

***Construction Summary: Assessment of the Nitrogen Removal and  
Viability of a Reactive Layer with Liner under a Conventional Septic  
System Drainfield***

***Division of Environmental Assessment and Restoration***

***Florida Department of Environmental Protection***

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## Introduction

Construction of the experimental drainfield at 1914 Orchard Drive in Apopka was completed during the week of July 18, 2016. Site restoration and installation of the monitoring devices occurred the following week. This summary provides information on the construction activities and challenges as well as specifics on measurements and any deviations from the construction and monitoring plan. In general, only minor deviations from the original design occurred. The experimental drainfield was put on line on July 29, 2016.

## Experimental Design

This experimental drainfield was constructed as designed for the most part. Construction activities, actual dimensions and deviations are described below. **Figure 1** shows the site layout. **Figures 2, 3 and 4** show the actual dimensions and depths of components as installed. **Figures 5 and 6** show the actual locations and depths of the monitoring components. **Table 1** provides summary information on the construction depths and relative elevations of system components and monitoring devices. Photographs in **Appendix A** document the stages of construction and methods used for installation.

- This design was constructed using a conventional gravity flow drainfield system consisting of a bed of infiltration chambers. The actual drainfield footprint was 9 feet by 36 feet instead of 10 by 36 feet, which resulted in a wider than anticipated margin between the drainfield edge and the edge of the liner.
- The drainfield was underlain by 19 to 20 inch thickness of native sand.
- A 13 to 14-inch thickness of recycled wood mulch was installed. After compaction, the thickness of the wood mulch layer may be closer to 10 inches in thickness. The recycled wood mulch consisted of 4 inch or finer shredded hardwood obtained from Raynor Shine Wood Mulch Products in Apopka.
- A 30 mil reinforced polyethylene liner was installed on a level surface before the mulch was emplaced. Leveling of the bottom was done by hand with use of a laser level and

carpenter's level. The liner was manufactured by GEI Works for ponds and lagoons. Sand was installed by hand along the outside edge of the liner to create a sloped berm around the margins of the liner. A level and tape were used to make certain that the edge of the liner on the berm was consistently 6 inches about the bottom. Water percolating through the sand and wood mulch will collect on the liner to create a saturated zone of 6 inches within the mulch, flow over the edge of the plastic sheeting, and continue to seep downward.

- Monitoring devices were installed to measure water quality in the effluent, infiltrating effluent above the mulch layer, water residing within the saturated zone on top of the liner, infiltrating treated water along the liner edges, and shallow ground water immediately adjacent to the experimental drainfield. Water levels will be measured to monitor mounding within the mulch layer and flow to the system will be measured with a flow meter installed on the water supply line to the residence.

## **Installation Steps**

The installation of the experimental drainfield and monitoring system occurred during the weeks of July 18 and 25. Construction took 5 days, followed by 2 days of work to install monitoring devices and 1.5 days of site restoration. **Table A1** in **Appendix A** provides a timeline of the construction project, instrumentation for monitoring and site restoration.

The following activities occurred in the construction and set up of the experimental drainfield:

**1-Preparing the Septic Tank Outlet and Installation of Flow Diversion:** Shelley's Septic Tanks was the contractor who installed the system. The contractor exposed the top and outlet end of the septic tank to install new piping to connect the septic tank to both the in-use drainfield and the experimental drainfield. Two knife valves were installed side by side at the septic tank outlet end to divert flow. These were both enclosed in a 2-foot-diameter riser with domed lid. In addition, the contractor replaced a section of the septic tank lid which showed signs of deterioration and installed a riser on top of the new lid at the tank outlet end. The tank outlet was used as an elevation reference for all of the experimental drainfield



components. The bottom of the tank outlet was approximately 3 feet (36 inches) below land surface in the tank area.

**2-Excavation of Pit and Leveling:** The contractor used a Case 580 Series backhoe loader to excavate the pit for installation of the liner, mulch, sand backfill, and drainfield and a mini trachoe to complete backfilling and leveling. Due to caving sands, the actual excavation dimensions exceeded the footprint of the 16 by 42 foot lined area by 3 to 4 feet on each side. Due to the depth of the septic tank outlet, which was approximately 3 feet below land surface, it was necessary to excavate the pit to a depth of approximately 7 feet. This required removal and management of approximately 300 cubic yards of material from the pit area. To manage the amount of stockpiled material and allow access of the equipment for mulch installation and backfilling, the excavation of the pit, installation of the liner and installation of the mulch occurred in stages.

