FLORIDA DEPARTMENT OF HEALTH

Florida Onsite Sewage Nitrogen Reduction Strategies Study

Task C.5

Quality Assurance Project Plan

Final Report

December 2009

Revised February 2010

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HAZEN AND SAWYER
Environmental Engineers & Scientists

In association with

SCHOOL OF MINES COLORADO 1874

AET Applied Environmental Technology

OTIS ENVIRONMENTAL CONSULTANTS, LLC

Florida Onsite Sewage Nitrogen Reduction Strategies Study

TASK C.5
FINAL REPORT

Quality Assurance Project Plan

Prepared for:

Florida Department of Health
Division of Environmental Health
Bureau of Onsite Sewage Programs
4042 Bald Cypress Way Bin #A-08
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FDOH Contract CORCL

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Section 1.0 Introduction

1.1 Project Background

Nitrogen is an important concern for water quality and nitrate-nitrogen represents perhaps the most common groundwater pollutant. Animals, crops, ecosystems, and human health can be adversely impacted by the presence of nitrogen in water supplies. The environmental effects of nitrogen on groundwater and surface water can ultimately lead to the degradation of surface waters in watershed systems that have strong groundwater/surface water interactions. Nitrogen that enters surface water bodies via these interactions can lead to algal blooms and eutrophication. These processes lead to oxygen depletion in surface waters which can be harmful to natural aquatic life. In Florida, the protection of watersheds, in particular surface water bodies, has led to the legislation of protection of these areas (i.e., the Wekiva River Protection Act).

Nitrogen transport in the subsurface is a complex process, especially when considering the nitrogen inputs from onsite sewage treatment and disposal systems (OSTDS). Figure 1-1 summarizes the conceptual understanding of the inputs of nitrogen and the transformative and advective processes that lead to nitrogen contamination of groundwater. Additional discussion regarding the fate and transport of nitrogen and its movement and distribution in groundwater related to OSTDS was presented in the Task C Literature Review.

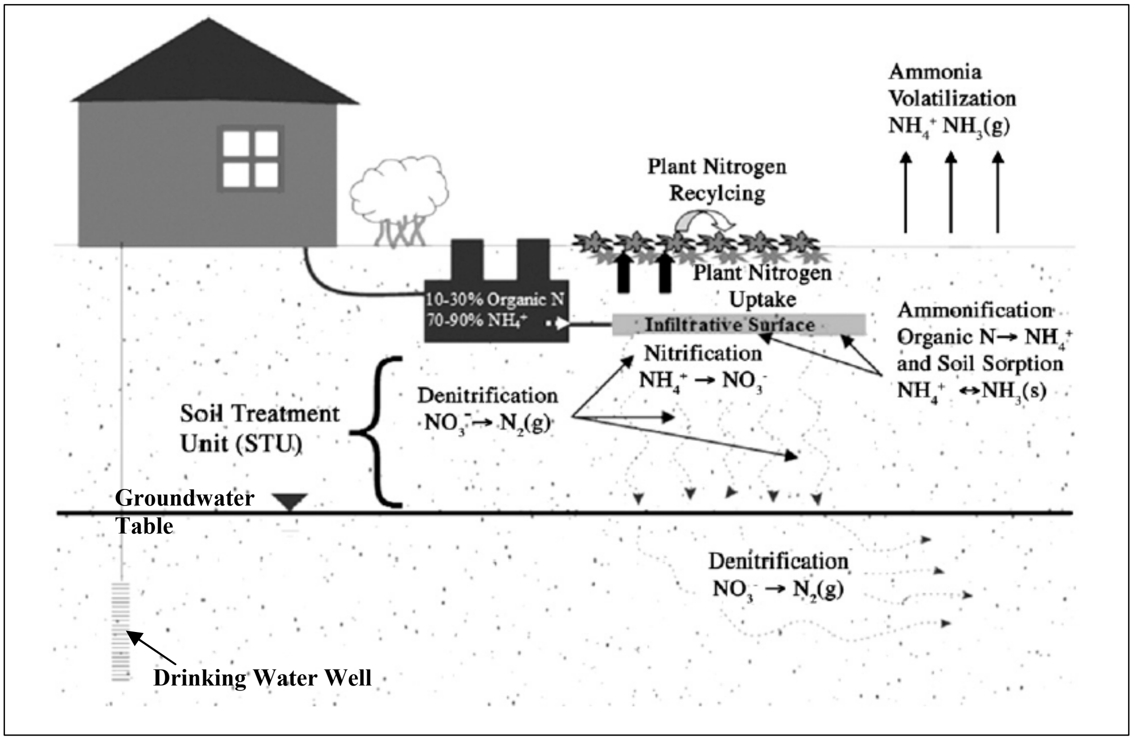

Figure 1-1: Nitrogen Processes Occurring in a Typical OSTDS (after Heatwole and McCray, 2007)

As a result of the widespread impacts of nitrogen on groundwater and surface waters in Florida, the management of nitrogen sources, including OSTDS, is of paramount concern for the protection of the environment. As part of Task C of the Florida Onsite Sewage Nitrogen Reduction Strategies (FOSNRS) Study, field testing related to nitrogen fate and transport will be conducted at the University of Florida Gulf Coast Research and Education Center (GCREC) and individual residential home sites to evaluate expected full-scale performance and produce data required for calibration and validation of fate and transport models developed in Task D.

1.2 Project Scope and Purpose

The overall goal of Task C is to critically characterize nitrogen reduction in Florida soils and groundwater. To accomplish this goal several objectives are identified:

- determine the cumulative mass loading of N to the soil and groundwater (i.e., at the GCREC),

- identify how currently designed and implemented OSTDS perform (i.e., home sites),
- understand treatment processes involved, and
- obtain/refine model parameter inputs (e.g., denitrification rates).

To meet these objectives a combination of controlled field testing and field monitoring at home sites is planned. Controlled field testing will be conducted at the GCREC. Home sites will be selected from three regions: north Florida, central Florida, and south Florida. Monitoring at each site will include effluent quality, hydraulic loading rate to the soil, soil properties, groundwater properties, groundwater concentrations, and climate/weather conditions. The project approach is described in detail in Section 2.0.

1.3 Project Organization

Task C is comprised of several interrelated subtasks that fall within four primary categories:

1) literature review and work plan development,
2) controlled pilot-scale testing,
3) field monitoring, and
4) reporting.

The literature review and work plan development are the first tasks to be completed. This Quality Assurance Project Plan (QAPP) describes the proposed testing and field monitoring framework building off of the existing knowledge of OSTDS performance. The literature review has been previously submitted to the Florida Department of Health (FDOH) and the Research Review and Advisory Committee (RRAC) for review (Task C.1). Supplemental plans to this QAPP will include the homeowner agreement (Task C.6), home site installation reports (Task C.7), and the test facility design and construction (Tasks C.11 – C.18).

The work described in this QAPP encompasses the entire scope of the 5 year project. However, the funding for subsequent years remains unclear which prevents detailed description of unfunded activities. In addition, efforts to be completed in subsequent years will build off of the previous findings using the observational method. The field monitoring described herein is designed to provide different levels of information and understanding independent of future year activities, but when all levels of information are combined together provides a comprehensive understanding of nitrogen reduction strategies in Florida. The project work scope is described in Section 2. The methods of data collection and handling to ensure the data quality objectives are met are described in Section 3. Finally, health and safety precautions required during project activities are described in Section 4. Table 1 summarizes the overall project scope and levels of information to be gathered.

Table 1.1
Overall Project Scope and Levels of Information to be Gathered

Level	Information Goal	Activity Planned	Funding Year
1: Controlled pilot-scale testing at the GCREC Soil and Groundwater Test Facility	Detailed data gathering at one location (GCREC) to evaluate mechanisms and conditions that impact nitrogen reduction. Enables development of simple tools in Task D.	Design and construction of test areas	1
		Unsaturated zone and groundwater monitoring	2
		Unsaturated zone and groundwater monitoring, and plume delineation	3 – 5
2: Field-scale testing at the existing GCREC mound system	Bridges the controlled GCREC (level 1) and uncontrolled home site (level 3) monitoring. Enables calibration of the simple tools in Task D.	Instrumentation, plume delineation, and groundwater monitoring	1
		Groundwater monitoring	2 – 5
3: Uncontrolled field-scale monitoring at field sites	Provides insight into behavior of typical OSTDS currently in use. Enables comparison of the output from simple tools developed in Task D under different soil conditions.	Monitoring conducted at the GCREC OSTDS (level 2) with better operational control and higher monitoring frequency than at future home sites.	1
		Home site identification, instrumentation, plume delineation, and groundwater monitoring	2 – 5

The mound OSTDS currently serving the GCREC will be the first field site monitored to establish the monitoring framework while enabling greater control of system operation as well as higher resolution of field monitoring.

Controlled pilot-scale testing will be conducted at the GCREC Soil and Groundwater Test Facility to characterize nitrogen fate and transport under a variety of typical operating conditions. The test area will be highly monitored in the both the unsaturated and saturated zones to enable definition of key treatment processes. Tracer tests are also planned to determine groundwater velocity and enable assessment of the groundwater dilution that occurs in an OSTDS. Each test area will be monitored to delineate effluent quality, hydraulic and nitrogen loading rates to the soil, nitrogen transformation in the vadose zone, and potential groundwater impacts. Sufficient temporary piezometers will be used to enable hydrogeologic characterization.

Field monitoring will be conducted at residential home or other field sites in Florida to evaluate current nitrogen reduction in soil and groundwater. The nitrogen mass loading to the environment and the resulting groundwater concentrations will provide input for parameter selection as well as validation of the simple models developed in Task D. Each site will be monitored to delineate the OSTDS effluent quality, hydraulic and nitrogen loading rates to the soil, and potential groundwater impacts. Sufficient temporary piezometers will be used to enable hydrogeologic characterization.

Reporting of Task C results and findings will be through submittal of routine monitoring reports. A final report summarizing the results of Task C will be provided at the completion of the overall project.

1.4 Key Project Personnel and Responsibilities

Mr. Damann Anderson of Hazen and Sawyer is the FOSNRS Manager responsible for project management and oversight. Mr. Anderson and Ms. Kathryn Lowe of the Colorado School of Mines are co-Task C leaders responsible for day-to-day operations and activities. The Task C leaders are also responsible for ensuring that this project plan is completed and the DQOs are met.

Personnel from Hazen and Sawyer will be responsible for conducting field activities and monitoring. A field team leader will be identified for each field activity and responsible for interfacing with subcontractors and task leaders as well as providing daily coordination of field activities. Field personnel involved in onsite operations are responsible for notifying the field team leader of any nonconforming field events or problems and ensuring that all co-workers are aware of such problems. Field personnel are to perform only those tasks that they can do safely and immediately report any accidents and/or unsafe conditions to the field leader and/or Task leader. Field personnel include all individuals performing field tasks and will demonstrate the experience and/or ability to perform the assigned tasks. Equipment operators (e.g., drillers, backhoe operator, etc.) shall be able to verify training and experience for the required capabilities.

Prior to initiating field work, all field personnel will be required to attend a brief site orientation given by the field team leader that will cover the description of work to be performed (task orientation), standard operating procedures (SOPs), QA/QC measures, and safe work practices. In addition, a brief daily “tailgate” meeting will be held to discuss potential concerns and refresh personnel on work task, QA/QC measures, and safe work practices. These field meetings will be documented in the field team leader’s logbook.

Dr. Craig Stanley of the University of Florida will be responsible for interfacing with GCREC personnel (e.g., GCREC support staff, graduate students, analytical laboratory managers, etc.). Laboratory technicians will perform sample analysis following methods described in this QAPP and will have received training on the instrument being used.

All project personnel are responsible for taking all reasonable precautions to prevent injury to themselves and to their fellow employees. The qualifications for key Task C personnel were provided in the proposal (Mr. Anderson, Ms. Lowe, Dr. Stanley, Mr. Mark Mechling, Mr. Harmon). Mr. Mark Mechling and Mr. Harmon Harden will be responsible for home site identification, instrumentation and monitoring activities planned in subsequent project years.

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Section 2.0
Task C Description

Field testing will be conducted at the mound OSTDS currently serving the GCREC during the first funding year of Task C. Controlled pilot-scale testing and field monitoring at individual home sites will be conducted in subsequent funding years. This approach will enable more efficient instrumentation and monitoring of home sites by applying what has been learned from the controlled GCREC field testing to the monitoring framework at each home. For example, if it is determined that specific conditions are critical to capture (e.g., significant rainfall events) the frequency of monitoring may be modified to ensure key operational stages or conditions are sufficiently characterized. The following sections describe the field activities that will be conducted during the first funding year and outline the field activities at individual home sites anticipated in subsequent years.

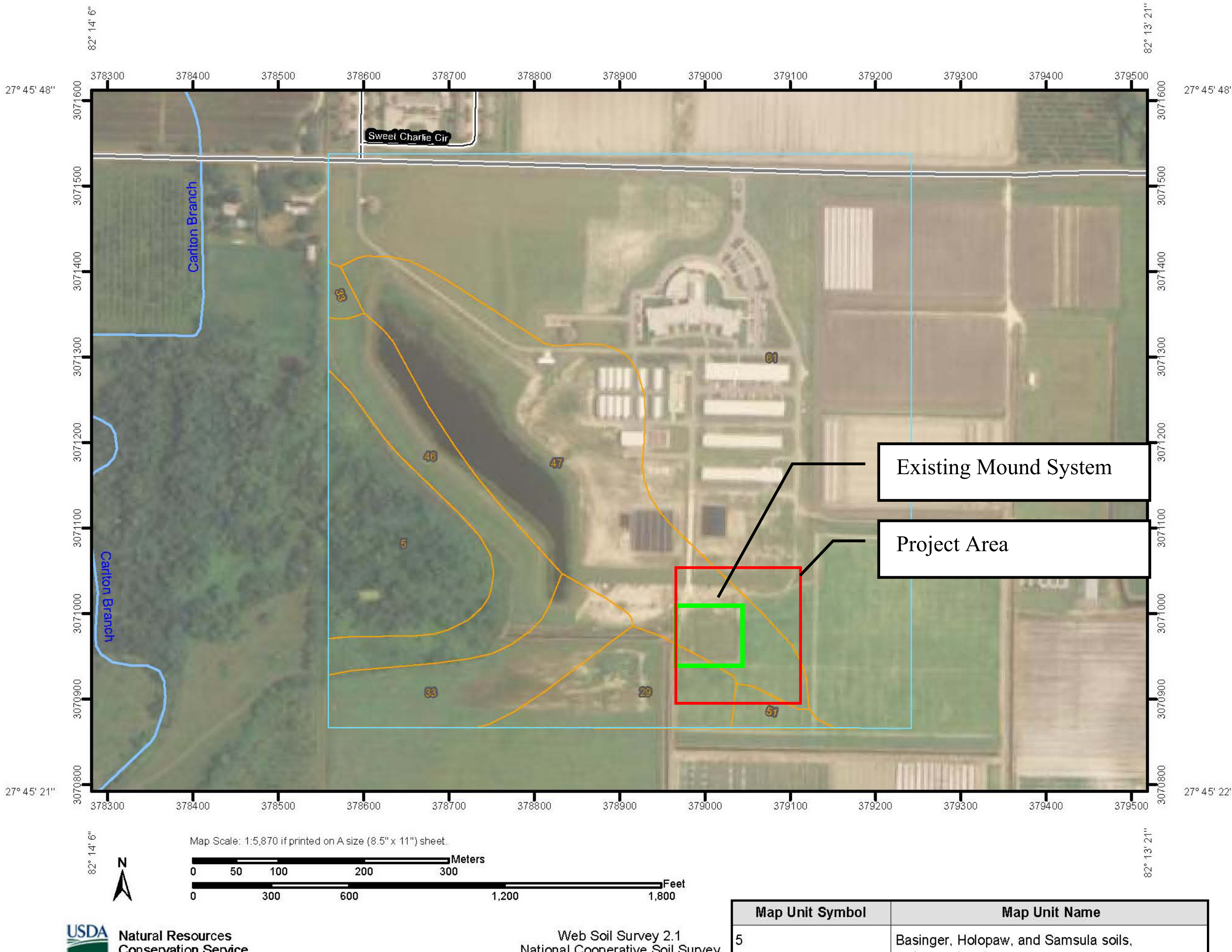
2.1 Description of Activities at the GCREC

The work scope described in this section is consistent with the scope of work and deliverables in the FOSNRS contract. The following description of activities provides detail related to the controlled field testing and field monitoring including the test area design, operating conditions, number and location of monitoring points, sample collection and analyses, and data handling.

The overall goal of Task C is to critically characterize nitrogen reduction in Florida soils and groundwater. To accomplish this goal several objectives are identified.

2.1.1 GCREC Site Conditions

The GCREC facility is located at 14625 County Road 672, Wimauma, Florida. The facility is situated on 475 acres of land that were donated by Hillsborough County government. A preliminary soils assessment conducted by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) identified the soils in the area to be used for this project as primarily Seffner fine sand and Zolfo fine sand, with a limited area of Myakka fine sand (Figure 2-1). The Zolfo fine sand in the northeastern portion of the project area gradually transitions to Seffner find sand in the southwestern portion of the project area. These soils are somewhat poorly to poorly drained and are typical of the Florida flatwoods land resource area. A well developed spodic horizon was identified between 54 and 58 inches in the northeastern portion of the project area.



