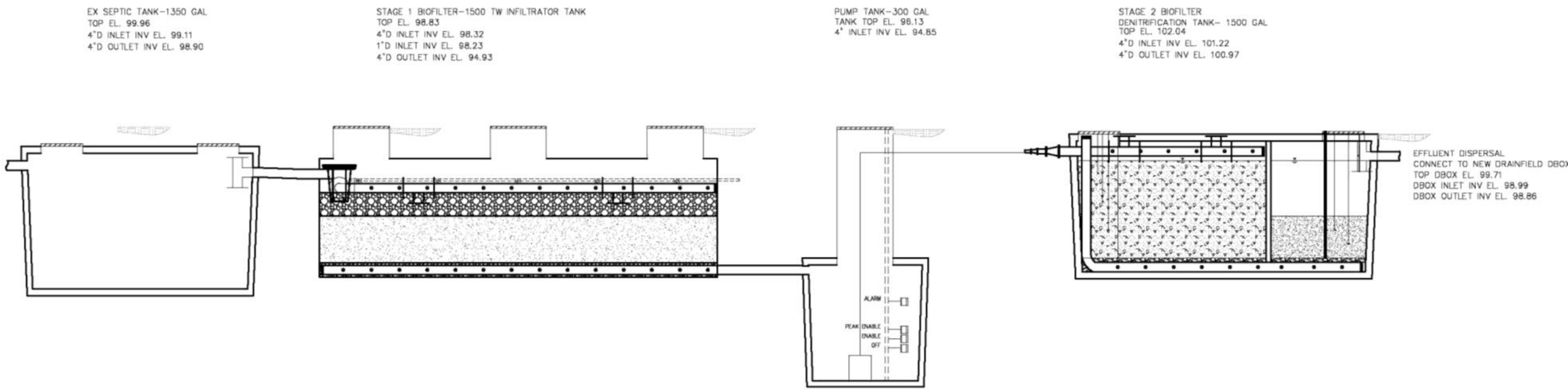

Figure 2
Flow Schematic of B-HS5 PNRS installed in Seminole county

Installation

Installation of the system commenced June 24, 2013 and was completed on June 28, 2013. The installation began with removing the existing concrete sidewalk (Figure 3) which was covering the existing septic tank outlet and existing concrete d-box for the drainfield (Figure 4). A new distribution box was installed (Figure 5). A two-way valve (Bull Run™) (Figure 5) was installed following the septic tank outlet to allow the flow to either be completely directed to the new passive system (to the Stage 2 biofilter) or to the distribution box (to the existing drainfield). A riser pipe was installed to grade over the valve, so that the valve can be turned after installation is complete. The valve is turned with a wrench on a rod which is long enough to reach with the riser installed.