**3-Liner Installation:** The liner was installed in three stages and met the construction specifications for width and length and uniform depth below the reference elevation. At completion, the bottom of the lined area was 16 by 42 feet. To allow it to be installed in stages, the liner was first unfolded and spread out on an obstruction-free area, properly oriented to be installed, then rolled up so that it could be put in the pit and unrolled as construction proceeded. Installation proceeded from the header end, with liner installed beneath the area to be covered by the header. It was emplaced on the smoothed and leveled bottom of the pit so that at least 3 feet of liner extended beyond the anticipated edge of the drainfield in all four directions. The edges of the liner were turned up on a sloped berm of sand to create a uniform 6 inch depth of the reservoir. The liner bottom is approximately 75 inches (6.8 feet) below land surface, which is 39 inches (3.3 feet) below the septic tank outlet.

**4-Mulch Layer Installation:** The contractor obtained approximately 27 cubic yards of wood mulch from Raynor Shine and stockpiled it for installation after the liner was prepared. The installation of the mulch was preceded by the installation of clean backfill on top of the liner at the header end. At the header end, the sand layer extended to the edge of the drainfield. The installation of the mulch then proceeded. Marked stakes inserted in the mulch area on top of the liner were used to maintain a uniform thickness of mulch as it was

installed, compacted by walking on it, and leveled. The edge of the mulch layer was kept within the level portion of the lined area. The thickness of the mulch at installation ranged from 13 to 14 inches (1.1 feet), as the surface of the mulch was irregular.

**5-Backfilled Sand Layer Installation:** Clean sand from the stockpile was installed on top of the mulch layer after it was installed. Sand was installed to an average thickness of 19 inches (1.6 feet). Sand installed directly on the liner at the header end of the drainfield was packed down and built up to support the header. After setting the header, the sand layer was then smoothed and sloped to achieve the necessary fall from the header as the rows of infiltrators were installed.

**6-Drainfield Installation:** The drainfield was constructed of 4 rows of infiltration chambers that were spaced approximately 6 inches apart. This drainfield is 9 feet wide by approximately 36 feet long and has 432 square feet of infiltrative surface. The drainfield was constructed of Infiltrator Quick 4 EQ36™ infiltration chambers that were covered by fabric prior to burial. The drainfield was oriented on top of the lined area so that a minimum of 3 feet of lined margin extended on all sides. Actual margin ranged from 3 feet 4 inches to 5 feet because the drainfield was 1 foot narrower than the design and had to be articulated slightly to accommodate piezometers that were installed earlier. The edge of the liner was marked by wooden stakes and PVC pipes that were placed to help locate the position of deep lysimeters to be installed after construction.

**7-Monitoring Device Installation:** The monitoring devices installed during the construction phase included 6 horizontal well points installed on top of the liner perpendicular to the long axis and 3 piezometers that were installed on top of the liner along the midline of the drainfield. After the construction, 6 deep lysimeters were installed along the edge of the liner, 6 shallow lysimeters were installed between the infiltration chambers to monitor infiltrating water above the mulch layer and 1 shallow lysimeter was installed beneath the header. In addition, a flow meter was installed on the water supply line from the well to measure flow of water to the house and drainfield (excluding the irrigation system). A monitoring well installed adjacent to the drainfield site prior to the construction activities will also be included in the monitoring plan. Depths of the monitoring devices were established using the bottom of the septic tank outlet as an elevation point of reference. **Table 1**

provides the monitoring device installation depths and bottom elevations relative to the experimental drainfield system components.