Map Unit Symbol	Map Unit Name
5	Basinger, Holopaw, and Samsula soils, depressional
29	Myakka fine sand
33	Ona fine sand
46	St. Johns fine sand
47	Seffner fine sand
51	Haplaquents, clayey
61	Zolfo fine sand

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Figure 2-1: GCREC Facility Soil Survey (NRCS, 2009)

Selected key soil properties of the soils in the project area are summarized in Table 2.1. The Test Facility Site Evaluation with soils information is provided in Appendix A for reference.

Table 2.1
Selected Soil Properties of Soils Identified at the GCREC Facility[1]

Soil Name	Depth (in.)	USDA Texture	Moist Bulk Density (g/cm^3)	Organic Matter (%)	Cation Exchange Capacity (meq/100g)
Seffner fine sand	0-13	fine sand	1.35 – 1.45	0 – 2.9	1.2 – 7.6
	13-21	fine sand, sand	1.35 – 1.45	0 – 2.9	0.7 – 5.6
	21-80	fine sand, sand	1.50 – 1.60	0 – 2.9	0.7 – 5.6
Zolfo fine sand	0-3	fine sand	1.35 – 1.55	0 – 2.9	1.0 – 3.8
	3-60	fine sand, sand	1.30 – 1.60	0 – 2.9	0.8 – 3.6
	60-80	fine sand, sand	1.50 – 1.70	0 – 2.9	--
Myakka fine sand	0-5	fine sand	1.35 – 1.45	0.5 – 2.0	--
	5-20	fine sand, sand	1.45 – 1.60	0 – 1.0	--
	20-30	fine sand, sand, loamy fine sand	1.45 – 1.60	1.0 – 6.0	--
	30-80	fine sand, sand	1.45 – 1.70	0 – 0.8	--

[1] *Typical soil properties from "Soil Survey of Hillsborough County, FL", NRCS*

Seasonal high water table indicators were found between 24 and 39 inches. Water level measurements were obtained from existing piezometers in the project area in March, June and July 2009. Based on these water level measurements depth to groundwater ranged from approximately 3 ft to 6 ft below ground surface. It should be noted that the 6 ft depth to groundwater was measured in March 2009 after a three-year drought in the area. The regional groundwater gradient in the project area is from northeast to southwest.

Wastewater from the GCREC research offices and onsite dormitories flow to an existing OSTDS. Wastewater from Facility laboratories is not directed to the OSTDS. This existing OSTDS consists of a pressure dosed mound system designed for 2,850 gallons per day. Two septic tanks (2,500 and 1,250 gallons) provide primary treatment followed by a dosing tank (3,000 gallons). The mound drainfield has 4,351 ft^2 of infiltrative area (design hydraulic loading rate of 0.65 gpd/ft^2) with each half of the drainfield receiving alternating doses. As part of this project, a flow meter will be installed to monitor the actual daily flow to the drainfield.

2.1.2 Controlled Field Testing at GCREC Soil and Groundwater Test Facility

Controlled pilot-scale testing will be conducted at the GCREC soil and groundwater test facility to characterize nitrogen fate and transport under a variety of typical operating conditions. Pilot-scale test areas will be established to monitor a range of operating conditions and determine mechanisms critical for nitrogen reduction. The range of parameters monitored and the frequency of data collection will be maximized to enable development of simple tools (Task D).

2.1.2.1 Test Area Design

Test areas representative of typical mounded OSTDS will be established at the GCREC Soil and Groundwater Test Facility to enable controlled testing and evaluation of nitrogen reduction in soil and groundwater. Four test areas will be established receiving either septic tank effluent (STE) or nitrified effluent delivered to the soil via a pressure dosed mound or a shallow drip dispersal system (Table 2.2). Effluent will be delivered to the soil at the maximum allowable rate for the sandy soils of 0.8 gpd/ft^2. The combination of STE at the maximum hydraulic loading rate represents the highest allowable mass loading rate to the soil and is therefore expected to provide the most conservative nitrogen removal resulting in the highest expected concentrations of nitrogen reaching the groundwater. However, it is also recognized that many systems in Florida employ an aerobic treatment unit (ATU) which results in delivery of a nitrified effluent to the soil treatment unit (aka, drainfield). Delivery of both STE and nitrified effluent to the soil will enable comparison of the groundwater plumes and evaluation of the benefits (or lack of) of nitrogen transformation and/or reduction prior to groundwater recharge. These two effluents will be delivered to the soil via conventional pressure dosed mound systems or shallow subsurface drip dispersal systems (mounded as required to meet groundwater separation). The drip dispersal system is designed to optimize nitrogen removal through plant uptake and reduce the mobile nitrate-nitrogen fraction that recharges the groundwater. A more detailed description of nitrogen uptake in drip dispersal systems can be found in Parzen (2007).

Table 2.2
Study Design Conditions for Test Areas

Test Area ID	Effluent Quality	Design HLR (gpd/ft^2)	Soil Treatment Unit Design
TA1	STE	0.8	pressure dosed mound
TA2	STE	0.8	shallow drip dispersal
TA3	nitrified effluent	0.8	pressure dosed mound
TA4	nitrified effluent	0.8	shallow drip dispersal
TA5	in situ nitrified effluent (Task A)	from PNRS II pilots	mounded drip dispersal over denitrification media
TA6	in situ STE effluent (Task A)	from PNRS II pilots	mounded drip dispersal over denitrification media

STE will be pumped from the first GCREC septic tank to a holding tank near the test areas. Excess effluent will be returned to the existing GCREC mound to prevent effluent from discharging to the ground and to minimize the holding tank residence time. A portion of the STE from this holding tank will be directed to an approved aerobic treatment unit (e.g., textile filter, single pass sand filter, or other) with the treated effluent held in a separate tank as the source of the nitrified effluent. The aerobic treatment unit will be operated in accordance to approved manufacturer specifications and allowed to begin nitrifying (10 to 30 days from start-up) prior to delivery to the soil.

Test areas TA1 – TA4 will have an infiltrative surface of 40 ft^2 (20 ft long and 2 ft wide) and receive effluent in 6 equal doses of 5.33 gallons/dose each day. Equal distribution of effluent to the soil will enable replicate monitoring locations along the length of each test area. Orifice controlled pressure distribution, with orifices located at 1 ft intervals, will be used to deliver the effluent to the mound test areas. This delivery approach will ensure that effluent is equally distributed along the length of the mound. Effluent will be delivered via commercial pressure tubing with pressure compensating emitters located at 1 ft intervals in the drip dispersal systems.

Mound test areas will be constructed using two rows of orifice controlled pressure distribution piping placed 1 ft apart in the center of a 20 ft long, 2 ft wide, and 1 ft thick gravel (mineral aggregate meeting requirements of 64E-6.014(5)(C)) infiltrative surface. One ft of mound or filter sand will underlie the gravel and be placed on the ground surface, providing at least 2 ft of unsaturated separation during high water tables and 3 or more ft of unsaturated separation during low water tables. Native soil will be placed over the gravel with vegetation to minimize erosion. Sides of the mound will be graded to a slope of 2:1 (horizontal:vertical). Additional detail is illustrated on the 100% Test Facility Design drawings provided in Appendix B for reference.

Drip dispersal test areas will be constructed in 1.5 ft of mound or filter sand placed on the ground surface, again providing at least 2 ft of unsaturated separation during high water tables and 3 or more ft of unsaturated separation during low water tables. Two rows of commercially available drip tubing will be placed 4 to 6 inches deep and 1 ft apart. Turf grass will be placed on the drip dispersal area to replicate a typical residential installation. Additional detail is illustrated on the 100% Test Facility Design drawings provided in Appendix B for reference.

Test areas will be separated by 20 to 30 ft to minimize potential plume interactions between each test area. In addition, prior to test area construction, vertical and horizontal groundwater gradients will be determined. Test areas will be oriented with the 20 ft dimension in line with the horizontal gradient to further minimize potential plume interactions and enable groundwater plume characterization with fewer monitoring points.

2.1.2.2 Monitoring Framework Soil and Groundwater Test Facility

Each test area will be monitored for operational conditions, unsaturated and saturated nitrogen concentrations, soil properties, groundwater properties, and weather conditions.

Operational conditions include effluent quality, hydraulic loading rate to the soil, and ponding on the soil infiltrative surface. The STE and nitrified effluent quality will be monitored weekly for the first month and then bi-monthly for the duration of testing. Due to the multiple wastewater sources to the septic tank, the STE quality is expected to be relatively consistent (compared to typical single family residential homes). The sampling frequency will be further reduced, if indeed the effluent quality is consistent, but the frequency will remain sufficient to estimate nitrogen mass loading rates to the soil. Effluent samples will be analyzed for temperature, specific conductance, pH, dissolved oxygen (DO), total kjeldahl nitrogen (TKN), nitrate-nitrogen plus nitrite-nitrogen (NO_x), ammonium-nitrogen, and chloride. In addition, half of the samples will also be analyzed for pH, alkalinity, 5-day carbonaceous biochemical oxygen demand ($cBOD_5$), total phosphorus, total solids (TS), total suspended solids (TSS), fecal coliform and *E.coli*. Up to 10% of the samples will also be analyzed for anions and cations. Anions will include bromide, chloride, fluoride, nitrate, nitrite, ortho-phosphate, and sulfate. Cations will include aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, molybdenum, nickel, potassium, selenium, silica, silver, sodium, strontium, thallium, vanadium, and zinc (standard list of metals detected by the same method). Sample collection, handling and analysis methods will be in accordance with Florida Department of Environmental Protection (FDEP) standard operating procedures (SOPs) and are discussed in Section 3.0. The hydraulic loading rate to the soil will be monitored by recording the delivery pump cycles and with a flow meter for each test area. Should ponding develop within the gravel of the mound test areas, the ponding height will be recorded with water level indicators (+/- 1/32 in. ponding) and visual observations.

The center of test areas TA1 – TA4 will be equipped with unsaturated and shallow saturated zone monitoring instrumentation. Up to two sets of such monitoring equipment will be placed in each of the four test areas. This instrumentation will include suction lysimeters, soil moisture probes, and tensiometers. Suction lysimeters, soil moisture probes, and tensiometers will be located at various depths below the bottom of the gravel or below the drip emitter. During installation, the depth intervals will be determined to capture the transition between soil layers (e.g., spodic horizon noted in Soil Survey) and the capillary zone of the low water table. At least four soil moisture probe depth intervals will be located in the unsaturated zone to ensure adequate parameter estimation during inverse modeling (Ritter et al. 2004). Installation methods are discussed in Section 3.0. Figure 2-2 provides general schematics illustrating the locations of the unsaturated zone instrumentation.

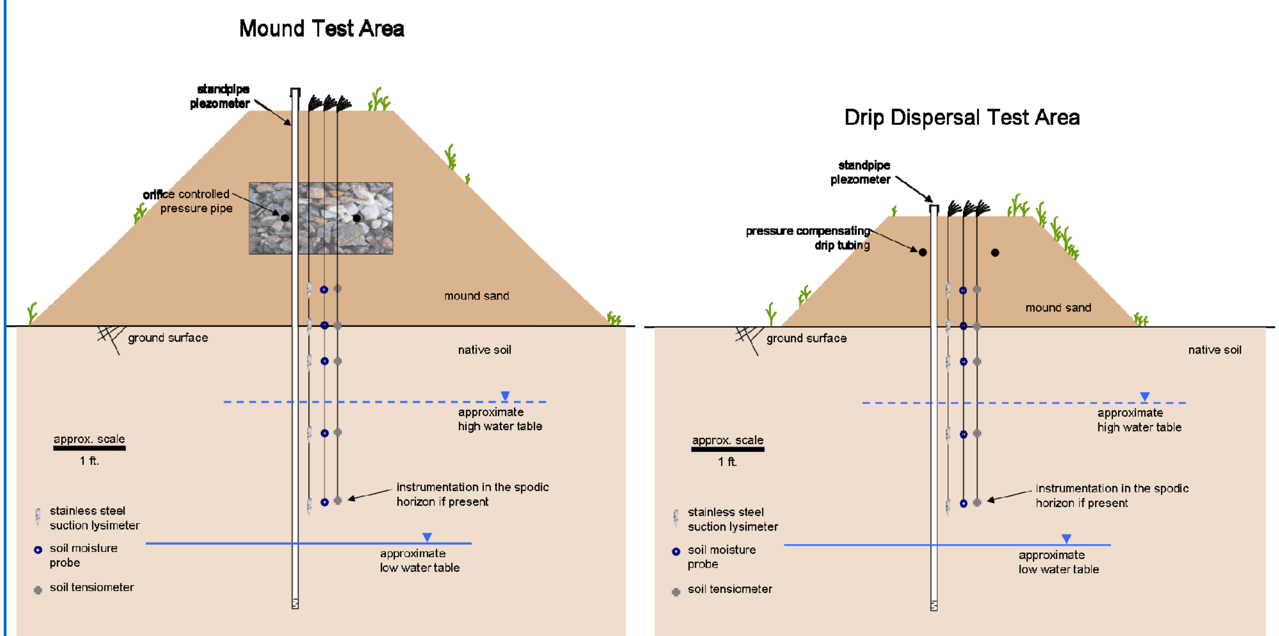

Figure 2-2: General Schematic of Unsaturated Zone Monitoring Framework at the GCREC

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It is anticipated that suction lysimeter samples will be collected at 1, 3, 5, 7, 9, and 11 months after effluent delivery. All unsaturated zone solution samples will be analyzed for temperature, pH, specific conductance, DO, TKN, NO_x, ammonium-nitrogen, and chloride. In addition, half of the samples will also be analyzed for alkalinity, chemical oxygen demand (COD), and total phosphorus. COD is a measure of the oxygen equivalent of the organic matter content that is susceptible to oxidation by a strong chemical oxidant and can be empirically related to $cBOD_5$. Because $cBOD_5$ is expected to be at very low concentrations in soil moisture and groundwater samples and is time consuming to measure, COD will be analyzed instead of $cBOD_5$. Separate analysis of nitrate and nitrite (or NO_x – nitrate) will be conducted to determine if incomplete nitrification or denitrification are occurring. If nitrite concentrations are below detection limits or low (+10% of detection limit), then the combined sample analysis will be terminated. Up to 10% of the samples will also be analyzed for dissolved organic carbon (DOC), anions, and cations. Note the 0.2 micron nominal pore size of the suction lysimeter precludes total organic carbon (TOC), solids, and microorganism sample analyses. Sample handling and analysis methods will be in accordance with FDEP SOPs and are discussed in Section 3.0. Sample frequency may be increased or decreased to capture seasonal trends and/or changes in system performance as the biozone is developed. Previous work at CSM with suction lysimeter sampling suggests changes in treatment performance within a mature soil treatment unit are adequately captured with samples collected at intervals up to 2 to 3 months (Tillotson, 2009). In addition, samples collected daily over 2 weeks showed relative percent difference (RPD) in soil pore water concentrations of only 13% for ammonium, 11% for nitrate, and 10% for chloride. Rather than discrete time intervals, it is more important to capture changes in operating conditions (e.g., start-up vs. mature system) and seasonal changes (rainy season vs. dry season, hot periods vs. cool periods, etc.). Soil moisture content will be collected at least hourly through an automated data logging system. During selected intervals, soil moisture content may be collected every minute to provide high resolution data for short time periods such as capturing effluent movement between doses. Soil tension will be measured at selected time periods to obtain sufficient data resolution to correlate with soil moisture measurements and for parameter estimation during Task D.

Saturated zone monitoring will include groundwater quality, depth of groundwater table, and gradient (i.e., water level). Groundwater will be monitored through two types of piezometers: small diameter standpipe piezometers and drive point piezometers (Figure 2-3). Standpipe piezometers are 0.75 to 1.0 inch diameter wells for groundwater sampling, water levels, and hydraulic testing (e.g., pump tests, slug tests, etc.). Drive point piezometers are stainless steel drive points attach to polyethylene tubing and will be used to locate and define groundwater plumes and enable collection of groundwater samples. Installation methods are described in Section 3.0. Initially up to 12 drive point piezometers will be installed along 2 or 3 transects perpendicular to groundwater flow. Seven or more multi-level piezometers will be installed within the project area (encompassing all four test areas) to monitor vertical gradients, horizontal gradients, and nitrogen flux. One standpipe piezometer will be located at the center of the test area adjacent to the unsaturated zone instrumentation. Two additional standpipe piezometers and up to 6 additional drive point piezometers will be installed down gradient of the test area as the plume develops through the duration of this study. These downgradient piezometers will be located as the groundwater plume expands (or contracts) and additional hydrogeologic information is required.