Figure 3
Concrete sidewalk removed

Figure 4
Existing drainfield distribution box

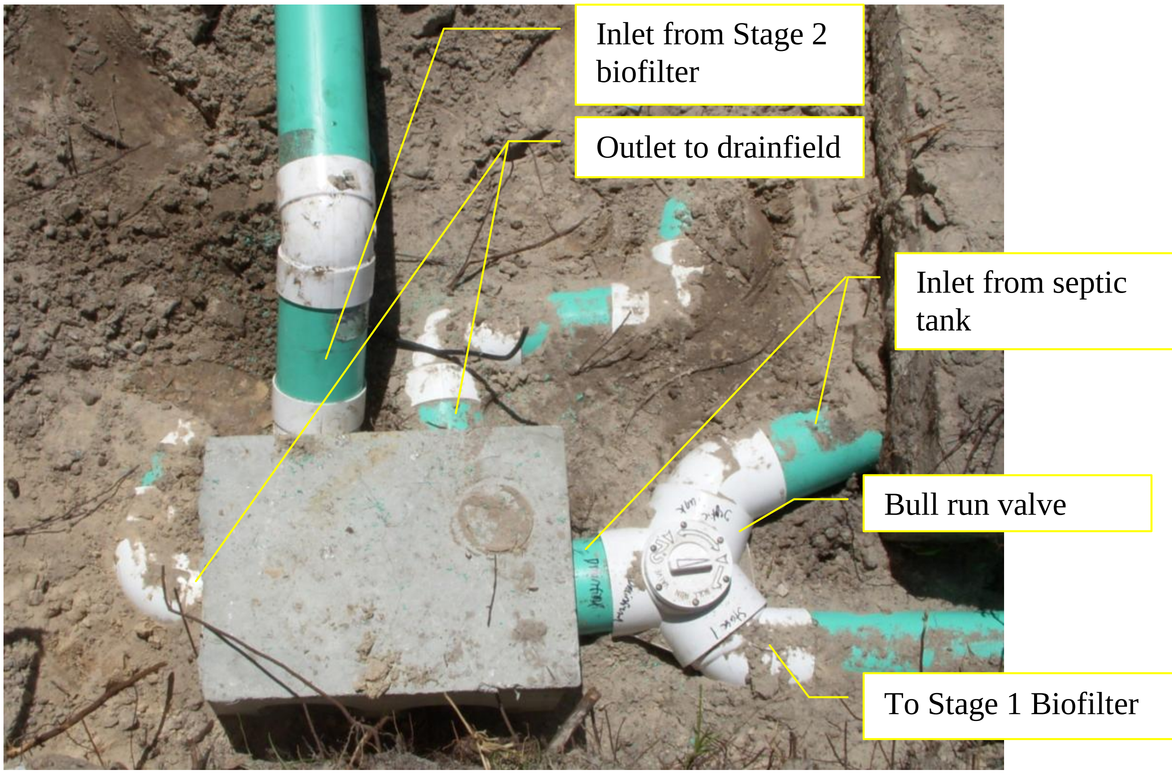

Figure 5
New drainfield distribution box

An effluent screen (Polylok™, PL-68) was installed in the outlet tee of the second chamber (Figure 6).

Figure 6
1,350 gallon, primary Tank effluent screen

The remaining passive nitrogen reduction system components were installed (Table 1). A single chamber (1,500 gallon) plastic Infiltrator™ tank was installed beside the primary tank (Figure 7). The purpose of this tank is to hold the Stage 1 expanded clay media. The 4"D inlet of the tank is connected (gravity flow) to the septic tank outlet. The 1"D inlet, installed through the standard outlet, is connected (pressurized flow) to the recirculation pipe from the pump tank (Figure 8). The 3"D outlet (Figure 8) of the pipe is located near the bottom of the tank to allow for unsaturated operation. Following gravel installation and leveling (Figure 9), 21-inches of fine (3/16 Riverlite™) expanded clay media was installed (Figure 10). Above the fine media, 12-inches of coarse (1/4 Riverlite™) expanded clay media was installed (Figure 11). Following media installation and leveling, the influent distribution network was installed (Figure 11). The 4"D influent pipe, connected to the septic tank discharge, discharges into a distribution box which flows to two 3"D perforated pipes across the top of the media (Figure 11). The 1"D influent pipe was installed along the centerline with five spray nozzles attached to distribute the recirculated effluent (Figure 12). The spray nozzles are removable for cleaning in the event clogging occurs (Figure 12).

Table 1
Passive Nitrogen Reduction System Components

	Tank Volume (gal)	Surface Area (ft^2)	Media
Primary Tank	1,350	55	none
Stage 1 Biofilter	1,500	78	• 12" Riverlite 1/4 • 21" Riverlite 3/16
Pump Tank	300	12	none
Stage 2a Biofilter, downflow	1,000 (1,500 total)	36 (54 total)	42" lignocellulosic (Southern yellow pine)
Stage 2b Biofilter, upflow	500 (1,500 total)	18 (54 total)	18" Elemental sulfur (90%) & oyster shell mixture (10%)

Figure 7
1500 gallon, single chamber, stage 1 biofilter tank

Figure 8
Stage 1 biofilter 3”D outlet pipe, with cleanout

Figure 9
Stage 1 biofilter gravel underdrain

Figure 10
Stage 1 biofilter 21-inches of fine media (3/16 Riverlite™)