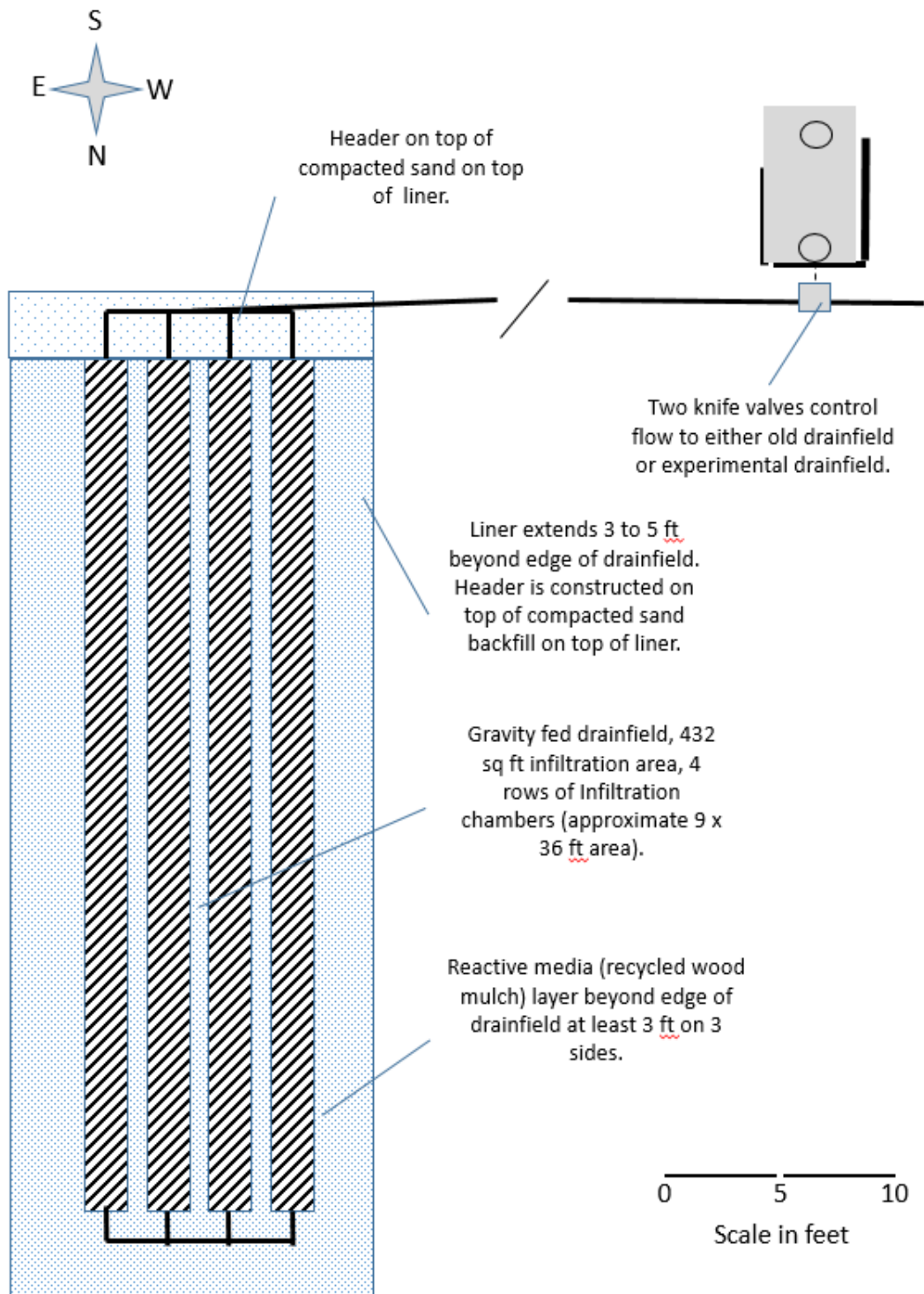
**6-Site Restoration:** After the drainfield was installed, the remaining open excavation was carefully backfilled and smoothed to the pre-existing grade. The combined area of the excavation site, soil and mulch stockpile areas and equipment turnaround areas was approximately 60 by 80 feet. This entire area was resodded after the site grading, removal of excess mulch and rubble, and installation of the monitoring devices.