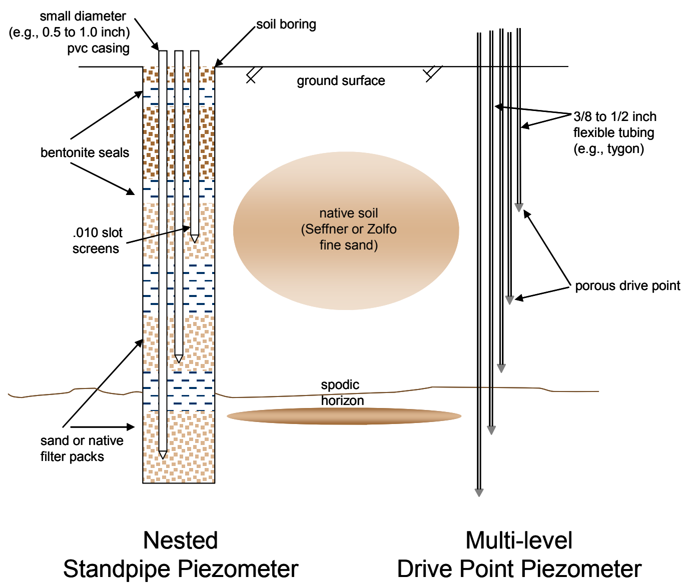

Figure 2-3: Illustration of Standpipe and Drive Point Piezometers

Water level measurements will be taken from all piezometers monthly. Initially, specific conductance, NO_x, and chloride will be monitored monthly, at a minimum, to identify development of a groundwater plume from each test area. After development of a groundwater plume, groundwater samples will be collected at the same frequency and for the same analytes as the soil suction lysimeter samples described above. In addition, all groundwater samples will be analyzed for specific conductance, DO, and chloride. The location of the groundwater samples will be based on groundwater quality field screening (specific conductance). Sufficient groundwater samples will be collected to delineate the groundwater plume (horizontal and vertical) and determine denitrification rates.

2.1.2.3 Tracer Testing at Soil and Groundwater Test Facility

Tracer tests will be conducted at two time points during test area operation; prior to effluent delivery and after six months or more of effluent delivery. Bromide (Br^-) will be used as a conservative tracer (added to clean water or effluent as potassium bromide) representative of the water movement through soil, although some diffusion from mobile to immobile water may occur. The first tracer test, prior to effluent delivery to the test areas, will enable characterization of the background groundwater velocity and dilution. A second test may be conducted after a groundwater plume has been defined and enable comparison of the subsurface changes attributed to effluent delivery. During this second tracer test, a nitrogen isotope tracer (^{15}N ammonium chloride) may be added to assess concentration, movement and species partitioning of nitrogen in the effluent delivered to the soil. If tracer testing with a conservative tracer (e.g., bromide) is conducted within a groundwater plume, the appropriateness of the tracer will be evaluated (e.g., tracer residence time in the subsurface combined with the interference caused with nitrate-nitrogen and DOC analyses). Tracer test methods are described in Section 3.0.

2.1.3 Field Monitoring at GCREC Mound System

Field monitoring will be conducted at field sites in Florida to evaluate current nitrogen reduction in soil and groundwater, to assess groundwater impacts due to conventional and nitrogen removal systems, and to provide data for parameter estimation, and verification and validation of models developed in Task D. Field monitoring will be conducted in subsequent phases of this project and are dependent on continued funding. However, the existing mound OSTDS at the GCREC will be monitored during this first phase allowing for methodology refinement for future field site monitoring. Monitoring at the GCREC mound will also serve as a bridge between the controlled pilot-scale testing (Section 2.1.2) conducted within the same type of soils and the home sites in different soils, but monitored at a lower frequency.

2.1.3.1 Monitoring Framework at GCREC Mound System

The existing OSTDS at the GCREC provides a unique opportunity to combine controlled field testing with uncontrolled home site monitoring. Methods for field monitoring and refinement of the overall monitoring framework will be conducted here to enable development of the simple groundwater model in Task D and streamline future data collection at home sites. The following framework is specific to the existing OSTDS at the GCREC. Field monitoring at home sites will be patterned on the same framework with revisions to sample locations and frequency based on the findings at the GCREC mound as well as the controlled pilot-scale testing (Section 2.1.2).

Field monitoring will follow 5 general steps as summarized in Table 2.3. First, the plume extent and location will be determined. Second, based on the delineation of the plume, the site will be instrumented with drive point and standpipe piezometers. Next the aquifer will be characterized to determine the groundwater gradient, hydraulic conductivity, and velocity. Following aquifer characterization, routine monitoring will be conducted for at least 12 months. Finally, based on each data collection event, the need for additional information and instrumentation will be assessed. Unsaturated zone monitoring will not be conducted. Additional data will be collected as needed to refine the evaluation of nitrogen reduction from OSTDS (e.g., higher resolution of data collection for a short period of time to capture key conditions). Methods for field activities and laboratory analyses during each step are described in Section 3.0.

Table 2.3
Summary of Field Monitoring Framework at GCREC Mound

Step	Purpose	Approach	Data to be Collected
1	Plume identification	sampling grid for groundwater screening	in-field measurements of groundwater specific conductance
2	Instrumentation	install multi-level drive point piezometers and shallow standpipe piezometers	soil properties determined from soil borings during standpipe piezometer installation
3	Aquifer characterization	conduct pump test and slug tests on standpipe piezometers	hydraulic gradient, saturated hydraulic conductivity
		baseline tracer test using a conservative tracer	establish groundwater velocity, dispersivity coefficients, and groundwater dilution
4	Routine monitoring	effluent quality, groundwater concentrations, water levels, climatic conditions	water quality parameters as necessary to determine nitrogen reduction
5	Additional instrumentation, testing, and/or monitoring	as warranted	refine plume delineation, denitrification rates, aquifer properties, etc.

Initially a grid will be established downgradient of the soil treatment unit. A 25 ft by 25 ft grid will be marked. Hand held methods (e.g., slide hammer, hand auger) will place a drive point connected to flexible tubing in the subsurface. The specific conductance of the groundwater at that location will be measured and recorded. The drive point will be advanced to additional depths, as feasible, to obtain a vertical conductivity profile at that location. Based on the groundwater specific conductivity, the general plume location and extent will be determined.

After the groundwater plume has been identified, drive point and standpipe piezometers will be installed. Up to 20 multi-level (up to 5 depths) drive point piezometers will be installed based on the extent of the plume. This network of drive point piezometers will enable vertical and horizontal monitoring of nitrogen in groundwater. At a minimum, the depth intervals of the drive point piezometers will include the groundwater surface, any key lithology changes, and above the confining layer. Four standpipe piezometers will also be installed: one upgradient of the plume and three within the plume downgradient of the soil treatment unit. These standpipe piezometers will enable aquifer characterization of the gradient and saturated hydraulic conductivity. Soil samples will be collected from the soil borings during standpipe installation to determine general soil properties (lithology, soil features, organic matter content, grain size, etc.). An installation report describing the monitoring system installed will be provided.

Next the aquifer will be characterized through a pump test and slug tests to determine the saturated hydraulic conductivity and variability within the plume. A conservative tracer test will be conducted to determine groundwater velocity and the affect of aquifer dilution. If tracer testing with a conservative tracer (e.g., bromide) is conducted within the groundwater plume, the appropriateness of the tracer will be evaluated (e.g., tracer residence time in the subsurface combined with the interference caused with nitrate-nitrogen and DOC analyses).

Routine groundwater and effluent quality monitoring will be conducted at least four times (i.e., seasonally) to capture the range of likely climatic conditions. Groundwater and effluent samples will be analyzed for temperature, pH, specific conductance, DO, TKN, NO_x, ammonium-nitrogen, and chloride. Effluent samples will also be analyzed for TS and TSS. In addition, half of the samples will also be analyzed for alkalinity, $cBOD_5$ or COD, total phosphorus, fecal coliform and *E.coli*. Up to 10% of the samples will also be analyzed for anions and cations. Sample collection, handling and analysis methods will be in accordance with FDEP SOPs and are discussed in Section 3.0. Higher frequency sample collection and additional sample analysis as needed for model development, calibration, and validation may be conducted. Sufficient groundwater samples will be collected to delineate the groundwater plume (horizontal and vertical) and determine denitrification rates. A monitoring report describing each monitoring event will be provided (see Section 3.4.3).

Finally, based on the field monitoring results, additional testing and/or instrumentation may be required. Additional testing and monitoring will be conducted as needed to ensure the data quality objectives (DQOs) are met or it is determined that the required data collection is not feasible (Section 3.1).

2.2 Description of Activities at Field Sites

Field monitoring will be conducted at residential home sites in Florida to evaluate current nitrogen reduction in soil and groundwater, to assess groundwater impacts due to conventional and nitrogen removal systems, and to provide data for parameter estimation, and verification and validation of models developed in Task D. Field monitoring will be conducted in subsequent phases of this project and are dependent on continued funding.

2.2.1 Site Selection

Up to 8 additional field sites from three geographical regions (north, central, and south Florida) will be selected for inclusion in this study. Five of these additional field sites will be monitored. The remaining sites will enable quick replacement of a home site if it is subsequently deemed inappropriate after monitoring has begun (i.e., unplanned extended absence of the homeowner, homeowner withdraws, etc.). A minimum of one home site will be monitored in each region.

The three geographical regions have been selected to encompass a range of soil conditions representative of Florida. Home sites located in Wakulla County will serve as representative homes of northern Florida. Wakulla County covers approximately 607 square miles and is predominantly rural (~51 people per square mile). Home sites in Wakulla County are currently being monitored by project team members (Water Research Consulting, LLC) to assess nitrogen in groundwater from performance-based treatment systems. Selected locations within the soil treatment unit have been monitored, but the full extent of the groundwater plume has not been delineated. Leveraging monitoring at these sites will provide historical information beneficial to understanding longer-term behavior and performance. For central Florida, home sites will be located in the Wekiva Study Area, and for southern Florida, home sites will be located near the Gulf Coast in Charlotte County. The Wekiva Study Area covers approximately 300,000 acres within Seminole, Lake and Orange Counties, and is the subject of considerable recent study and proposed nitrogen reduction regulations pertaining to OSTDS. Home sites in the Wekiva Study Area have also been previously monitored by project team members (Mechling Engineering & Consultants, Inc.) to assess fate and transport of nitrogen in highly vulnerable aquifers. Leveraging monitoring at these sites will build off of a large existing knowledge base and again provide understanding of longer-term behavior and performance. Charlotte County covers approximately 694 square miles and is predominantly urban in the eastern portions of the county and rural in the western portions (~216 people per square mile). FDOH permit information will be gathered for each candidate site and an existing system evaluation according to the procedure outlined in 64E-6 F.A.C. will be conducted at the selected sites. If suitable home sites with willing home owners cannot be identified in these locations, the search for sites will be broadened to include additional Counties.

Factors that will be considered during site selection will encompass a range of conditions affecting nitrogen mass loading to the soil and resulting groundwater concentrations. It is not the intent of this study to monitor older OSTDS which do not meet recent or current code requirements. Rather, only approved and permitted sites will be considered ranging in system age from 5 to 10 years old. To enable comparison of the findings with the controlled testing at GCREC, one conventional OSTDS (i.e., STE) and one approved ATU or nitrogen reducing OSTDS (i.e., nitrified effluent) will be monitored in each geographic location. Key factors to be considered also include homeowner amenability, site access, occupancy, and daily household flow. Homeowner amenability is critical. Field monitoring will include installation of numerous instruments which the homeowner must be comfortable with. After potential candidate sites are selected based on FDOH permit review, project team members will meet with prospective homeowners to discuss the project goals and scope. An agreement will be established with the homeowner if identified for inclusion in this study. Site access is also a critical factor. Only sites with readily accessible OSTDS will be selected (no landscape interferences, nearby power and clean water). Candidate sites will have two or more occupants residing in the home year round. To the extent possible, home sites with daily household flow within typical ranges (e.g., 50 – 70 gallons per capita per day) will be selected. After selection, each home site will be equipped with a flow meter. Should daily household flow rates be significantly outside the typical range, the site will be removed from the study and an alternate site included. While numerous subtleties exist between individual OWS, monitoring these key conditions and factors will enable comparison of sites between the three geographical regions and determination of the relative impact of mass loading and nitrogen reduction based on hydraulic loading rate, effluent quality, and season.

2.2.2 Monitoring Framework at Field Sites

Field monitoring at field sites will be patterned on the same framework as the GCREC mound system with revisions to sample locations and frequency based on the findings at the GCREC mound as well as the controlled pilot-scale testing (Section 2.1.2).

Field monitoring will follow 5 general steps as summarized in Table 2.4. First, the plume extent and location will be determined. Second, based on the delineation of the plume, the site will be instrumented with drive point and standpipe piezometers. Next the aquifer will be characterized to determine the groundwater gradient, hydraulic conductivity, and velocity. Following aquifer characterization, routine monitoring will be conducted for at least 12 months. Finally, based on each data collection event, the need for additional information and instrumentation will be assessed. Unsaturated zone monitoring will not be conducted at the home sites. Additional data will be collected as needed to refine the evaluation of nitrogen reduction from OSTDS (e.g., higher resolution of data collection for a short period of time to capture key conditions). Methods for field activities and laboratory analyses during each step are described in Section 3.0.

Table 2.4
Summary of Field Monitoring Framework at Field Sites

Step	Purpose	Approach	Data to be Collected
1	Plume identification	sampling grid for groundwater screening	in-field measurements of groundwater specific conductance
2	Instrumentation	install multi-level drive point piezometers and shallow standpipe piezometers	soil properties determined from soil borings during standpipe piezometer installation
3	Aquifer characterization	conduct pump test and slug tests on standpipe piezometers	hydraulic gradient, saturated hydraulic conductivity
		baseline tracer test using a conservative tracer	establish groundwater velocity, dispersivity coefficients, and groundwater dilution
4	Routine monitoring	effluent quality, groundwater concentrations, water levels, climatic conditions	water quality parameters as necessary to determine nitrogen reduction
5	Additional instrumentation, testing, and/or monitoring	as warranted	refine plume delineation, denitrification rates, aquifer properties, etc.

Initially a grid will be established downgradient of the soil treatment unit. A 10 ft by 10 ft grid will be marked as appropriate. Hand held methods (e.g., slide hammer, hand auger) will place a drive point connected to flexible tubing in the subsurface. The specific conductance of the groundwater at that location will be measured and recorded. The drive point will be advanced to additional depths, as feasible, to obtain a vertical conductivity profile at that location. Based on the groundwater specific conductivity, the general plume location and extent will be determined.

After the groundwater plume has been identified, drive point and standpipe piezometers will be installed. Up to 10 multi-level (up to 3 depths) drive point piezometers will be installed based on the extent of the plume. This network of drive point piezometers will enable vertical and horizontal monitoring of nitrogen in groundwater. At a minimum, the depth intervals of the drive point piezometers will include the groundwater surface, any key lithology changes, and above the confining layer. Three standpipe piezometers will also be installed: one upgradient of the plume and two within the plume downgradient of the soil treatment unit. These standpipe piezometers will enable aquifer characterization of the gradient and saturated hydraulic conductivity. Soil samples will be collected from the soil borings during standpipe installation to determine general soil properties (lithology, soil features, organic matter content, grain size, etc.). An installation report describing the monitoring system installed will be provided for each home site (Deliverable C.7).

Next the aquifer will be characterized through a pump test and slug tests to determine the saturated hydraulic conductivity and variability within the plume. A conservative tracer test will be conducted to determine groundwater velocity and the affect of aquifer dilution. If tracer testing with a conservative tracer (e.g., bromide) is conducted within a groundwater plume, the appropriateness of the tracer will be evaluated (e.g., tracer residence time in the subsurface combined with the interference caused with nitrate-nitrogen and DOC analyses).

Routine groundwater and effluent quality monitoring will be conducted at least four times (i.e., seasonally) to capture the range of likely climatic conditions. Groundwater and effluent samples will be analyzed for temperature, pH, specific conductance, DO, TKN, NO_x, ammonium-nitrogen, and chloride. Effluent samples will also be analyzed for TS and TSS. In addition, half of the samples will also be analyzed for alkalinity, $cBOD_5$ or COD, total phosphorus, fecal coliform and *E.coli*. Up to 10% of the samples will also be analyzed for anions and cations. Sample collection, handling and analysis methods will be in accordance with FDEP SOPs and are discussed in Section 3.0. Higher frequency sample collection and additional sample analysis as needed for model development, calibration, and validation may be conducted based on the results from the GCREC OSTDS monitoring. Sufficient groundwater samples will be collected to delineate the groundwater plume (horizontal and vertical) and determine denitrification rates. A monitoring report describing the each monitoring event will be provided for each home site (see Section 3.4.3).

Finally, based on the field monitoring results, additional testing and/or instrumentation may be required. Additional testing and monitoring will be conducted as needed to ensure the data quality objectives (DQOs) are met or it is determined that the required data collection is not feasible (Section 3.1).

2.3 Performance Assessment

The performance assessment of Task C will be evaluated by the acquisition of sufficient data to:

- delineate nitrogen reduction in the soil and groundwater at the selected sites, and
- calibrate and validate the simple model developed in Task D.

Successful completion of the first measure listed above will enable determination of the cumulative mass loading of N to the soil and groundwater, identify how currently designed and implemented OSTDS perform, and provide understanding of treatment processes occurring with OSTDS. The second measure will enable development of a simple, yet robust, model for nitrogen fate and transport in Florida subsurface environments in Task D. The combination of these two measures will provide an understanding of how Florida OSTDS perform and a user-friendly tool to predict nitrogen concentration at specified location downgradient of an OSTDS or the nitrogen loading / mass flux at a specified location.