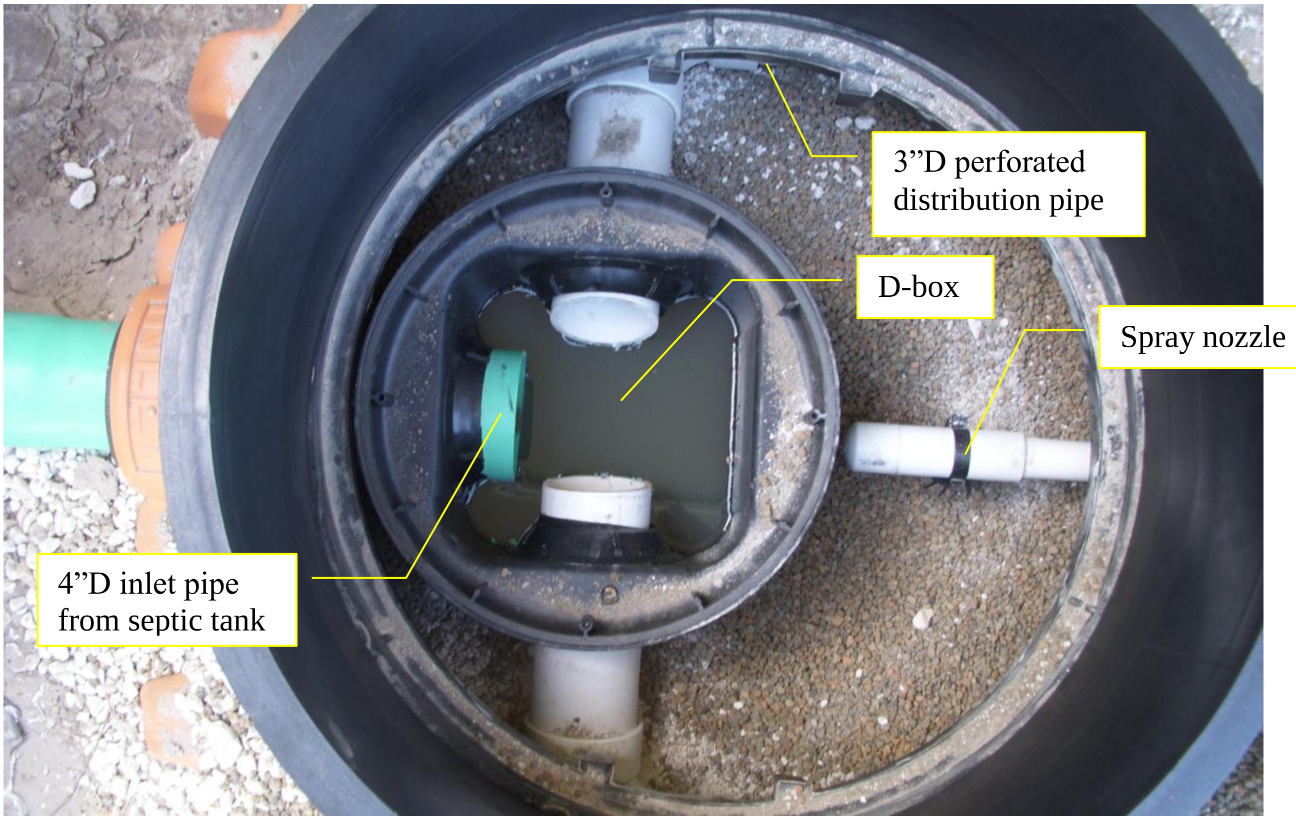

Figure 11
Stage 1 biofilter 12-inches of coarse media (1/4 Riverlite™)