## **Next Steps**

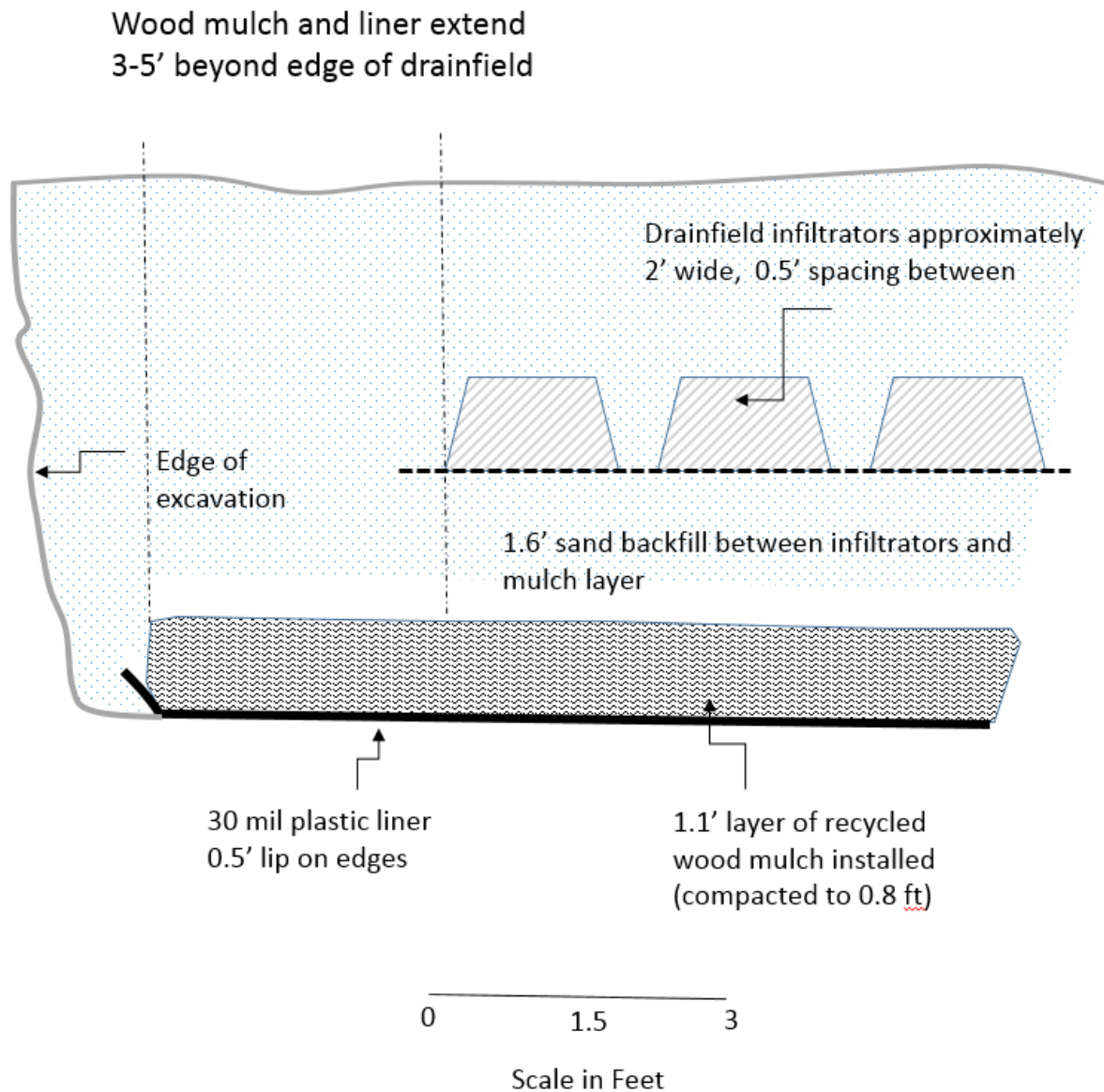
DEP staff will return to the site after 1 month of system operation to collect samples and record measurements of flow and water levels in the piezometers and monitoring well. After three months of monitoring data are collected and analyzed, the first quarterly report will be submitted.