2.4 Contingency Measures

The observational method for technical decision making will be employed during controlled field testing and field monitoring. This method is a continuous, integrated, process of design, monitoring, and review that enables modifications to be incorporated into the field monitoring framework as appropriate. The observational method provides for initial design based on the most probable conditions rather than the most unfavorable. The gaps in the available information are then filled by observations (e.g., nitrogen concentrations, subsurface soil layers, daily flow rates, etc.) which aid in the assessment of the groundwater by modifying the monitoring framework based on these findings.

This approach enables decisions in the field and can be described as a “learn as you go” method. For example, the observational method enables locating groundwater piezometers based on field screening of groundwater specific conductance rather than at preselected locations that may not capture the highest nitrogen concentrations (critical for being able to determine the denitrification rate and nitrogen fate and transport). Coupled with the observational method for this study are identification of additional home sites, in-field screening approaches, frequent data review and assessment, and flexibility in the number and location of sampling points as well as frequency of sample collection. This initial monitoring framework described herein and observational method will be consistent with the Task C DQOs (Section 3.1). It is important to note that while the actual number of monitoring points or samples collected are expected to vary, significant changes to the approach and type of data to be collected will not occur (e.g., plume delineation will occur at each site, groundwater cations and anions will be analyzed at each site, but potentially at a higher frequency at some sites if warranted, etc.). Specifically, the observational method does not allow a task to stop unless the DQOs have been satisfied or an alternative has been identified when the proposed task cannot meet the DQOs.

During Task C, corrective actions may be required for two types of problems: analytical or equipment problems and nonconformance problems. Analytical or equipment problems may occur during sampling, sample handling, sample preparation, field measurements, laboratory analysis, and data review. Nonconformance problems may develop at any time during these activities and are often discovered during data review. Analytical laboratory contingency measures are discussed in Section 3.3.

Members of the field team will monitor ongoing work performance as a normal part of their daily responsibilities. All project personnel will promptly identify, report, and solicit approved correction for conditions adverse to quality. All findings and actions concerning equipment problems and nonconformance problems will be documented in field or office logbooks.

Equipment problems or nonconformance problems should be reported to the Hazen and Sawyer project manager. The field team will then document the condition, its cause, any other related information, and the proposed corrective action. The field team will implement the corrective actions and document them in the field logbook. If appropriate, the field team will ensure that no additional work that is dependent on the nonconforming activity is performed until the corrective actions are completed.

Examples of corrective actions for field measurements include:

- Repeat the measurement to check the error;
- Check for all proper adjustments for ambient conditions, such as temperature;
- Check instrument batteries;
- Recalibrate instrument or device; and
- Replace the instrument or measurement device.

Section 3.0
Quality Assurance and Quality Control

3.1 Data Quality Objectives (DQOs)

The general quality assurance (QA) objective for Task C is to ensure that the field data collected are of known and acceptable quality. When available, FDEP SOPs will be used for conducting field sampling to ensure that representative data will be collected (FDEP-SOP-001/01, FDEP-QA-002/02). Specific DQOs for Task C are to:

- ensure that the home sites selected for monitoring are sufficiently characterized to be representative of the target waste stream and of properly installed OSTDS in Florida;
- ensure that the groundwater contamination by nitrogen is defined and the nitrogen reduction that is occurring is quantified at the home sites and the controlled field test site;
- ensure that soil, soil pore water, and groundwater samples are of sufficient quality to assess the presence and concentration of nitrogen (TKN, ammonium-nitrogen, nitrate-nitrogen), pH, alkalinity, carbon (TOC/DOC, $cBOD_5$, COD), and fecal coliform bacteria;
- ensure sufficient sample resolution to assess the variability within home sites and at the controlled field test site; and
- ensure sufficient sample resolution to determine model input parameters required for Task D model calibration and verification for assessment of nitrogen removal.

Of key importance is to define the groundwater concentrations and areal extent of contamination. This data will enable development of model input parameters as well as field calibration and verification of the simple model developed in Task D. Ultimately the data collected during Task C will be used to make decisions on the behavior of groundwater plumes and the mechanisms contributing to nitrogen reduction (e.g., dilution, denitrification, aerobic treatment prior to soil dispersal). While some uncertainty in the groundwater concentrations is expected, sufficient sampling locations are required to define the groundwater plume (both vertical and horizontal extent) such that factors affecting nitrogen reduction can be assessed. For example, to determine nitrogen reduction (C/C_o),

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the maximum groundwater concentration is essential to determine the maximum reduction.

Data quality indicators will be used to collectively define the quality of the submitted data. These indicators include both qualitative and the quantitative quality control (QC) measures. Task C activities that affect data quality include the sampling design (Section 2, Appendix B), field collection methods (Section 3.2), laboratory analysis (Section 3.3), and data analysis (Section 3.4). The specific methods and quantitative data QA measures (e.g., accuracy, precision, completeness and detection limit) are described in the following sections. In addition, specific qualitative control measures to be used both field and the laboratory are also described (e.g., data type, frequency of use, handling of failed QC measures).

3.2. Field Activities

The Task C sampling framework and methodology were described in Section 2. The following descriptions pertain to the field methods to be used. Laboratory activities are described in Section 3.3.

3.2.1 Sample Methods

To preserve the sample integrity, proper sample handling procedures will be employed from the time of sample collection in the field through sample analysis. Table 3.1 lists the FDEP SOPs that are pertinent to Task C. The SOPs will be kept on site and will be used by field personnel performing field work for the project.

Table 3.1
List of FDEP SOPs (FDEP-SOP-001/01) for Task C

SOP	Description
FC 1000	Cleaning / Decontamination Procedures
FD 1000	Documentation Procedures
FQ 1000	Field Quality Control Requirements
FS 1000	General Sampling Procedures
FS 2200	Groundwater Sampling
FS 2400	Wastewater Sampling
FS 3000	Soil
FT 1000	General Field Testing and Measurement
FT 1100	Field Measurement of pH
FT 1200	Field Measurement of Specific Conductance
FT 1400	Field Measurement of Temperature
FT 1500	Field Measurement of Dissolved Oxygen
FT 1900	Field Continuous Monitoring
FT 2000	Residual Chlorine

3.2.1.1 Sample Collection

As described in Section 2, several different types of samples will be collected in Task C including effluent samples, soil samples, groundwater samples, and soil pore moisture samples (see Section 3.2.3 for soil pore moisture samples). In addition, routine monitoring will include several field measurements including pH, temperature, specific conductance, oxidation-reduction potential (Eh), dissolved oxygen (DO), soil moisture content, and soil tension. Finally operating conditions and weather conditions will be monitored and recorded. Sampling methods will be in accordance with FDEP-SOPs (FS 1000). The sample collection methods and field measurement methods are described below and are summarized in Tables 3.2 and 3.3. Associated QC samples are summarized in Section 3.2.1.4.

Table 3.2
Summary of Sample Collection

Type of Sample	Analysis	Frequency[a]	Sample Collection Method
Controlled GCREC Soil and Groundwater Test Facility			
Effluent	TKN, nitrate-nitrogen, ammonium-nitrogen	weekly during the first month of operation, then bimonthly	peristaltic pump grab sample
	pH, alkalinity, $cBOD_5$, total phosphorus, total solids, total suspended solids, fecal coliform and *E.coli*	50% of the samples	
	anions and cations	10% of the samples	
	TKN, nitrate-nitrogen, ammonium-nitrogen, pH, alkalinity, $cBOD_5$	to be determined	depth specific grab sample
Soil	lithology, soil features, organic matter content, grain size	Soil samples taken with depth at location of standpipe piezometers	direct push soil core
Groundwater	nitrate-nitrogen	monthly at drive point piezometer locations until plume is established	low flow peristaltic pump grab sample
	TKN, nitrate-nitrogen, ammonium-nitrogen	every 2 months at drive point piezometer locations after plume is established	
	pH, alkalinity, COD, total phosphorus	50% of the samples	
	anions and cations	10% of the samples	
Soil moisture	TKN, nitrate-nitrogen, ammonium-nitrogen	1, 3, 5, 7, 9, and 11 months after effluent delivery	in situ suction lysimeter
	pH, alkalinity, COD, total phosphorus	50% of the samples	
	anions and cations	10% of the samples	

Table 3.2 continued
Summary of Sample Collection

Type of Sample	Analysis	Frequency[a]	Sample Collection Method
GCREC Mound and Field Sites[b]			
Effluent	TKN, nitrate-nitrogen, ammonium-nitrogen	four times	peristaltic pump grab sample
	pH, alkalinity, $cBOD_5$, total phosphorus, total solids, total suspended solids, fecal coliform and *E.coli*	50% of the samples	
	anions and cations	10% of the samples	
Soil	lithology, soil features, organic matter content, grain size	Soil samples taken with depth at location of standpipe piezometers	direct push soil core
Groundwater	water level	monthly	water level indicator
	TKN, nitrate-nitrogen, ammonium-nitrogen,	four times	low flow peristaltic pump grab sample
	pH, alkalinity, COD, total phosphorus, fecal coliform and *E.coli*	50% of the samples	
	anions and cations	10% of the samples	

see Tables 3.5 and 3.6 for analysis methods, detection limits, preservation, and holding times.

[a] *The number, location, and frequency of sample collection will be based on the observational method (in-field screening approaches, frequent data review and assessment).*

[b] *Sample locations and frequency based on the findings at the existing GCREC OSTDS.*

Table 3.3
Summary of Field Measurements

Type of Measurement	Measurement	Frequency[a]	Field Method
Controlled GCREC Soil and Groundwater Test Facility			
Operational Conditions	HLR	weekly	flow meter
	ponding		visual observation
Weather Conditions	temperature, precipitation, barometric pressure, wind speed, relative humidity, ET	at least weekly and during rain events (data recorded every minute)	field weather station
Effluent	temperature, specific conductance, pH, Eh, DO, and chloride	weekly during the first month of operation, then bimonthly	flow through test cell, ISE
Groundwater	specific conductance and chloride	monthly until plume is established	flow through test cell, ISE
	specific conductance, Eh, DO, and chloride	every 2 months after the plume is established	flow through test cell, ISE
Soil moisture	purge and sample volumes	1, 3, 5, 7, 9, and 11 months after effluent delivery	graduated cylinder or flask
	temperature, specific conductance, pH, Eh, DO, and chloride		flow through test cell
	soil moisture content	hourly	in situ probes with automated data logger
	soil tension	to be determined	in situ tensiometers
GCREC Mound and Field Sites[b]			
Operational	HLR, ponding	every visit (4 times)	flow meter and visual observation
Effluent	temperature, specific conductance, pH, Eh, DO, and chloride	every visit (4 times)	flow through test cell, ISE
Groundwater	temperature, specific conductance, pH, Eh, DO, and chloride	every visit (4 times)	flow through test cell, ISE

see Tables 3.5 and 3.6 for measurement methods, detection limits, preservation, and holding times.

[a] *The number, location, and frequency of field measurements will be based on the observational method (in-field screening approaches, frequent data review and assessment).*

[b] *Sample locations and frequency based on the findings at the existing GCREC OSTDS.*

Effluent samples will be collected in accordance with FS 2400, Wastewater Sampling. Grab samples will be collected at the controlled test site and the individual home sites. Grab samples will enable estimation of the mass loading of nitrogen to the soil. The frequency of effluent sample collection and analyses methods are summarized in Tables 3.2 and 3.3. Effluent samples will be collected using a peristaltic pump with dedicated tubing (FS 2430). The suction inlet tubing will be located in the mid section of the clear liquid phase in the latter most tank at the home sites and of the effluent holding basins at the GCREC immediately prior to discharge to the soil. Effluent samples will be collected into a 500 mL or larger sample container and placed in a cooler on ice.

Soil samples will be collected from the cores during installation of standpipe piezometers (see Section 3.2.2 for field methods and equipment) following FDEP-SOP FS 3000 using direct push techniques (FS 3220-5.0). Soil characteristics, will be obtained from up to 4 boreholes located within the area of interest (controlled test site or home site). The number and layout of the boreholes may be adjusted as necessary based on field results. Borings will be drilled to a maximum depth of 30 ft using direct-push equipment and GeoProbe sampling tools. Continuous core samples will be obtained starting at the surface. The soils retrieved during coring will be used for field and laboratory analytical analysis (Tables 3.2 and 3.3). Soil samples will be collected with depth from the water table for soil texture, soil features, total organic carbon (TOC), and grain size distribution. Depending upon the results of these field measurements and analyses, specific analytes, locations, or frequency may be altered.

All groundwater samples will be collected using a peristaltic pump and dedicated tubing in accordance with FDEP-SOP (FS 2201-2.1.1, FS 2220-3.4, and FS 2221-1.1). Prior to groundwater sample collection, the piezometer will be micropurged using low-flow purging and sampling methods (USGS 1998, Kearl et al, 1992 and 1994). The flow rate of the peristaltic pump is adjusted to match the piezometer groundwater yield rate by monitoring the water level until it is stabilized. Micropurging is continued until water quality indicators (temperature, pH, specific conductance, Eh, DO, turbidity) are stabilized (three consecutive measurements within the limits as stated in FS 2212-3.1). Groundwater samples will be collected into a 500 mL or larger sample container and placed in a cooler on ice. The frequency of groundwater sample collection and analyses methods are summarized in Tables 3.2 and 3.3. The number and location of groundwater samples will be adjusted as necessary based on field screening results and the previous sample results. Field measurements of pH, specific conductivity, temperature, Eh, and DO will be conducted in accordance with FDEP-SOPs (FT 1000, FT 1100, FT 1200, FT 1400, and FT 1500).

All non-dedicated sampling equipment will be decontaminated (soap wash, triple DI rinse, and acid wash as required) between sampling locations in accordance with FDEP-SOPs (FC 1000).

In addition, operating and weather conditions will be monitored in the field (Table 3.3). A flow meter installed on the pump discharge will measure daily flow. The flow meter will be recorded at least weekly to determine HLRs to the test area or home site. In addition, a data logger with time stamp may be used to record pump cycles and assess water use patterns and peak flows. Should ponding occur, visual observations will measure the depth of ponding from a standard reference point at each test area or home site. A reference mark will be made on the observation port casing and the distance from this reference to the infiltrative surface measured. Ponding will be measured by lowering a measuring tape, with a hook on the tip, down the observation port so that when the tip of the hook breaks the surface of the effluent the distance on the measuring tape can be recorded. This technique provides a ponding height measurement accurate to ~ ±1/32 in. (±1 mm).

A weather station is located at the GCREC with weather conditions recorded every minute and data stored on a private website. Direct measurements for evapotranspiration (ET) will be conducted if estimates calculated from the available weather data are not sufficient for modeling in Task D. At individual home sites, the nearest weather station will be located and publicly available downloaded (again recorded every minute) for 1 to 2 months before/after field monitoring (e.g., http://www.rap.ucar.edu/weather/ surface/). The higher resolution or frequency of data collection for weather conditions is based in part on the expected variability (i.e., there is little variability in water quality while there is potentially large variation in water quantity). Due to hydraulic residence times in the effluent tanks and the subsurface travel times the effluent and groundwater quality is expected to be relatively constant with little value in higher frequency monitoring. However, very high resolution data is required to capture rainfall events because automated weather stations record data at specific times (e.g., 8:00) and not the cumulative data over a time period (e.g., 7am – 8am). While the input to the simple models developed in Task D will not require this higher resolution data, we must understand these inputs and the effect on field observations.

3.2.1.2 Sample Handling and Custody

Sample handling procedures include the use of correct sample containers, labeling, documentation, preservation, and transport. Sample bottles will be purchased precleaned where applicable; certificates of cleanliness will be maintained in the project file. The bottles will be stored in a secured area to maintain integrity. Preservatives will consist of reagent grade chemicals and will be placed in the bottles prior to sample collection. Selection of sample containers is governed by sample type and size and the required analyses. Each sample aliquot will be labeled with the site ID, sample ID, date, time, and sampler initials and logged into laboratory notebooks. Sample identification nomenclature will provide a unique number for each sample location/type and is summarized in Table 3.4. For example, CE-HS1-DP3-240 is the groundwater sample collected from drive point piezometer 3 (240 cm below ground surface) at home site 1 in Central Florida. For simplification in the field, a 4-digit cross reference code may be noted on the sample label with the full sample identification recorded in the field logbook. Duplicate samples will be designated with a "D" or "dup" after the last character of the sample designation. Equipment rinsates will be designated with an "ER" after the last character of the last sample collected prior to the equipment rinsate. Field blanks will be numbered consecutively.

Due diligence will be exercised to minimize the time between sample removal from the site and transport to the laboratory for analysis. After the samples have been collected, labeled and preserved, the samples will be placed in a cooler and transported on ice or frozen Blue Ice® to the GCREC laboratory or commercial analytical laboratory for analyses. Each sample container will be secured in packing material as appropriate to prevent damage and spills. Sample delivery will be conducted on a daily to weekly basis, dependent upon the sampling frequency.