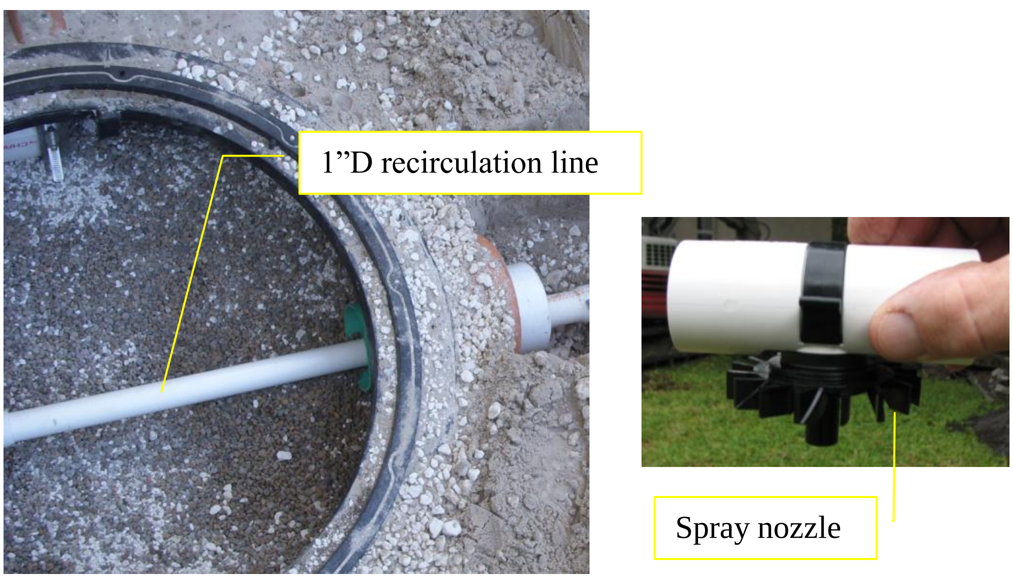

Figure 12
Stage 1 biofilter 1"D influent recirculation line

Next, the 300 gallon concrete pump tank was installed downgradient of the Stage 1 biofilter (Figure 13). The standard outlet pipe connection was plugged since the pump discharge pipe is installed through the riser. The pump was installed within a holding bracket which also supports the float tree (Figure 14). Three float switches were installed to maintain the effluent level in the pump tank and are attached to a float tree installed in the pump tank and connected to the control panel. The height of the floats is adjustable and once the proper heights were established, screws were used to secure the floats to the float tree.

Two inline flow meters were installed following the pump discharge (Figure 15). The pump discharge line was split so that a portion of the flow could be recirculated back to the Stage 1 biofilter while the rest of the flow proceeded to the Stage 2 biofilter. Two throttling gate valves were installed to allow for the adjustment of forward flow (F) and recirculated flow (R) to achieve the target recirculation ratio. The first inline flow meter installed downstream of the F globe valve measures the forward wastewater flow to the Stage 2 biofilter (Figure 15). The second flowmeter installed downstream of the R gate valve, to record the recirculated flow to the Stage 1 biofilter in gallons pumped from the pump tank (Figure 15). As previously discussed, the design includes two modes of operation. The first option (which will initially be tested) is to have the gate valves set so that there is no recirculation (100 percent F flow). Therefore, all the Stage 1 effluent is discharged to the Stage 2 biofilter. The second option is to have the recirculated effluent return to the top of the Stage 1 biofilter, dispersed by five spray nozzles. The recirculated effluent would have an opportunity to mix with incoming septic tank effluent discharged by the distribution box.