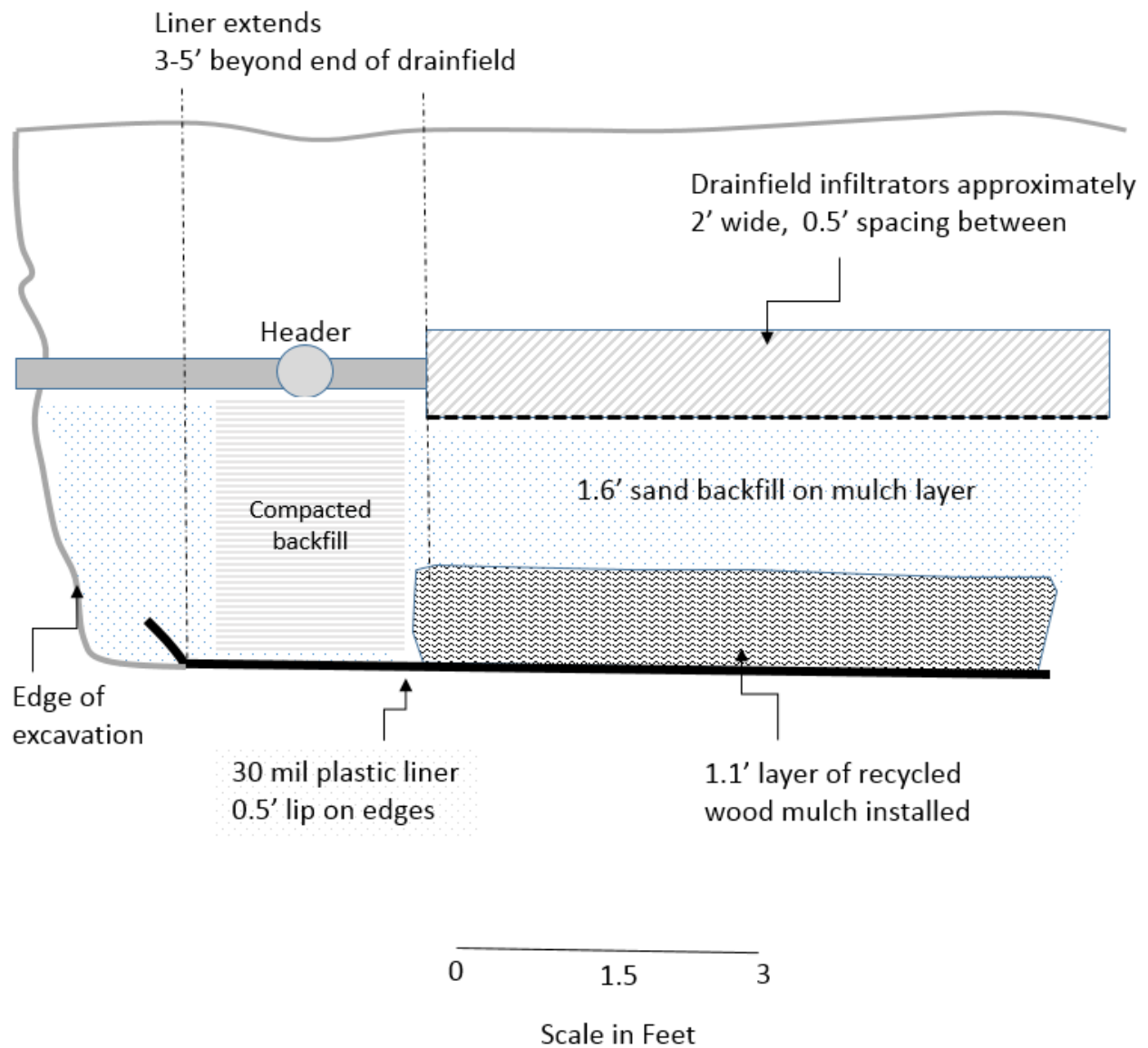
*Figure 1. Study site with existing septic tank, old drainfield area, and experimental drainfield locations.*