Table 3.4
Nomenclature for Sample Identification

Site ID		Sample ID	
Region (AA)[a]	**Location (AAN)[b]**	**Sample Type (AAA/N)[b]**	**Depth (NNN)[c]**
GC Gulf Coast Research Education Center	TA1 test area	STE effluent sample, septic tank effluent	NA
NO Northern Florida (Wakulla County)	HS1 home site	NTE effluent sample, nitrified effluent	NA
CE Central Florida (Wekiva Study Area)		SB1 soil sample, soil boring	60, 120, etc.
SO Southern Florida (Charlotte County)		SM1 unsaturated zone, soil moisture probe	15, 30, etc.
		ST1 unsaturated zone, soil tension probe	15, 30, etc.
		LY unsaturated zone, lysimeter soil pore water	15, 30, etc.
		SD1 groundwater, standpipe piezometer	90, 240, etc.
		DP1 groundwater, drive point piezometer	90, 240, etc.

[a] *character type: A = Alpha, N = Numeric*
[b] *numeric identifier for multiple locations of a similar type (e.g., HS1 = home site 1, SB1 = soil boring 1, etc.)*
[c] *depth in cm below infiltrative surface or below ground surface*

A sample will be considered under custody if it is in:

- actual possession of a member of the sampling crew,
- view of the sampling crew (constituting actual possession by the crew), or
- actual possession of the sampling crew and locked in a secured area or vehicle in a manner such as to prevent tampering.

Chain of custody forms will be used to document the transfer of samples from field personnel to the GCREC or analytical laboratory. One chain of custody form will be filled out for each set of samples and placed inside the cooler.

The chain of custody form will list the following:

- regional location,
- sampler(s),
- sample identification,
- sample type,
- date and time of collection,
- analyses requested,
- preservative (if applicable),
- signature and date, and
- remarks.

Sample custody for samples received by the analytical laboratory will be performed according to their procedures. The analytical laboratory will be in compliance with the FDOH Environmental Laboratory Certification Program (ELCP) and ensure that all samples are properly stored, handled, and analyzed within the required holding time (see Section 3.3). The laboratory will be notified of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped, as well as the anticipated date of arrival.

3.2.1.3 Sample Analysis

Tables 3.5 and 3.6 list the analytical methods, target analytes, sample containers, preservatives, and holding times for effluent, soil, soil pore moisture, and groundwater sampling that is anticipated to be conducted during Task C. Constituents of interest will be analyzed on effluent, groundwater, and soil pore moisture samples following standard methods as described in Table 3.5 (FDEP 2008, APHA 2005, Hach 1998). Laboratory analysis of the samples shall be performed on the unfiltered sample within 24 hours of collection or within the appropriate holding times as specified in individual analysis methods (Table 3.6). The analytical template for each of the test areas is summarized within Tables 3.7, 3.8 and 3.9.

Sample aliquots of approximately 15 mL each will be collected, placed into sterilized containers (e.g., 15 mL conical tubes), and immediately placed on ice for microbial analyses. Studies have shown that sample holding times of up to 24 hours have little impact on bacterial counts or coliphage numbers (Van Cuyk 2003, Selvakumar *et al*. 2004). Both fecal coliforms and *E. coli* will be enumerated using a modified version of the enzyme substrate test or membrane filtration (APHA 2005, 9222D). For the enzyme substrate test, samples are diluted and added to a chromogenic and flourogenic substrate. After adding sample to the substrates, the mixture is incubated at 45°C for 24 hours, the system then provides the concentrations of both fecal coliforms and *E. coli* through a most probable number result based on the substrate color change or UV fluorescence. Note that the incubation temperature has been modified from the manufacturer's recommendation of 35°C in order to enumerate only fecal coliforms rather than total coliforms. However, several groups (Yakub *et al.*, 2002; Chihara *et al.*, 2005) have shown similar fecal coliform counts when comparing the above method to the membrane filtration method.

Table 3.5
Sample Analyses Methods

Parameter	Detection Limits[a]	Method
Flow	Mnfr. Specification	Water meter
pH	0.1	Electrode - (APHA method 4500-H^+B)
Temperature	0.1 ^oC	Field method - (APHA method 2550B)
Eh	25mV	Electrode - (APHA method 2580B)
DO	0.1 mg-DO/L	Membrane Electrode - (APHA method 4500-O G)
Alkalinity	2.0 mg-$CaCO_3$/L 0.2[b] mg-$CaCO_3$/L	Titration - (APHA method 2320B)
$cBOD_5$	1.0 mg/L 0.3[b] mg/L	Carbonaceous 5-day test - (APHA method 5210B)
COD	3.0 mg/L 0.2[b] mg/L	Closed reflux, colorimetric method (APHA method 5220D and HACH method 8000 U.S. EPA-approved)
TOC / DOC	1.0 mg-C/L	Combustion-infrared method - (APHA method 5310B)
TS and TSS	5.0 mg/L	Gravimetrically, dried at 103–105^{o}C - (APHA methods 2540B and 2540D)
TKN	0.03 mg-N/L	Block digestion, flow injection analysis - (APHA method 4500N_{org} D)
Ammonia nitrogen	0.6 mg-N/L 0.03 [b] mg-N/L	Nessler method - (HACH method 8038, U.S. EPA-approved) Distillation and titration - (APHA method 4500-NH_3 C)
NO_x-nitrogen (nitrate + nitrite)	0.2 mg-N/L (nitrate) 0.005 mg-N/L (nitrite)	Spectrophotometric, chromotropic acid method (nitrate) and diazotization (nitrite) - (HACH method 10020 and 10207, both U.S. EPA-approved) Ion chromatographic method - (APHA method 4110)
Total phosphorus	0.06 mg-P/L	Nitric acid-sulfuric acid method - (APHA method 4500-P) Persulfate oxidation method - (U.S. EPA 365.2)
Chloride	4.0 mg-Cl/L	Solid state ion selective electrode - (U. S. EPA 9212) Ion chromatographic method - (APHA method 4110)
Anions	varies by analyte	Ion chromatography (IC) - (APHA method 4110)
Cations	varies by analyte	Inductively coupled plasma (ICP) - (APHA method 3120B)
Fecal coliform	1cfu/100mL	Enzyme substrate test - (APHA method 9223B, modified by incubation at 45°C)
E. coli	1cfu/100mL	Enzyme substrate test - (APHA method 9223B)

[a] *Detection limits are for wastewater samples. Actual minimum detection limits may vary due to sample concentrations and subsequent dilutions. The detection limit will be reported with the data.*

[b] *Lower estimated detection limit for groundwater samples.*

Table 3.6
Sample Analyses Requirements[1]

Parameter	Minimum Volume (mL)	Container Requirements	Preservative and Holding Time
Flow	NA	NA	NA
pH	5	Pre-cleaned plastic or glass	None, analyze immediately
Temperature	5	Pre-cleaned plastic or glass	None, analyze immediately
Eh	5	Pre-cleaned plastic or glass	None, analyze immediately
DO	5	Pre-cleaned plastic or glass	None, analyze immediately
Alkalinity, total	50	Pre-cleaned plastic or glass	<6^{o}C, 24 hours
$cBOD_5$	60	Pre-cleaned plastic or glass	<6^{o}C, 6 hours
COD	2	Pre-cleaned glass	<6^{o}C, 24 hours with H_2SO_4 to <pH2, 28 days
TOC / DOC	5	Pre-cleaned acid washed amber glass	<6^{o}C, 28 days
TS and TSS	20	Pre-cleaned plastic or glass	<6^{o}C, 7 days
TKN	5	Pre-cleaned plastic or glass	<6^{o}C, 24 to 48 hours with H_2SO_4 to <pH 2, 28 days
NO_x-nitrogen (nitrate + nitrite)	10	Pre-cleaned plastic or glass	<6^{o}C, 24 to 48 hours with H_2SO_4 to <pH 2
Ammonia-nitrogen	5	Pre-cleaned plastic or glass	<6^{o}C, 24 hours with H_2SO_4 to <pH 2, 28 days
Total phosphorus	5	1:1 HCl acid washed glass	<6^{o}C, 24 hours H_2SO_4 to <pH 2, 28 days
Chloride	<100	Pre-cleaned plastic or glass	<6^{o}C
Anions	<100	Pre-cleaned plastic or glass	<4^{o}C, 48 hours to 28 days
Cations	<100	HNO_3 acid washed glass	HNO_3 to <pH 2, up to 6 months
Fecal coliform	5	Sterile plastic or glass	<6^{o}C, 24 hours
E. coli	5	Sterile plastic or glass	<6^{o}C, 24 hours

[1] *Requirements are consistent with: FDEP-SOP-001/01, General Sampling Procedures; APHA 2005, Standard Methods; and U.S. EPA Test Methods.*

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Table 3.7
Analyses Template Controlled GCREC Soil and Groundwater Test Facility

<table>
<tr><th>Type of Sample</th><th>Number of Events</th><th>Sample Points</th><th>Analytes</th><th>Total Number of Analyses</th></tr>
<tr><td rowspan="12">Effluent</td><td rowspan="12">12</td><td rowspan="12">2</td><td>TKN</td><td>24</td></tr>
<tr><td>NOx</td><td>24</td></tr>
<tr><td>NH_3</td><td>24</td></tr>
<tr><td>Alkalinity</td><td>12</td></tr>
<tr><td>C-BOD_5</td><td>12</td></tr>
<tr><td>Total P</td><td>12</td></tr>
<tr><td>TS</td><td>12</td></tr>
<tr><td>TSS</td><td>12</td></tr>
<tr><td>Fecal</td><td>12</td></tr>
<tr><td>E. Coli</td><td>12</td></tr>
<tr><td>Anions</td><td>4</td></tr>
<tr><td>Cations</td><td>4</td></tr>
<tr><td rowspan="14">Soil</td><td rowspan="14">1</td><td rowspan="14">24</td><td>Lithology</td><td>24</td></tr>
<tr><td>OM</td><td>24</td></tr>
<tr><td>TOC</td><td>24</td></tr>
<tr><td>Grain Size</td><td>24</td></tr>
<tr><td>CEC</td><td>24</td></tr>
<tr><td>Moisture</td><td>24</td></tr>
<tr><td>Total P</td><td>24</td></tr>
<tr><td>Total N</td><td>24</td></tr>
<tr><td>Inorganic N</td><td>24</td></tr>
<tr><td>Organic N</td><td>24</td></tr>
<tr><td>Potassium</td><td>24</td></tr>
<tr><td>Calcium</td><td>24</td></tr>
<tr><td>Sodium</td><td>24</td></tr>
<tr><td>Magnesium</td><td>24</td></tr>
<tr><td rowspan="8">GW</td><td rowspan="8">12</td><td rowspan="8">44</td><td>NOx</td><td>528</td></tr>
<tr><td>TKN</td><td>528</td></tr>
<tr><td>NH_3</td><td>528</td></tr>
<tr><td>Alkalinity</td><td>264</td></tr>
<tr><td>COD</td><td>264</td></tr>
<tr><td>Total P</td><td>264</td></tr>
<tr><td>Anions</td><td>53</td></tr>
<tr><td>Cations</td><td>53</td></tr>
</table>

Table 3.7 (con't)
Analyses Template Controlled GCREC Soil and Groundwater Test Facility

Type of Sample	Number of Events	Sample Points	Analytes	Total Number of Analyses
Soil Moisture	12	20	TKN	240
			NOx	240
			NH_3	240
			Alkalinity	120
			COD	120
			Total P	120
			DOC	120
			Anions	24
			Cations	24

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Table 3.8
Analyses Template GCREC Mound

Type of Sample	Number of Events	Sample Points	Analytes	Total Number of Analyses
Effluent	4	1	TKN	4
			NOx	4
			NH_3	4
			Alkalinity	2
			C-BOD_5	2
			Total P	2
			TS	2
			TSS	2
			Fecal	2
			E. Coli	2
			Anions	1
			Cations	1
Soil	1	24	Lithology	24
			OM	24
			TOC	24
			Grain Size	24
			CEC	24
			Moisture	24
			Total P	24
			Total N	24
			Inorganic N	24
			Organic N	24
			Potassium	24
			Calcium	24
			Sodium	24
			Magnesium	24
GW	4	96	NOx	384
			TKN	384
			NH_3	384
			Alkalinity	192
			COD	192
			Total P	192
			Anions	38
			Cations	38

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Table 3.9
Analyses Template Field Sites (per site)

Type of Sample	Number of events (per site)	Sample Points	Analytes	Total Number of Analyses (per site)
Effluent	4	1	TKN	4
			NOx	4
			NH_3	4
			Alkalinity	2
			C-BOD_5	2
			Total P	2
			TS	2
			TSS	2
			Fecal	2
			E. Coli	2
			Anions	1
			Cations	1
Soil	1	24	Lithology	24
			OM	24
			TOC	24
			Grain Size	24
			CEC	24
			Moisture	24
			Total P	24
			Total N	24
			Inorganic N	24
			Organic N	24
			Potassium	24
			Calcium	24
			Sodium	24
			Magnesium	24
GW	4	96	NOx	384
			TKN	384
			NH_3	384
			Alkalinity	192
			COD	192
			Total P	192
			Anions	38
			Cations	38

3.2.1.4 QC Samples

Routine QC checks of sampling and analysis procedures will be in accordance with FDEP-SOP FQ 1000 and consist of two parts: 1) field QC samples and 2) laboratory QC samples. The primary goal of the QC samples is to ensure that all data are of known quality, and that the expected quality is appropriate for the desired use of the data. Field QC samples will be collected to ensure proper sample collection and handling. Laboratory QC samples will be analyzed to ensure proper sample preparation and analytical techniques (see Section 3.3). Non-routine QC checks will include laboratory testing as needed to assure SOPs do not affect the sample quality. A summary of the QC samples is presented in Table 3.7.

Table 3.10
Summary of QC Samples Collected and Analyses Conducted

QC Sample	Frequency
Field duplicate	10% of samples collected
Laboratory duplicate	per laboratory SOPs
Equipment rinsate	one per sampling event per region
Field blank	one per sampling event per region
Split sample	10% of samples collected
Laboratory blank	per laboratory SOPs
Laboratory spike	per laboratory SOPs
Non-routine method check	as necessary

Field QC samples will include duplicates, equipment rinsates, and field blanks. Duplicate samples will be collected with the regular samples. Field duplicate samples will be collected from the same 24-hr composite sample container. Duplicate grab samples will be collected at the same location in immediate succession with a regular sample. The number of duplicates collected will be 10% of the total samples collected. The identification numbers and locations of the duplicate and regular samples will be clearly indicated in the log book. Duplicate samples will undergo the same laboratory analyses as regular samples.

Field blanks are samples of the source water used for decontamination. These field QC samples are collected to ensure that constituents of interest (i.e., nitrogen) are not introduced into the sample during decontamination. The rinse water used for decontamination is typically organic-free deionized water. The water used for washing is potable tap water. At a minimum, one sample from each source of water for a given sampling event will be collected for analysis. The field blanks will be analyzed for the same parameters as the associated sample medium. The water used for decontamination will be resampled whenever the source or supplier is changed.

Equipment rinsate samples will be collected to determine the effectiveness of decontamination procedures. These samples will be collected by pouring deionized water into or through the sampling device after it is thoroughly decontaminated. The equipment rinsate samples will be analyzed for the same parameters as the associated samples. At least one equipment rinsate sample will be collected during each sampling event if the sampling involves the use of decontaminated equipment (e.g., samples may be collected with dedicated and/or disposable equipment; therefore, no decontamination is performed).

3.2.2 Field Testing

Field testing will include operational monitoring, piezometer installation for subsequent groundwater monitoring, field measurements, and weather monitoring. The field equipment for Task C includes a field spectrophotometer, flow meters for effluent delivery, meters for measuring pH, specific conductivity, temperature, Eh, DO, water levels, etc., and a weather station. Equipment used in the field will be maintained and calibrated in accordance with the manufacturers specifications (FDEP-SOP FT 1900). Field instruments will be thoroughly checked and calibrated before they are transported to the field. These instruments will be inspected for damage once they have arrived in the field. Damaged instruments will be immediately replaced or repaired. Service and repair of field instruments will be performed by qualified personnel and will be recorded in the field logbook.

Instruments and equipment used to gather, generate, or measure environmental data (e.g., field spectrophotometer, multiparameter sonde for pH, specific conductivity, temperature, Eh, DO) will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Calibration or calibration checks, as appropriate, of field instruments and equipment will be performed at least daily or at more frequent intervals as specified by the manufacturer. Calibrations may be performed at the start and completion of each test run. However, calibrations will be reinitiated as appropriate after a period of elapsed time due to meals, work shift change, or if damage has occurred. Records of calibration procedures, frequencies, lot numbers of standard reference solutions used as calibration standards, and any repairs or replacements will be recorded in the calibration log and/or field logbook.