Figure 13
300 gallon pump tank

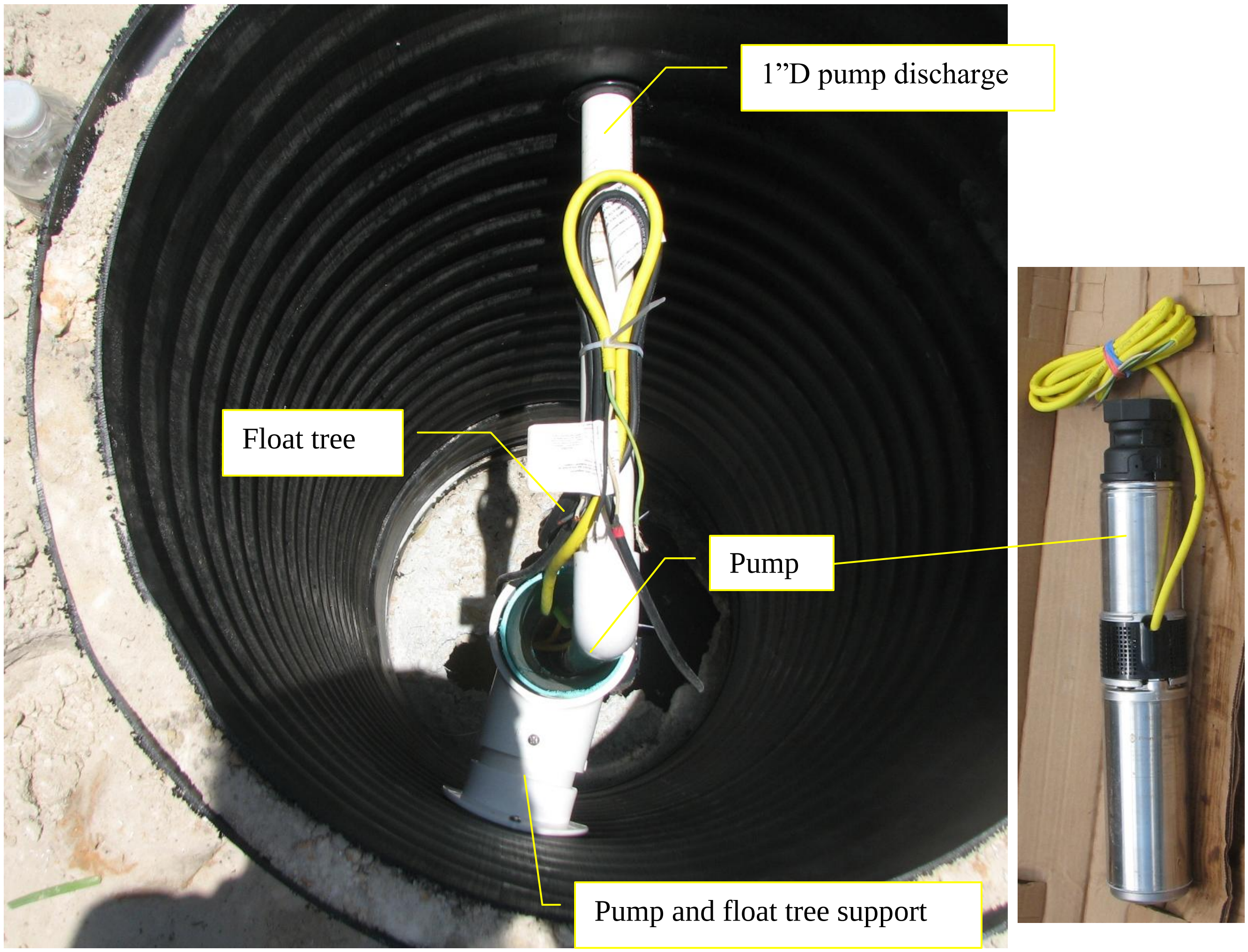

Figure 14
300 gallon pump tank (pump and float tree)