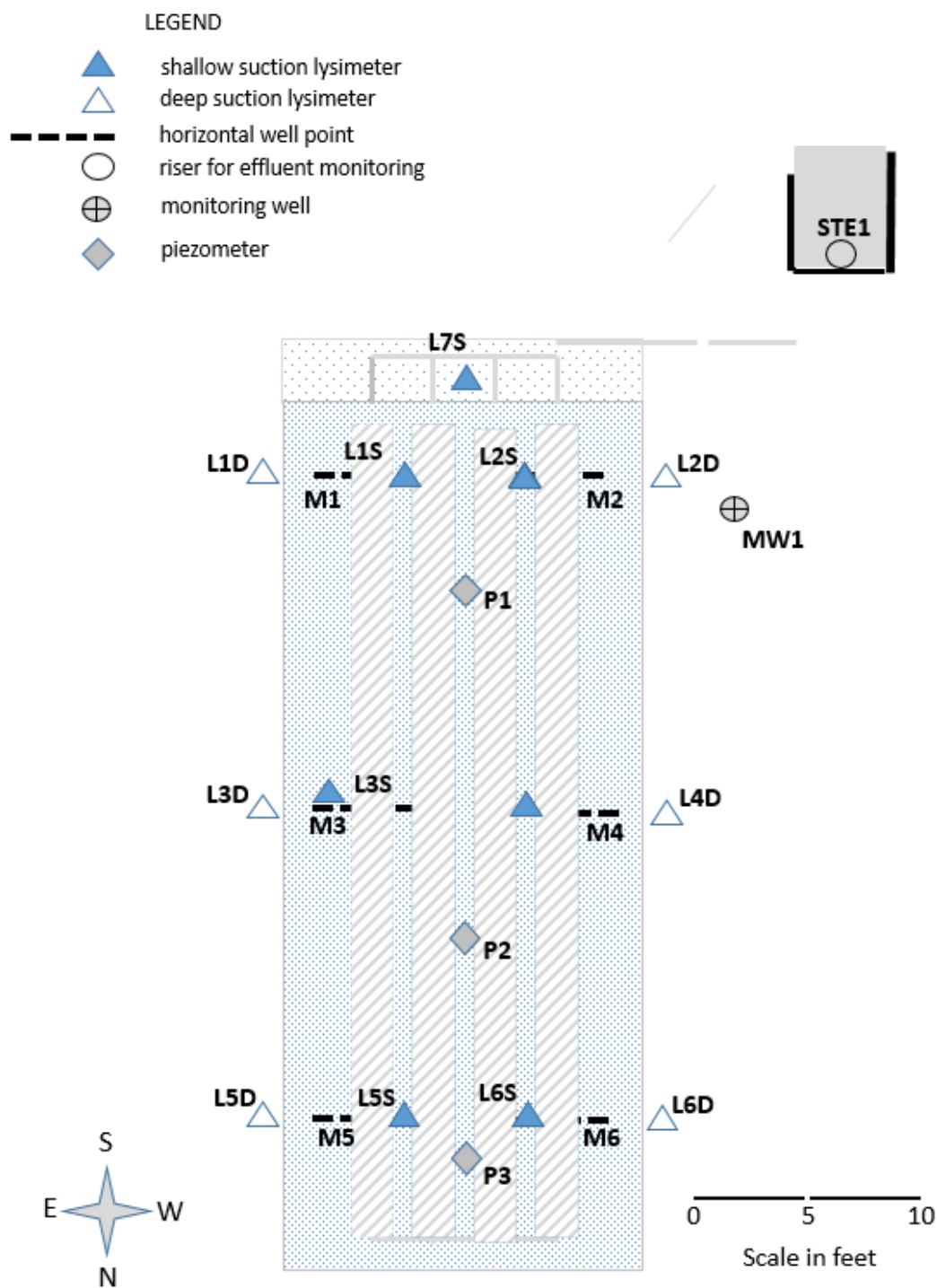
**Figure 2. Plan view of experimental drainfield.**