Piezometers will be installed to enable groundwater monitoring as described in Section 2. During standpipe piezometer installation, soil samples will be collected to characterize the soil and aquifer. Borings for standpipe piezometer installation will be drilled using direct-push equipment and sampling tools. Continuous core samples will be obtained starting at the surface. Soil samples will be collected at 2-ft intervals from the soil cores. The GeoProbe/Terraprobe sampling method utilizes a 4-ft. long x 2-in. inner diameter (ID) dual-tube assembly with polyethylenterephthalate (PETG) liners to collect continuous undisturbed samples. The dual-tube assembly is comprised of an outer stainless steel core barrel (3.25-in ID), an inner stainless steel core barrel (2.25-in ID) and PETG liners (2-in ID) inserted into the inner core barrel. The dual-tube assembly is hammered, without rotation, ~3.5 ft into the ground surface. The inner core barrel with PETG sleeve and soil core is then retrieved to the surface. Upon retrieval to the surface, the PETG liner with the intact soil core is removed from the sampler, capped and stored at 4°C prior to transporting to the laboratory for analyses. A clean PETG sleeve is then replaced into the inner core barrel and reinserted into the outer core barrel retained in the subsurface. The dual-tube assembly is then again advanced ~3.5 ft and the process repeated until a continuous core to the desired depth was obtained. These soil core collection methods enabled relatively intact core samples to be aseptically collected vertically downward.

Standpipe piezometers will be installed in the soil borings to a maximum depth of approximately 50 ft using standard well construction practices (Driscoll 1986). The screen length of each standpipe piezometer will be selected based on the soil profile at that location. All couplings will have flush threaded connections. No glues or lubricants will be used. The annular space will be filled with native filter pack or with a grade of silica sand pack selected based on the soil grain size and the slot size of the screen. The sand pack will extend one to two feet above the top of the screen with a one to two foot bentonite seal placed on top of the sand pack to prevent preferential flow between the multiple completions. Each standpipe piezometer will be grouted at the ground surface and have a locking cap to prevent tampering. Upon completion, all standpipe piezometers will be developed by surging and pumping (Driscoll 1986). Piezometers will be allowed to set for a minimum of 24 hours before development to allow the grout to set. Development will begin at the top of the screen and proceed vertically downward with pumping rates and water levels monitored and recorded during the development process. Development will continue until at least five times the volume of standing water has been removed or the water is as clear as practical. All development water will be recharged to the ground.

All direct push and soil sampling equipment (e.g., drive points, core barrels, sampling utensils, etc.) that contacts potential soil samples will be cleaned according to FDEP-SOP FC 1000 between each piezometer location. Any residual soil will be spread on the ground surface or containerized and disposed of to not alter home site landscaping.

Drive point piezometers will be used to locate and define groundwater plumes and enable collection of groundwater samples. Stainless steel drive points are attach to polyethylene tubing inserted into standard 3/4" (20 mm) NPT steel drive pipe which is widely available through local plumbing and hardware stores. The steel drive pipe allows for the drive point piezometers to be driven into the ground with either direct push drilling or hand methods such as slide hammers (FDEP-SOP FS 3000). The drive casing is then removed leaving the drive point at the desired depth and the attached tubing extending to the surface.

Following standpipe piezometer installation hydraulic tests will be performed. Single well step drawdown tests will be conducted to determine the relative distribution of hydraulic conductivity within the test area or home site. Understanding the permeability distribution will be critical for interpreting the results of the field monitoring. Alternatively, single-well recovery tests may be conducted (bail test or slug test). Analysis will be conducted using the Hvorslev (1951) or Bower and Rice (1976).

3.2.3 Non-standard or Alternative Field Methods

Tracer testing and unsaturated zone monitoring will require the use of non-standard field methods. Tracer testing will require the addition of a conservative tracer to the OSTDS and high frequency short duration analysis. These methods have been widely used in field research and are proven techniques (Beach 2001, VanCuyk et al. 2005). Monitoring of the unsaturated zone during the controlled field testing at the GCREC (Section 2.1.2.2) will require the use of non-standard field methods including suction lysimeters, in situ soil tensiometers, and in situ soil moisture probes. Again, these methods have been widely used in field research and are proven techniques (Anderson, 1994; Wolt, 1994; Hart and Lowery, 1997; Tackett, 2004; Dimick, 2005). Brief descriptions are provided here.

3.2.3.1 Tracer Test Methods

Tracer testing will be employed to evaluate travel times in the vadose zone. Bromide will serve as a conservative tracer representative of the water movement through soil, though some diffusion from mobile to immobile water may occur. The target concentration of ~500 ppm in the influent tank will allow for detection in the subsurface, but minimize issues associated with solution density and mixing. Bromide will be added in the form of potassium bromide salt. The necessary amount of potassium bromide will be calculated to obtain the target concentration based on the individual tank size. The bromide salt will then be measured and added to the tank with any large clumps broken up prior to adding it to the tanks. If necessary, the bromide salt will be placed in a clean bucket and dissolved in water prior to addition to the tank to ensure dissolution. Following addition into the tank, daily samples will be taken from the tank for quantification/verification of concentrations of added tracer. Samples will then be collected via the suction lysimeters placed below the infiltrative surface (for controlled pilot-scale testing at the GCREC only) or drive point and standpipe peizometers (for controlled pilot-scale testing at the GCREC, the existing mound OSTDS serving the GCREC and home sites). Samples will be collected every 24 or 48 hours with decreasing frequency to weekly and monthly until the tracer is no longer detected. Samples will be analyzed for bromide using an ion-selective electrode following manufacturer's specifications. Standard calibration curves will be generated daily from stocks of bromide solution. The correlation between electrode mV response and the standard concentration (in mg-Br/L) in then used to determine the bromide concentration. The electrode will be recalibrated as recommended by the manufacturer if the correlation (r^2) is less than 0.95 or if mV measurements were observed to drift during analysis.

It should be noted, that during tracer tests conducted at CSM, interference with several analysis methods due to bromide has been observed. Specifically, elevated bromide concentrations interfere with TS, TSS, COD, DOC, total nitrogen, and nitrate analyses. the most significant interference precludes combined analysis of bromide with TS, TSS, and nitrate. If conservative tracer tests using bromide are deemed to create a problem, an alternative conservative tracer will be identified (e.g., fluorobenzoic acids) or all groundwater and effluent quality samples will be collected and analyzed prior to tracer addition to the tank.

Nitrogen isotope tracers (^{15}N) have been used in agricultural studies and in wastewater research to track groundwater plumes. A ^{15}N tracer test may be conducted as part of the controlled pilot-scale testing at the GCREC to delineate the nitrogen mass balance. Test methods to be used are described in Parzen (2007). However, both tracer test preparation and tracer sample analysis is extremely time-consuming and challenging. Thus, isotope tracer tests will not be conducted at the home sites.

3.2.3.2 Unsaturated Zone Monitoring

Stainless steel and ceramic suction lysimeters (SW-074, Soil Measurement Systems, Tucson, AZ) will be installed at the controlled field test site (Figure 3-1). Suction lysimeters are preferred due to the minimal subsurface disruption and the ability to easily collect discrete samples compared to pan lysimeters. The 0.86-in. diameter lysimeters are 4.5-in. long including a 3.5-in. length that is porous with a nominal pore size of 0.2 microns and tubing that extends to the ground surface. The small pore size limits sampling for bacteria, but is necessary to inhibit air from entering the lysimeters in lieu of soil water solution. Lysimeters will be installed within a single 2-in. diameter borehole with a sieved native soil and water slurry (3:1 volume:volume) to ensure continuous contact between the porous lysimeter and surrounding undisturbed soil. A bentonite seal will be placed between the lysimeters to prevent preferential flow paths within the borehole that could yield artifacts during soil pore water sampling and analyses (see Figure 3-1).

Individual lysimeter tubing is inserted into a rubber stopper with another set of tubing leading to the vacuum line. A vacuum is applied to the tubing to facilitate sample collection from the unsaturated zone. The vacuum applied must be strong enough to overcome the soil moisture tension and to draw soil water present in the vadose zone into the lysimeter. The SW-074 lysimeters have a bubbling pressure of 700 millibars. This pressure is the air entry value, which is the air pressure required to force air through the thoroughly wetted porous material. The bubbling pressure is a function of pore size; the smaller the pores, the higher the bubbling pressure value. When this critical value is exceeded, the bonds attaching water to the porous material can be broken. Soil solution then travels up from the lysimeter by vacuum and drops into a pre-cleaned stoppered flask for sample collection (Figure 3-1). The initial soil solution volume collected is purged (dumped) in order to ensure a representative sample from the soil profile. To provide the vacuum needed for soil solution sampling, a manifold of PVC pipe will be connected with flexible tubing to vacuum pumps. All glassware will be washed in phosphorus-free soap, followed by acid/base baths separated by DI water rinses, allowed to air dry, and then covered with foil until use.

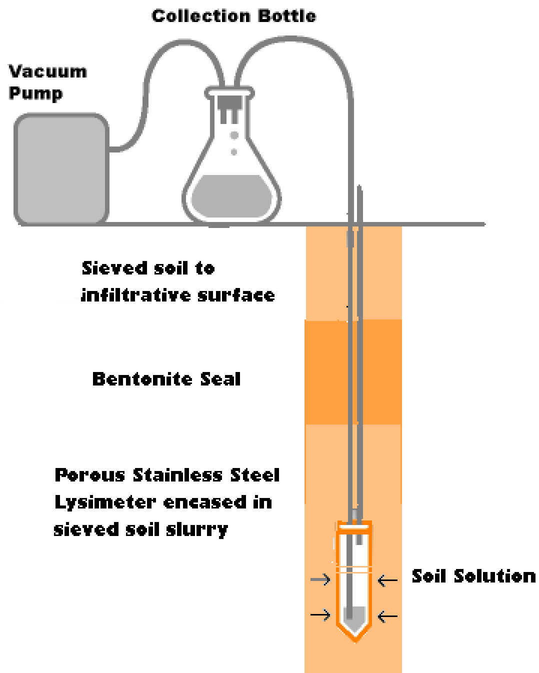

Figure 3-1: Example Configuration of Soil Suction Lysimeters Used for Pore Water Sample Collection (from www.soilmeasurement.com)

In situ soil tension and soil moisture measurements will be collected for model development in Task D. Parameter estimation for porous media flow by inverse modeling has been shown to be sufficient with four observation depths and at least two of three conditions: soil water content, matric pressure head, and or water flux (Ritter, 2004). The matric potential is the pressure potential due to the interaction of water and soil grains with both positive and negative pressures are measured with a tensiometer (Marshall et al., 1996). Soil moisture tension will be monitored with tensiometers installed at up to 4 depths as described in Section 2. Tensiometers have a ceramic cup and tube assembly equipped with a pressure transducer. The pressure transducer allows for precise measurement of the water potential. Tensiometers can be automated to enable recording of soil moisture tension at up to 15 minute intervals to evaluate short-term changes in soil moisture status associated with wastewater dosing events. Alternatively, tensiometers will be manually read at weekly intervals. Soil moisture will be measured through time domain reflectometry (TDR) probes. TDR measures the travel time of an electric pulse down a wave guide inserted in the soil. The travel time of the pulse depends on the apparent permittivity or dielectric constant, ε, of the soil media. Since the ε_{water} is approximately 70 times greater than ε_{soil} (dry soil), the $\varepsilon_{soil\ media}$ depends strongly on the water content (θ_w) of the soil system (Jury et al. 1991). Prior to installation, the global and individual settings for each wave guide will be adjusted according to the manufacturer's recommendations. Wave guides will be connected to a data logger to automatically acquire water content measurements for each TDR wave guide every 2 hours. The frequency of data logging may be modified based on the observational approach. Both tensiometers and soil moisture probes will be installed with direct push hand methods. During installation, the depth intervals may be adjusted to capture the transition between soil layers (e.g., spodic horizon noted in Soil Survey) and the capillary zone of the low water table.

3.3 Laboratory Activities

All laboratory activities will meet the minimum QC as specified in the FDEP-SOPs which meet the National Environmental Laboratory Accreditation Program (NELAP) requirements. However, if a certified laboratory is not identified, a waiver may be requested based on the research nature of this project (DEP 62-160.600 (1)(d) and (3)(f)). Regardless of if a waiver for the laboratory certification is obtained, all laboratories conducting work for this project will operate and maintain a QA Program consistent with NELAP standards. All laboratory methods to be utilized during Task C are standard methods. Should any non-standard laboratory methods be required, an addendum to this QAPP will be prepared.

Analytical methods, target analytes, sample containers, preservatives, and holding times for effluent, soil, soil pore moisture, and groundwater samples are discussed in Section 3.2.1.3 (Tables 3.5 and 3.6). Once samples are received, the laboratory will have a document-control system including: sample labels, analysis logbooks, computer printouts, and raw data summaries. The analytical laboratory will be in compliance with the FDOH ELCP and ensure that all samples are properly stored, handled, and analyzed within the required holding time. A qualitative assessment of each sample container will be performed to note any anomalies, such as broken or leaking bottles and any labeling or descriptive errors. In the event of discrepant documentation, breakage, or any condition that would compromise sample integrity, the laboratory will immediately contact the field team. The samples will be stored at a temperature of approximately <6°C (as applicable) until analyses are performed.

The analytical laboratory will have approved SOPs for preventative maintenance for each instrument system and for required support activity. These records will be reviewed by auditors who perform internal and external system audits of the laboratory. All laboratory instrumentation maintenance and calibration will be performed and documented in accordance with the laboratory SOPs.

Laboratory QC procedures will include split samples, method blanks, spikes, and duplicate samples. The analytical laboratory will be in compliance with the FDOH ELCP and routinely analyze QC samples in accordance with their approved SOPs. Split samples will be sent to an outside commercial analytical laboratory for 10% of the nitrogen samples. Reagent blanks will be run for all appropriate analyses to verify that the procedures used do not introduce contaminants that affect the analytical results. Surrogate spike analysis is used to determine the efficiency of recovery of analytes in sample preparation and analysis. Calculated percent recovery of the spike is used as a measure of the accuracy of the analytical method. A surrogate spike is prepared by adding to an environmental sample (before extraction) a known amount of pure compound similar in type to the one to be assayed in the environmental sample. Surrogate spike recovery must fall within certain limits; if the recovery is not within these limits, corrective action will be implemented. Duplicate samples will be used to confirm laboratory method precision. Replicate samples should have a relative standard deviation of <10%. If the recovery is not within these limits, corrective action will be implemented. Laboratory duplicate samples will be prepared from the same sample in immediate succession with a regular sample. A summary of the QC samples is presented in Table 3.7 (Section 3.2.1.4).

Corrective actions at the analytical laboratory are required whenever an out-of-control event or potential out-of-control event is noted. Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors and checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and other parameters. If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor, manager, and/or QA department for further investigation. Each certified laboratory has written SOPs specifying the corrective action to be taken when an analytical error is discovered or when the analytical system is determined to be out of control.

3.4 Documentation, Assessment, and Reporting

To ensure representative data is collected to meet the DQOs, the following documentation, assessment, and reporting methods will be performed.

3.4.1. Documentation

Information to be documented will be in accordance with FDEP-SOPs (FD 1000). Logbooks will be used by the project team members and subcontractors responsible for sample collection and analyses. Each team member will be responsible for recording daily activities and/or significant events, observations, and measurements. Enough information will be recorded such that clarification, interpretations, or explanations of the data and activities are not required from the originator of the documentation. Checklists and FDEP forms will be used as appropriate and maintained in the project files. Specifically, forms FD 9000-7, FD 9000-8, FD 9000-9, FD 9000-22, FD 9000-23, and FD 9000-24 are expected to be used. All logbooks will be bound books with entries signed and dated. All field data will be protected to prevent loss. All Task C documentation will be retained for a minimum of 5 years.

Entries in the logbooks will include the following when applicable:

- description of activity,
- date and time,
- location,
- weather conditions,
- names and affiliations of field team,
- work progress,
- test area and OSTDS operational conditions,
- field measurements and observations,
- equipment maintenance and calibration (Section 3.2.2), and
- any unusual occurrences, depending upon the nature of the occurrence, such as:
  - delays,
  - unusual situations,
  - departure from established field procedures,
  - equipment breakdown and repairs,
  - instrument problems, and
  - accidents.

In addition, the latitude and longitude of each fixed monitoring point (piezometers, suction lysimeters, etc.) will be documented. Sufficient information will be included such that all team members can easily locate the monitoring point. At the time of collection, each sample will be labeled with notations made in waterproof, indelible ink.

Minimum information on the sample label will include:

- unique sample identification number (Section 3.2.1.2),
- analyses required,
- preservative used (if any),
- name or initial of sample collector(s), and
- date and time of sample collection.

All original data recorded in field logbooks, standard checklists, and sample labels will be written with black indelible ink. If a previously recorded value is discovered to be incorrect or if blank lines are left, the wrong information or blank lines will be crossed through with a single line, the correct value written in, and the change initialed and dated. If the change is made by someone other than the original author or if the change is made on a subsequent day, the reason for the change will be recorded at the current active location in the logbook, with cross reference to the original entry. All monitoring results will be entered into an electronic database such as Microsoft Access or Excel.

Laboratory documentation will be in accordance with FDOH ELCP requirements and at a minimum include:

- project information (e.g., client name, project number, etc.),
- sample information (e.g., source, location of sample, matrix, etc.)
- analysis results (e.g., analyte, result, units, comment, etc.),
- laboratory QC information (e.g., blank results, matrix spike information, RPD, etc.)
- instrumentation/equipment maintenance performed, and
- instrument calibration results.