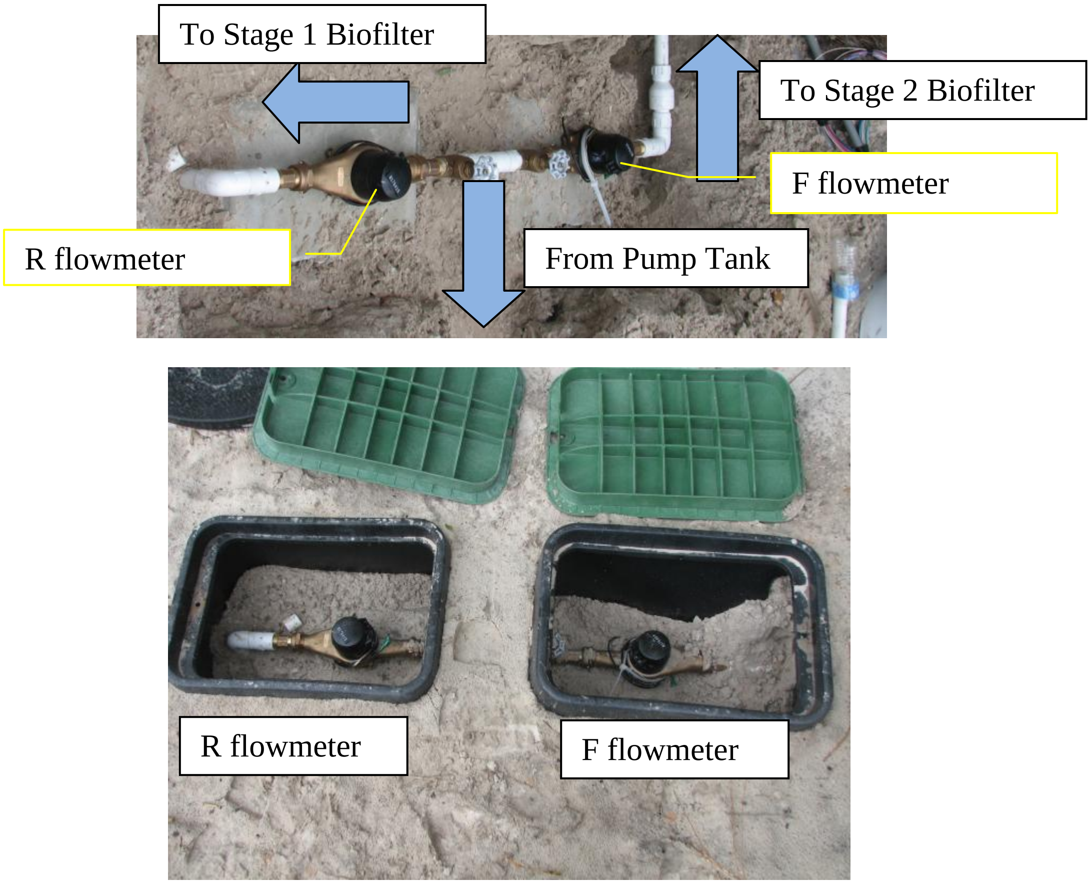

Figure 15
Flowmeters and flow split

The last tank installed was a two chamber (1,500 gallon) concrete tank (Figure 16). The purpose of this tank is to hold the Stage 2 lignocellulosic and sulfur media. The 1"D pipe downstream of the F flowmeter is expanded to 4"D and connects to a perforated pipe which distributes nitrified effluent over the lignocellulosic media within the first chamber of the Stage 2 biofilter. The nitrified effluent flows downward through the lignocellulosic media (within first chamber) and upward through the sulfur media mixture (within second chamber).

A 4"D underdrain pipe (perforated) with gravel surrounding was installed along the centerline of the bottom of the tank for transfer from the first chamber to the second chamber. The tank arrived with a coupling cast into the baffle wall near the bottom to connect both chambers of the tank. Following the underdrain gravel installation (Figure 17) and leveling, 18-inches of elemental sulfur and oyster shell media was installed and mixed (Figure 18) within the second chamber. A stainless steel drivepoint sampler tree (Figure 19) was installed for sampling at 6 and 12-inches above the bottom of the sulfur media mixture.

Above the gravel underdrain within the first chamber of the tank, 42-inches of lignocellulosic media was installed (Figure 19). A stainless steel drivepoint sampler tree was installed for sampling at 0, 12, 24 and 36-inches above the bottom of the lignocellulosic media (Figure 19). A 4"D perforated pipe was connected to the inlet of the tank for effluent dispersal above the lignocellulosic media (Figure 19). The 4"D outlet is connected to the distribution box to the existing drainfield.

Figure 16
1,500 gallon stage 2 biofilter tank

Figure 17
Stage 2 biofilter tank gravel underdrain covering perforated pipe along bottom

Figure 18
Stage 2 biofilter tank (sulfur mixed with oyster shell)