*Figure 3. Cross sectional view of experimental drainfield.*

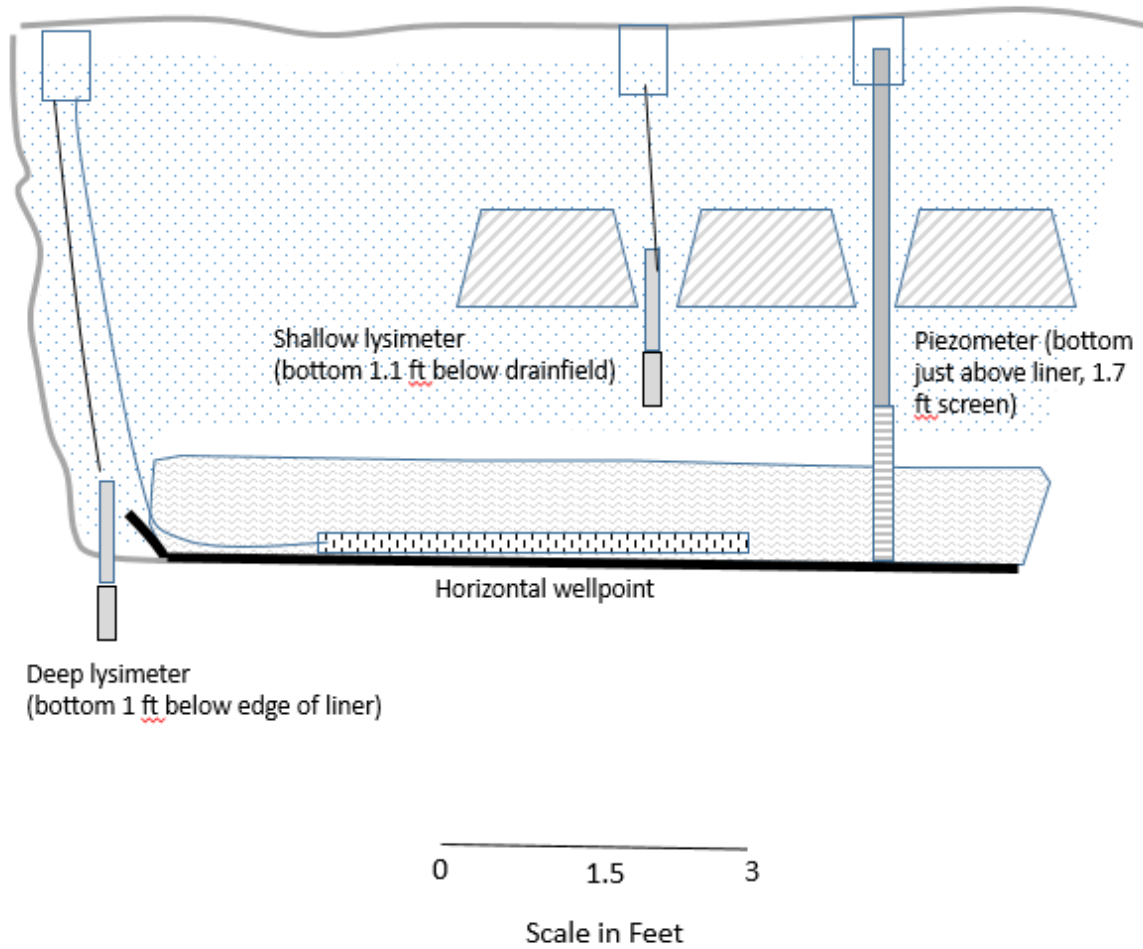


**Figure 4.** Cross sectional view of header area, experimental drainfield.



*Figure 5. Plan view of monitoring locations at experimental drainfield.*





*Figure 6. Cross section showing zones being monitored at experimental drainfield.*