The laboratory records shall contain sufficient information to allow independent reconstruction of all activities related to generating data that are submitted in data reports to the client (Hazen and Sawyer). All analytical results will be entered into an electronic database such as Microsoft Access or Excel.

3.4.2 Data Assessment

The data collected in Task C will be evaluated for precision, accuracy, representativeness, comparability, and completeness. When using these parameters as indicators of data quality, only precision and accuracy can be expressed in purely quantitative terms. The other parameters are mixtures of quantitative and qualitative expressions. All of these parameters are interrelated can be difficult to evaluate separately. Primary data will also be graphically examined to identify obvious effects and trends and then subjected to classic statistical analyses such as multifactor analysis of variance, principal components analysis, and/or multivariate regression analyses (e.g., Snedecor and Cochran 1980, Minitab 2000).

3.4.2.1 Precision

Measurements of data precision are necessary to demonstrate the reproducibility of the data. Precision objectives for field instruments are included in the SOPs for the instruments. To the extent possible, one set of field instruments will be used for the duration of the project.

All laboratory measurements will be made with high-purity materials, by knowledgeable laboratory personnel, and following internal QC. Duplicate samples will be collected and analyzed to assess the overall precision of laboratory procedures. Analytical precision may be expressed in terms of the standard deviation or RPD. RPD is calculated as follows:

$$RPD = ((X_1 - X_2)/X_{avg})(100)$$

where:

X_1 = analyte concentration of first sample

X_2 = analyte concentration of a duplicate sample

X_{avg} = average analyte concentration of first and duplicate samples.

3.4.2.2 Accuracy

The accuracy of a measurement is based on a comparison of the measured value with an accepted reference or true value. Accuracy of a procedure is best determined on a known quantity or quality. The accuracy of field measurements will be assessed through the use of calibration standards (e.g., pH standards), by comparing the measurement of a field instrument against a known standard. All calibration and instrument operations will be carried out using traceable standards and specified materials and methods. The accuracy of surveying measurements for the locations of wells and piezometers will be ± 0.5 ft. for horizontal measurements and ± 0.1 ft. for vertical measurements.

Sampling accuracy can be estimated by evaluating the results obtained from blanks. The types of blanks to be used for this evaluation are rinsates and field blanks. The accuracy of laboratory measurements can be expressed as percent recovery (PR) and is calculated as follows:

$$PR = ((A-B)/C)(100)$$

where:

A = spiked sample concentration
B = sample concentration
C = concentration of spike added.

3.4.2.3 Representativeness

All data obtained should be representative of actual conditions. The field procedures and laboratory analyses outlined in Section 2.0 were selected to provide data representative of site conditions. The representativeness of all field data will be qualitatively assessed by determining if the data are consistent with known or anticipated environmental conditions and accepted scientific and engineering principles. Field measurements will also be checked for completeness of procedures and documentation of procedures and results.

To preserve the integrity of water quality data, water quality samples will be collected using appropriate collection and handling methods. Field measurements will be conducted using a flow-through cell, if possible. Additionally, to protect the quality of samples, the sampling equipment and field instruments will be kept clean.

3.4.2.4 Comparability

Consistency in the acquisition, handling, and analysis of samples is necessary so the results may be compared. Factors that will affect comparability are sample collection and handling techniques, sample matrix, field measurement techniques, and analytical methods. Results from two or more sampling events may be compared by specifying and standardizing these factors as much as possible. To ensure the comparability of field measurements made throughout the duration of the project, all field samples will be measured immediately, and the same field instruments and measurement techniques will be used consistently. To ensure the comparability of analytical laboratory results, all samples will be transported to the laboratory promptly to ensure holding times are met, and the instruments and techniques used for sample collection will be used consistently. Calibrations will be performed in accordance with the manufacturer's specifications and/or approved SOPs.

3.4.2.5 Completeness

Field measurements will also be checked for completeness of procedures and documentation of procedures and results. Completeness of field efforts will be defined by comparing the planned scope to the actual field work completed (e.g., by comparing the total number of samples planned to be taken with the number of samples successfully received by the laboratory) and by evaluating the quality of the field work completed (e.g., by establishing that valid field data have been obtained through the use of proper procedures for field measurements and sample collection, etc.).

3.4.2.6 Validation

Field measurements will be made by competent engineers, environmental scientists, and/or technicians. Field data and analytical results will be validated using five primary procedures:

- Routine checks will be made during the processing of data to check for errors in data records.
- Internal consistency of a data set will be evaluated by plotting the data and testing for outliers.
- Comparison checks of related analytical results (e.g., ammonium-nitrogen + nitrate-nitrogen is less than 120% of TKN).
- Checks for consistency of the data set over time will be performed by visually comparing data sets against gross upper limits obtained from historical data sets, or by testing for historical consistency. Anomalous data will be identified.
- Checks will be made for consistency with parallel data sets, that is, data sets obtained from the similar home sites.

The purpose of these validation checks is to identify outliers or anomalies (i.e., an observation that does not conform to the pattern established by other observations). Outliers may be the result of transcription errors or instrumental breakdowns. Outliers may also be manifestations of a greater degree of spatial or temporal variability than expected. After an outlier has been identified, obvious mistakes in data will be corrected. If no plausible explanation can be found for an outlier, it may be excluded, but a note to that effect will be included in data reporting. In addition, an attempt will be made to determine the effect of an outlier when both included in and excluded from the data set.

3.4.3 Reporting

Reports of analytical results for Task C (Deliverable C.19, Monitoring Report) will contain data sheets and the results of analysis of QC samples. Sample reports will include a log of the sample identification numbers designated in the field and the corresponding laboratory sample numbers. Analytical reports will contain the following items:

- project identification,
- sample number,
- sample matrix description,
- date of sample collection,
- location of sample collection,
- date of sample receipt at the laboratory,
- analytical method and reference citation,
- date of analysis (extraction, first run, and subsequent runs),
- individual parameter results,
- quantification limits,
- dilution or concentration factors, and
- corresponding QC report.

Electronic data will be tab-delimited. The final project report will contain a compilation of all the QA/QC data generated, a discussion of out-of-control events, and any corrective actions taken.

3.5 QA Surveillance

The Hazen and Sawyer project manager will be responsible for QA/QC and will ensure compliance with this QAPP. Field surveillances and assessments will be performed by the field leader at the initiation of sampling associated with the controlled test site and again at the initiation of home site sampling. These QA surveillances of the field activities will focus on verifying proper use of field procedures for sample collection and documentation. All surveillances and necessary corrective actions will be documented in the field logbook. QA reports will include a discussion of the methods used for field activities and any items that differ from those described in this QAPP. QA reports will also include a short discussion of the quality of field documentation of data, instrument calibration, corrective actions, and other field information pertinent to the field effort.

Performance audits of the analytical laboratories will be conducted on a regular basis to verify the effectiveness and implementation of the laboratory QA/QC plan as specified in the laboratory SOPs. Results of the internal audits shall be documented and kept on file at the laboratory.

Section 4.0
Health and Safety

4.1 Hazard Assessment

Field activities will consist of drilling, piezometer installation, and environmental sampling. An activity hazard analysis table will be available in the field at all times (see Appendix C). All field activities will be conducted in areas without chemical hazards. However, bentonite pellets will be used during piezometer installation. Bentonite contains crystalline silica which may induce long term respiratory problems at high exposures. Bentonite pellets or granular bentonite will be used to minimize dust. Biological hazards are associated with exposure to high concentrations of microorganisms in wastewater. The most common bacterial pathogens found in untreated wastewater are *Salmonella* and *Shigella* (Bitton 1999). Other bacterial microorganisms include *Vibrio*, *Campylobacter*, and *Leptospira* (Bitton 1999). The following are general personnel hazards anticipated during Task C field work:

1) Infectious disease exposure;
2) Slip, trip, and fall potential;
3) Potential for pinch points and striking objects due to mechanical hazards;
4) Potential electric shock from improperly grounded equipment; and
5) Potential noise hazards from drilling operations.

Proper personal hygiene and use of personal protective equipment (PPE) can significantly reduce or eliminate the biological safety hazard. Constant attention will be given to physical hazards encountered during work activities, particularly those associated with drilling equipment. Qualifications (i.e., demonstrated experience and ability) with respect to the tasks to be performed will be required. Only qualified, competent personnel with prior experience will operate drilling equipment. Prior to any site activities, all equipment will be inspected. Custom modifications to equipment is prohibited unless authorized in writing by the original equipment manufacturer or certified as safe by a registered professional engineer.

Biological Hazards Three general categories of pathogenic organisms that may be present in wastewater include bacteria, viruses and parasites (including protozoans and helminths). The principle pathogenic organisms found in STE and untreated wastewater and the corresponding infectious dose are shown in Table 4.1. Microorganisms of concern commonly found in STE include pathogenic bacteria at sustained high concentrations and virus at highly variable and episodically released levels (Bicki *et al*., 1984; Van Cuyk *et al*., 1999). The most common pathogenic viruses found in groundwater are hepatitis, Norwalk-like agent, echovirus, poliovirus and coxsackie virus. Enteric virus includes 72 types of virus (e.g. polio, echo and coxsackie virus) that can cause gastroenteritis, heart anomalies and meningitis. The diseases caused by common pathogens in wastewater are summarized in Table 4.2.

Table 4.1
Microorganisms Found in STE and Untreated Wastewater (in MPN/100mL)

Organism		Conc. in STE	Infectious Dose
Bacteria	Total Coliform	10^6-10^9	
	Fecal Coliform	10^5-10^8	10^6
	Clostridium perfringens	10^3-10^5	1-10^{10}
	Enterococci	10^4-10^5	
	Fecal streptococci	10^3-10^6	
	Pseudomonas aeruginosa	10^3-10^4	
	Shigella	10^0-10^2	
	Salmonella	10^2-10^4	
Protozoa	*Cryptosporidium* oocysts	10^1-10^3	1-10
	Entamoeba cysts	10^{-1}-10^1	10-20
	Giardia cysts	10^3-10^4	<20
Helminths	Ova	10^1-10^3	
	Ascaris lumbridcoides		1-10
Viruses	Enteric Virus	10^3-10^4	1-10
	Coliphage	10^1-10^4	

(US EPA 2002; Crites and Tchobanoglous, 1998; Anderson et al., 1994; Brown et al., 1980; Ziebell et al. 1974). The most probable number (MPN) method is not an actual concentration, but a statistical estimate of concentration using serial dilutions.

Table 4.2
Pathogenic Microorganisms Found in STE and Untreated Wastewater
(Lowe et al., 2007)

Organism		Disease Caused	Symptoms
Bacteria	Salmonella typhi	Typhoid fever	High fever, diarrhea
	Shigella	Bacillary dysentery	Dysentery
	Vibrio cholerae	Cholera	Diarrhea, dehydration
	Yersinia enterocolitica	Gastroenteritis	Diarrhea
	E. coli (pathogenic)	Gastroenteritis	Diarrhea
	Legionella pneumophila	Legionnaires' disease	Malaise, acute respiratory illness
	Leptospira spp.	Weil's Disease	Jaundice, fever
	Campylobacter jejuni	Gastroenteritis	Diarrhea
Virus	Adenovirus	Respiratory disease	
	Enteroviruses	Gastroenteritis, meningitis, heart anomalies	
	Poliovirus		
	Echovirus		
	Coxsackie virus		
	Hepatitis A	Infectious hepatitis	Jaundice, fever
	Norwalk	Gastroenteritis	Vomiting
	Parvovirus	Gastroenteritis	Diarrhea
	Rotavirus	Gastroenteritis	Diarrhea
	HIV	AIDS	
Protozoa	Cryptosporidium parvum	Cryptosporidiosis	Diarrhea, low-grade fever
	Giardia lamblia	Giardiasis	Diarrhea, nausea, indigestion
	Balantidium coli	Balantidiasis	Diarrhea, dysentery, intestinal ulcers
	Entamoeba histolytica	Amoebic dysentery	Diarrhea, dysentery
	Cyclospora	Cyclosporasis	Severe diarrhea, nausea, vomiting, severe stomach cramps

Partially adapted from Bitton (1999) and from Crites and Tchobanoglous (1998)

Cold and Heat Stress Personnel will be monitored for heat stress during summer monitoring activities. The length of periods of active work without a break will be adjusted as the weather dictates. Anyone exhibiting signs or symptoms of heat-related illness will be removed to a controlled temperature location immediately.

Noise Hearing protection will be available for all field workers. Hearing protection is required at 85 decibels or above, on the A-weighted scale on a slow response scale as per American National Standards Institute (ANSI). Hearing protection will be worn at all times in proximity of the direct push drilling rig during soil sampling and piezometer installation.

Electrical All temporary, 120V, single-phase, 15- and 10-ampere receptacles and cord sets will be protected by approved ground fault circuit interrupts (GFCIs) as prescribed in 29 CFR 1926.404(b)(ii). Prior to setting the drilling rig at location for piezometer installation, the field leader will determine the distance to electrical transmission lines. If the voltage of electrical transmission lines is unknown, a distance of 20 ft. will be maintained. If the voltage is known, the equipment will not be operated when any part enters a minimum radial distance of 10 ft. to electrical transmission lines as specified in 29 CFR 1910.181.

Other Physical Hazards Other physical hazards may be present. These hazards may include buried water lines; equipment movement; and equipment malfunctions. Utility locator surveys will be conducted for each area where piezometer installation will be conducted. In addition, routine hoisting and rigging will be necessary for lifts associated with the drilling activities. Improper lifts will be avoided. Tripping, slipping and falling hazards and specific hazards pertaining to the operation of the drilling equipment will be evaluated. Equipment guards will be used on any mechanical gears, belts, and drive shafts where applicable, as mandated by Occupational Safety and Health Administration (OSHA) regulations, to minimize personnel exposure to moving parts during piezometer installation. OSHA safety mandates and guidelines will be implemented by personnel that work near potentially dangerous drilling equipment.

The following are general health and safety standard operating procedures.

1) Wear designated PPE and safety equipment at all times while in the work area.

2) Do not eat, drink, chew gum or tobacco, smoke, or apply cosmetics in the work area.

3) Do not work with open wounds, including bandaged wounds, or other injuries that could provide a route of entry for possible microorganisms.

4) Prevent spillage. If a spill occurs, contain wastewater and dispose properly.

5) Practice good housekeeping. Keep everything orderly and out of potentially harmful situations.

6) Be familiar with the physical characteristics of the site, including:
   a. nearest emergency assistance;
   b. accessibility to associates, equipment, and vehicles;
   c. communication facilities at and near the site; and
   d. site access and egress.

7) Keep the number of personnel and equipment in the work area to a minimum but only to the extent consistent with work force requirements of safe site operation.

8) Dispose of all waste generated properly.

9) Report all injuries, no matter how minor, to the field leader.

10) Do not wear loose clothing and jewelry while working with or near drilling equipment.

11) If desired, wear gloves or other equipment for protection against physical hazards in addition to the above-mentioned PPE.

12) Be continually aware of potentially dangerous situations (e.g., presence of strong, irritating, or nauseating odors) and immediately take precautionary measures to ensure the safety of everyone.

4.2. Personal Protection Requirements

During Task C, the primary exposure risk is ingestion through splashes that contaminate food, drinks and/or hands (most common); inhalation of infectious agents or aerosols, and contact with unprotected cuts and abrasions. There is no airborne exposure pathway associated with the microbiological constituents present in residential STE or nitrified effluent. To mitigate these exposure routes for workers, eating, drinking or smoking will prohibited in the field during monitoring. Good personal hygiene such as avoiding touching the mouth, frequent hand washing, and use of disposable gloves (latex or nitrile) will be implemented. During routine field activities, personal protection equipment will include long pants, close-toed shoes, and appropriate gloves. Hard hats and safety glasses will be worn when equipment is being set up and when in the proximity of the drilling rig or other overhead hazards.

The primary potential public and environmental exposure risk is the discharge of STE or nitrified effluent to the ground surface or groundwater underlying the site. To mitigate public exposure risk, all STE released to the environment will occur below ground; there will be no surface application of wastewater effluent. In addition, access to the test site will be controlled (fencing, locking caps on monitoring points, etc.).

4.3 Emergency Response

The following procedures will be implemented in the event of an emergency during field activities. In case of emergency dial 911. The location of the nearest medical facility will be made available prior to field activities. Notify the Hazen and Sawyer project manager of any emergencies. Maps consisting of directions to the nearest medical facility and hospital will be posted at the job-site.

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Section 5.0
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Appendix A
GCREC Memo

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M E M O R A N D U M

DATE: May 18, 2009

FOR: Elke Ursin, Florida Department of Health

FROM: Damann L. Anderson, P.E.

SUBJECT: Evaluation of Test Facility Site

Hazen and Sawyer is conducting the Florida Onsite Sewage Nitrogen Reduction Strategies (FOSNRS) Study under contract CORCL with the Florida Department of Health. Under Task A of this project, we are in the process of identifying test facility sites where multiple assessments of onsite nitrogen reduction technologies and groundwater quality can be conducted in subsequent phases of the study. Two potential sites identified in the response to the ITN were the University of South Florida Lysimeter Facility property and the University of Florida's Gulf Coast Research and Education Center (GCREC) near Wimauma, FL. Salient issues include space availability, site access, wastewater source of sufficient quantity and quality, subsurface hydrology, power supply and security.