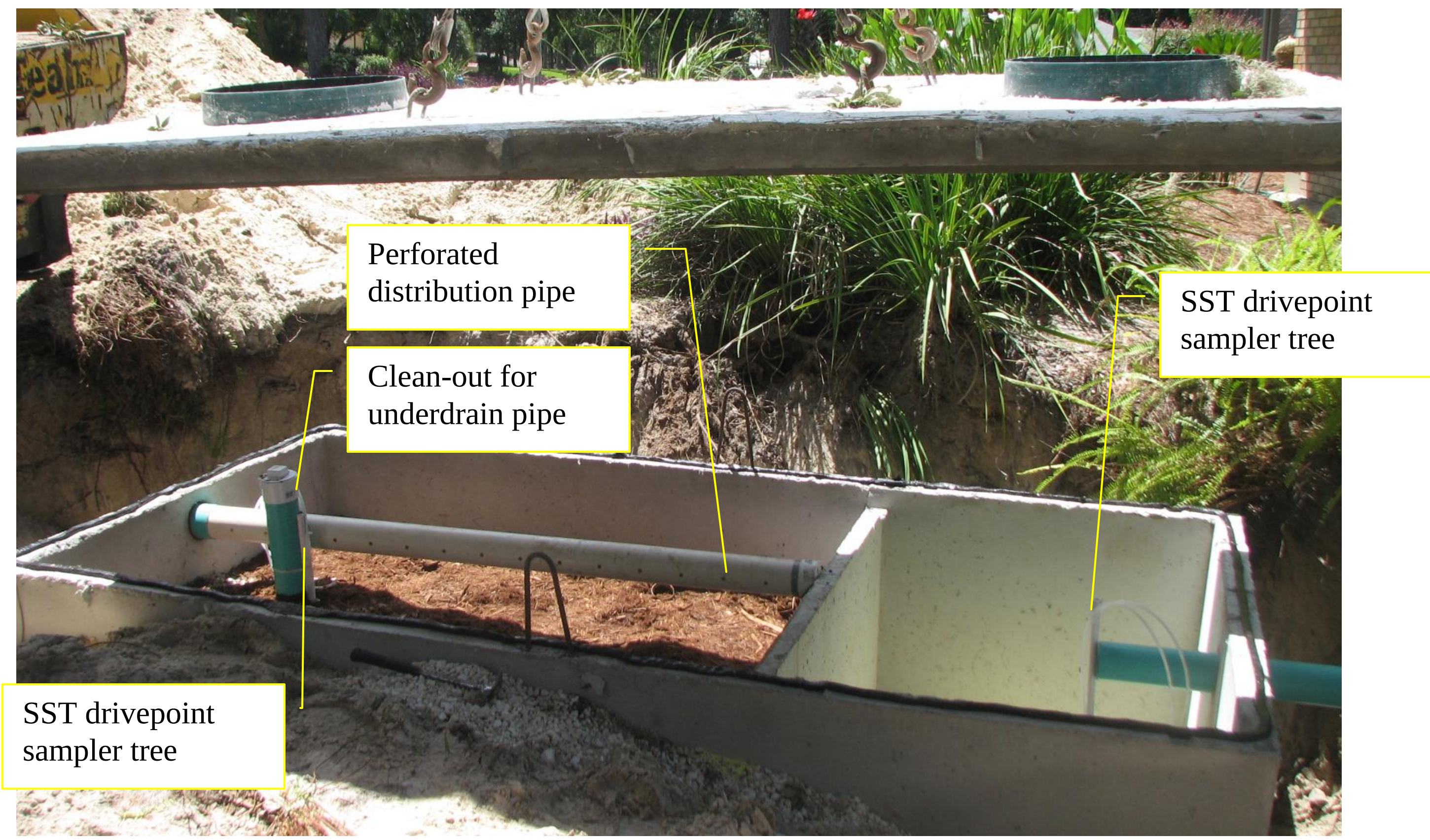

Figure 19
Stage 2 biofilter tank (lignocellulosic media)

A power meter was installed between the main power box of the house and the control panel to record cumulative power usage of the system in kilowatts. The equipment connected to the power meter are the pump and the control panel. Figure 20 shows the power meter installed inside the control panel.