**Table 1. Depths and Relative Elevations of Experimental Drainfield Components and Monitoring Devices**

| <b>Point</b>                       | <b>Relative Elevation</b> | <b>Depth below land surface</b> | <b>Depth below outlet</b> | <b>Height above liner bottom</b> | <b>Height above liner edge</b> |
|------------------------------------|---------------------------|---------------------------------|---------------------------|----------------------------------|--------------------------------|
| Average land surface at drainfield | 103.5                     | 0.0                             | -3.5                      | 6.8                              | 6.3                            |
| Septic tank outlet                 | 100.0                     | 3.5                             | 0.0                       | 3.3                              | 2.8                            |
| Header                             | 99.8                      | 3.8                             | 0.3                       | 3.0                              | 2.5                            |
| Infiltrator top                    | 100.3                     | 3.3                             | -0.3                      | 3.5                              | 3.0                            |
| Infiltrator base                   | 99.3                      | 4.3                             | 0.8                       | 2.5                              | 2.0                            |
| Liner bottom                       | 96.8                      | 6.8                             | 3.3                       | 0.0                              | -0.5                           |
| Liner edge                         | 97.3                      | 6.3                             | 2.8                       | 0.5                              | 0.0                            |
| Deep lysimeter bottom              | 96.2                      | 7.3                             | 3.8                       | -0.6                             | -1.1                           |
| Shallow lysimeter bottom           | 98.2                      | 5.3                             | 1.8                       | 1.4                              | 0.9                            |
| Horizontal well point mid          | 97.1                      | 6.4                             | 2.9                       | 0.4                              | -0.1                           |
| P1 measuring point                 | 102.7                     | 0.8                             | -2.7                      | 6.0                              | 5.5                            |
| P1 bottom                          | 97.0                      | 6.6                             | 3.1                       | 0.2                              | -0.3                           |
| P2 measuring point                 | 102.5                     | 1.0                             | -2.5                      | 5.8                              | 5.3                            |
| P2 bottom                          | 97.0                      | 6.6                             | 3.1                       | 0.2                              | -0.3                           |
| P3 measuring point                 | 102.4                     | 1.1                             | -2.4                      | 5.7                              | 5.2                            |
| P3 bottom                          | 97.0                      | 6.6                             | 3.1                       | 0.2                              | -0.3                           |
| MW1 measuring point                | 102.5                     | 1.0                             | -2.5                      | 5.8                              | 5.3                            |
| MW1 bottom                         | 60.5                      | 61.5                            | 58.0                      | -54.8                            | -54.2                          |

Notes: Depths and elevations in feet. Elevations are relative to septic tank outlet bottom, assigned elevation of 100.0 feet. Land surface based on average across drainfield area.

***Table 2- Timeline of Site Activities***

| <b>Date</b> | <b>Activity</b>  |
|-------------|--|
| July 18     | Construct diversion to experimental drainfield and knife valves, replace damaged septic tank lid and install riser at effluent end of septic tank, stake out drainfield dimensions   |
| July 19     | Begin excavation, extend effluent pipe from septic tank to drainfield, install liner at header end, obtain mulch, move sand pile to get access to next segment of pit to excavate  |
| July 20     | After overnight rain event, repair excavation and pump out water accumulated on liner, install mulch on approximately 1/3 of liner, continue excavation and move accumulated soil pile to allow access to remaining area to excavate |
| Jul 21      | Install sand in header area, complete excavation and install remaining liner and mulch in two stages, construct header   |
| July 22     | Complete mulch installation, install sand layer, install drainfield, obtain inspection, backfill remaining excavated area  |
| July 25     | Complete final grading of site and pick up   |
| July 27-28  | Install lysimeters   |
| July 29     | Install flow meter, re-sod construction area   |

## **APPENDIX A**

### **Experimental Drainfield Construction Photographs**



*Drainfield area prior to construction. Jared and Kim from DOH.*



*Knife valves and effluent sampling/inspection riser on septic tank. Green pipes are inspection ports to confirm flow direction.*





*Excavation of pit and leveling for liner installation*





*Liner installation, first stage*



*Impact from heavy rain event*





*Building up berm around edge of liner*



*Leveling to assure 6 inch depth*





*Horizontal wellpoint on liner*



*PVC pipe marking location for deep lysimeter, notch in liner to direct flow to lysimeter*





*Stockpiled shredded hardwood mulch*





*Mulch installation, second stage*





*Installing mulch adjacent to compacted sand for header, first stage*





*Completed mulch installation. Pipe is piezometer. Stakes used to assure uniform depth of mulch*



*Installing backfill on top of mulch, 19 to 20 inches thick*





*Header installation*





*Drainfield installation*





*Completed drainfield, piezometers between second and third rows. PVC pipes on edges mark edge of liner. Pipes between infiltrators are piezometers. Tubes go to horizontal wellpoints.*





*Fabric cover being installed over infiltrators*





*Covering drainfield after inspection, string marks edge of liner*





*Excavation filled prior to final grading*



*Edge of drainfield and material stockpile and equipment turning area, to be re-sodded*





*Installing lysimeters in graded drainfield area*



*Lysimeters installed in hand augered boreholes*





*Flow meter installed on supply line to house, next to water well. Irrigation line is separate.*



*Valve to experimental drainfield opened after flow meter installed*





*Total of 14 pallets of sod laid to restore damaged area*



*Site restored*