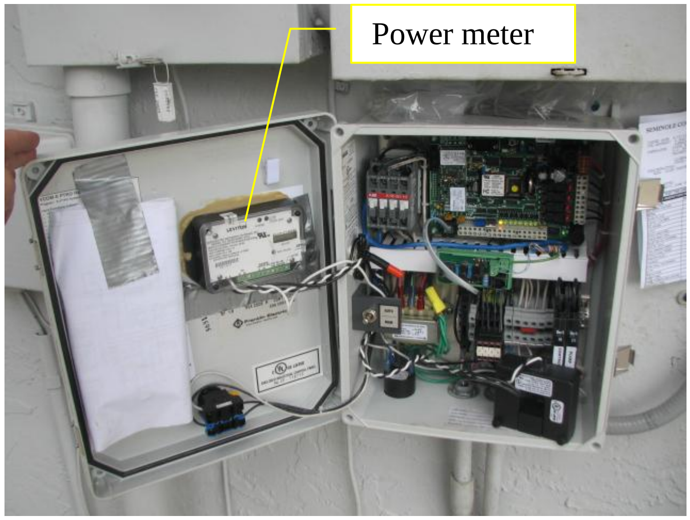

Figure 20
Control Panel

The system control panel (Figure 20) allows for a timed pump cycle which can be overridden if the effluent levels are too low or too high in the pump tank. If the floats indicate a low effluent level in the tank, the timed cycle is turned off to protect the pump. If the floats indicate a high effluent tank level, then the pump cycles faster (off cycle reduced) until the water level reaches the optimal range. An alarm will indicate if the water level goes above a critical level. The control panel is connected to a phone line which transmits data to Vericomm for monitoring.

During final testing of the system, the system operated with no visible signs of leaks, etc. The system area was filled and all disturbed areas on the property were graded (Figure 21).

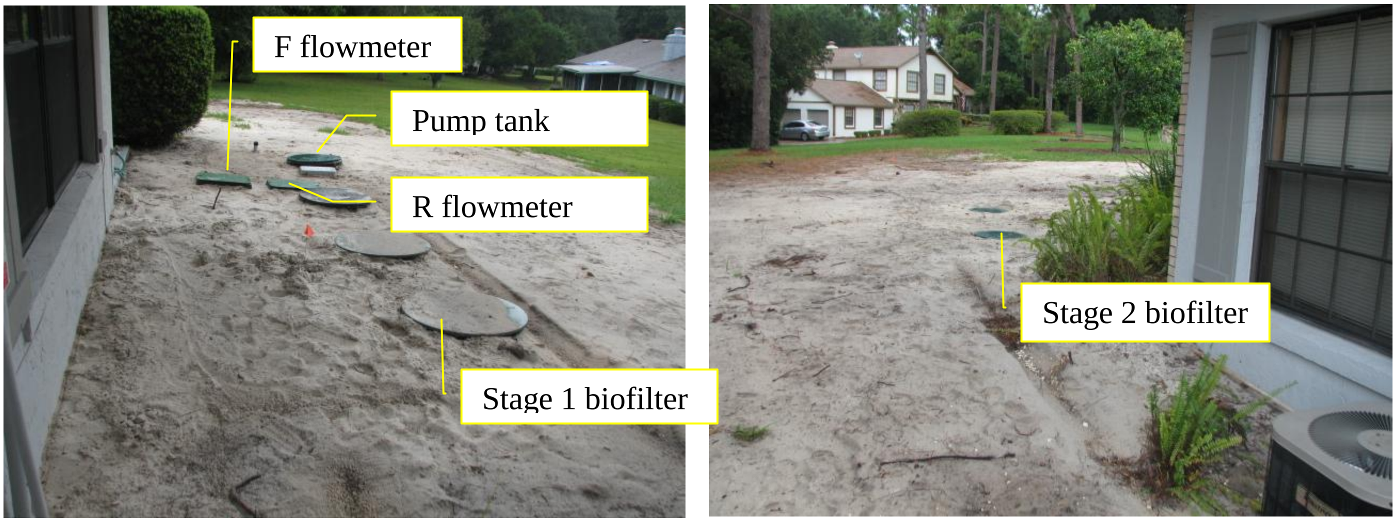

Figure 21
Overall PNRS system installed

Estimated Cost

The final construction cost for the installed system was $22,361.55 as detailed in Appendix B.

System Start-up

The system was started up July 8, 2013, when all flow was diverted to the new passive system. Routine checks of the system will be made to ensure the system is functioning as intended.

APPENDIX A

RECORD DRAWINGS

APPENDIX B

CONSTRUCTION COSTS