After a preliminary assessment of the USF Lysimeter Facility, we feel that the cost of rehabilitating this facility will be beyond the budget allocated for that effort. Also, since space is limited at the USF facility and it is not conducive for groundwater quality assessments, we have concluded that it would be more cost effective to have only one test facility, where the controlled testing portion of the project could be conducted. It is our recommendation that the GCREC be selected as the test facility site. This memorandum summarizes the characteristics of the GCREC facility, as related to establishment of this test facility.

The GCREC facility is located at 14625 County Road 672, Wimauma, Florida. The facility is situated on 475 acres of land that were donated by Hillsborough County government. The facility contains research trials for vegetables, small fruit and ornamental plants. In addition, 16 laboratories are housed onsite, one being a water quality laboratory which is available and can provide many of the analyses of interest for the FOSNRS project. One of the active programmatic areas is soil and water science. A preliminary agreement to participate has been obtained, and the key personnel at the facility are interested in the FOSNRS study. A suitable area for the proposed work has been identified at the facility as depicted in Figure 1.

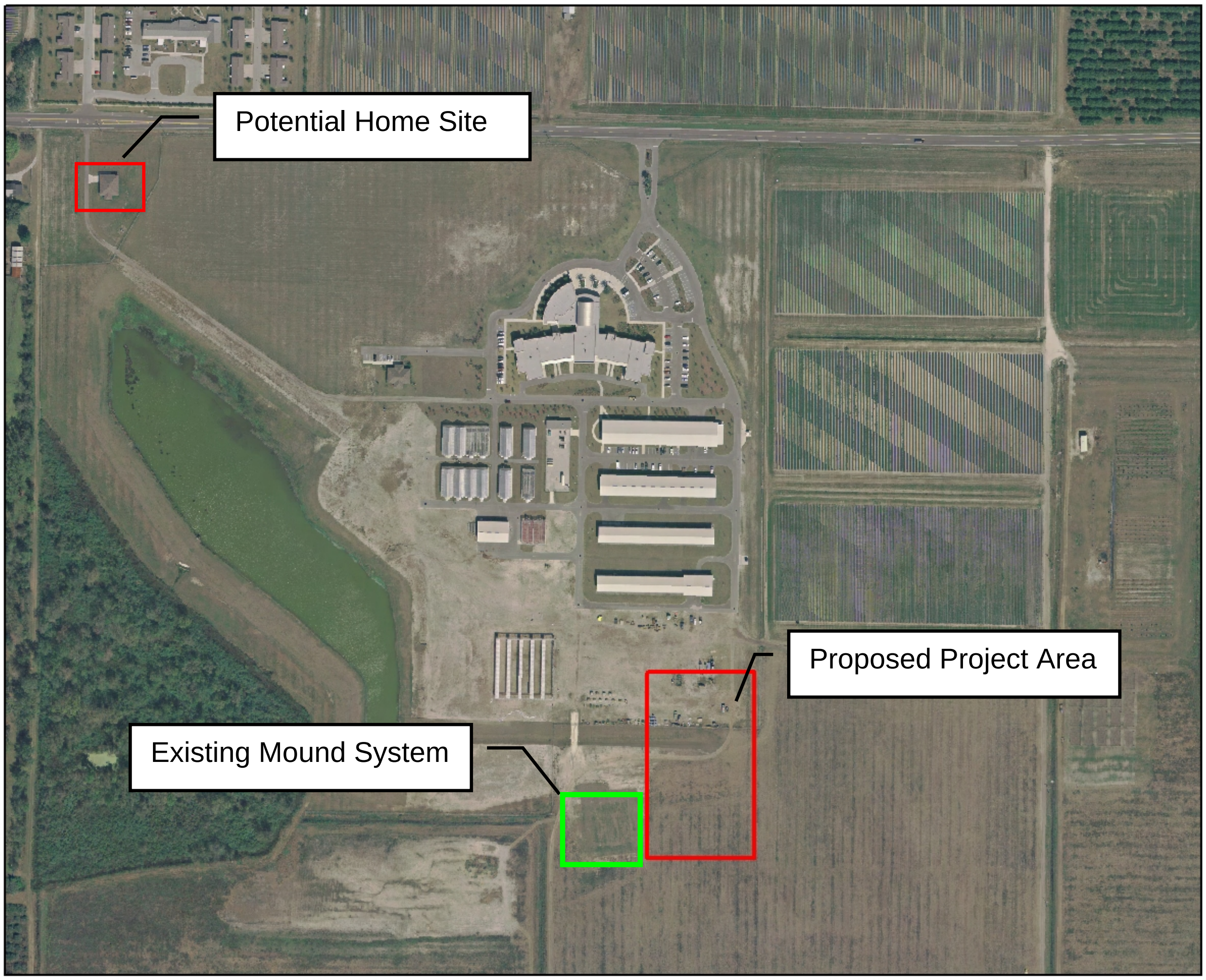

Figure 1. GCREC Facility and Proposed Project Area

Figure 2 is the web soil survey for the project area produced by the National Cooperative Soil Survey operated by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). As shown, the primary classification of soils on the site are Zolfo and Seffner fine sands.

HAZEN AND SAWYER
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10002 Princess Palm Avenue
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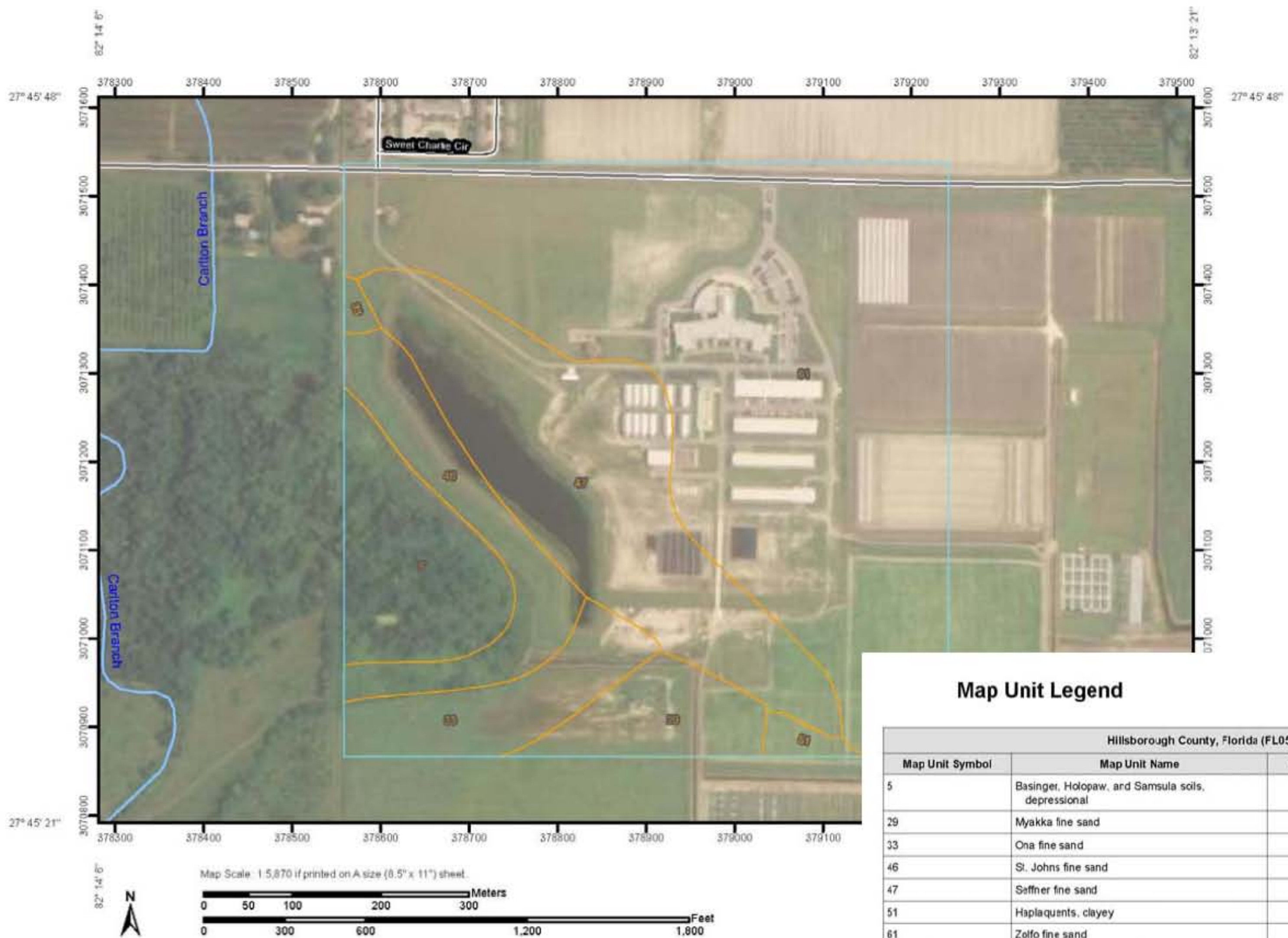
Soil Map—Hillsborough County, Florida



USDA Natural Resources Conservation Service

Web Soil Survey 2.1
National Cooperative Soil Survey

Map Unit Legend

Hillsborough County, Florida (FL057)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
5	Basinger, Holopaw, and Samsula soils, depressional	9.4	8.2%
29	Myakka fine sand	5.1	4.5%
33	Ona fine sand	7.1	6.3%
46	St. Johns fine sand	8.5	7.5%
47	Seffner fine sand	22.6	19.9%
51	Haplaquents, clayey	0.9	0.8%
61	Zolfo fine sand	59.9	52.8%
Totals for Area of Interest		**113.4**	**100.0%**

Figure 2

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Richard Ford, a Resource Soil Scientist with the NRCS, conducted a preliminary soils assessment of the GCREC project area on March 26, 2009. The objective of the soils assessment was to confirm the soil characteristics on the site, obtain soil profile descriptions and morphology, and obtain an estimate of the depth to seasonal high water table at the site. The mapped soils in this area are primarily Seffner fine sand (47) and Zolfo fine sand (61), with a limited area of Myakka fine sand (29). These are soils of the Florida flatwoods land resource area. Seffner and Zolfo fine sands are classified as somewhat poorly drained and Myakka fine sand is classified as poorly drained. A letter from Mr. Ford describing his assessment is included with this memo as an attachment.

Figure 3 indicates the approximate locations where five soil borings were augered on site to a depth of eighty inches.

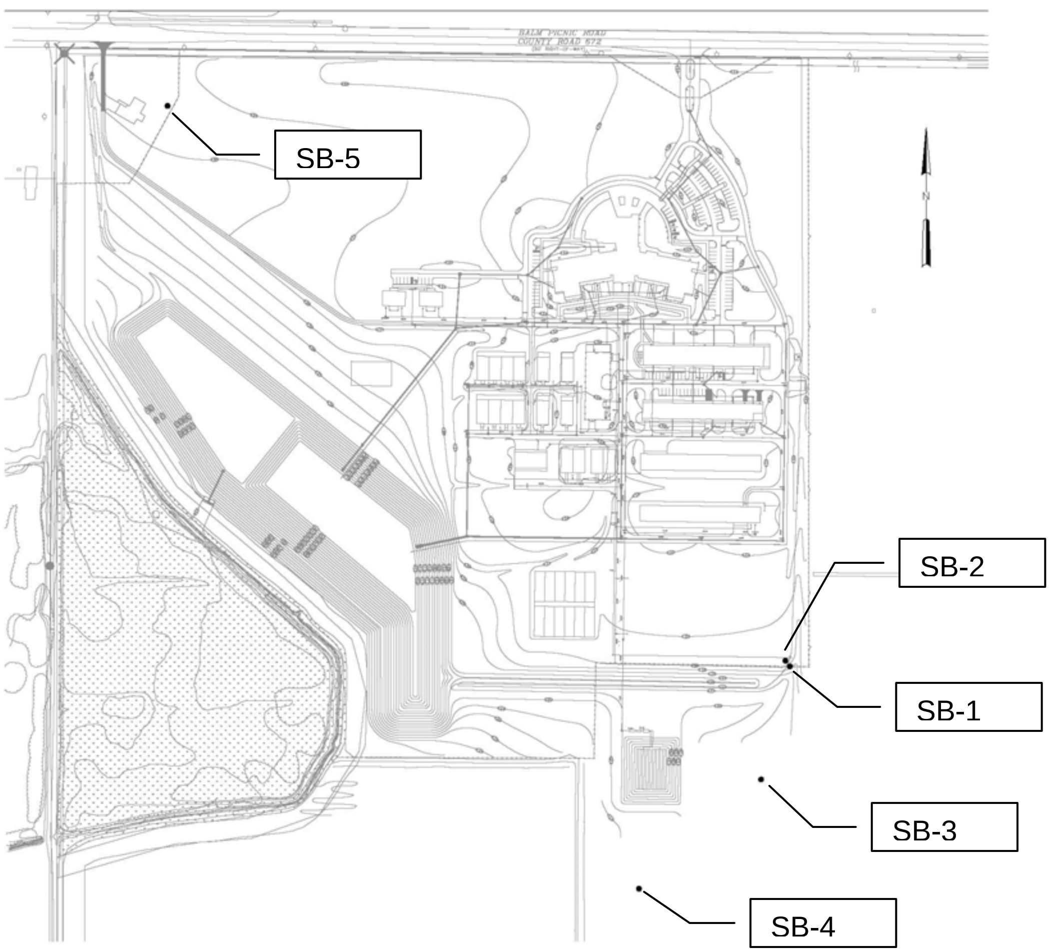


Figure 3. Approximate Soil Boring Locations

Soil boring 1 was identified as Zolfo fine sand. This profile had a well developed spodic horizon at about 58 inches. There was also evidence of some sand fill noted at the surface. It was estimated at approximately 10 inches thick. The soil profile at SB-2 was also identified as Zolfo fine sand. The well developed spodic horizon was at approximately 54 inches. There was about 10 inches of fill on the surface. The seasonal high water table was determined to be 30 inches plus or minus 6 inches. Soil boring 3 was mapped and identified in the field as Zolfo fine sand. The seasonal high water table indicators were found between 24 and 39 inches. The location of SB-4 is in or near an area mapped as Myakka fine sand based on the Soil Survey of Hillsborough County, Florida. However, the soil identified on site more closely resembled Seffner fine sand. This soil differs from Myakka fine sand by being somewhat poorly drained rather than poorly drained. The seasonal high water table was determined to be 30 inches plus or minus 6 inches. Soil boring 5 was identified as Zolfo fine sand. The seasonal high water table was also determined to be 30 inches plus or minus 6 inches. Seffner and Zolfo fine sands are both deep, somewhat poorly drained soils formed in sandy marine sediment. They are found on low-lying ridges on the flatwoods.

Based on the soils found on site, the soil mapping is representative. Water table depths determined on site were within the range of the mapped soils with only one exception. This occurred at soil boring 4 where Seffner fine sand was identified rather than Myakka fine sand. In addition, the area identified as Haplaquents in the Soil Survey of Hillsborough County was not encountered in the area investigated. If present, this area must exist south of the drainage ditch that forms the southern boundary of the study area, which was not investigated.

Another salient issue regarding the project site is a wastewater source of sufficient quantity and representative quality. The existing onsite wastewater treatment system consists of a pressure dosed mound system designed for 2,850 gallons per day. The septic tank receives flow from the research facility offices and approximately 11 graduate students that live in onsite dormitories. The laboratory liquid waste flow is not sent to the onsite wastewater system. Table 1 provides a summary of the system based on design drawings located at the GCREC.

Table 1. GCREC Onsite Wastewater Treatment System Summary

Primary Treatment – two precast septic tanks in series	-One 2,500 gallon precast septic tank-Category 4 without baffle -One 1,250 gallon precast septic tank-Category 4 with outlet screen
Dosing Tank	3,000 gallon precast pump/dosing tank-Category 4
Mound System Drainfield	4,351 ft2 infiltrative area (0.65 gpd/ft2)

A grab sample was collected at the outlet of the second septic tank on March 26, 2009. Results of laboratory analyses of this sample are summarized in Table 2.

Table 2. Septic Tank Effluent Field & Laboratory Analyses

pH (measured in field)	6.51
Temperature (^{o}C, in field)	25.4
Dissolved Oxygen (mg/L, in field)	0.13
Alkalinity (mg/L)	220
TKN (mg/L)	52
Ammonia (mg/L)	39
Nitrate (mg/L)	0.24
Nitrite (mg/L)	0.022
$CBOD_5$ (mg/L)	300
COD (mg/L)	680
Fecal Coliform (Col/100 mL)	10E6
Phosphorus (Total) (mg/L)	8.5
Total Dissolved Solids (mg/L)	590
Total Suspended Solids (mg/L)	80

Six piezometers were installed at the facility on March 17, 2009 to determine subsurface hydrology. Figure 3 depicts the approximate piezometer locations and the water table elevations measured on March 26, 2009.

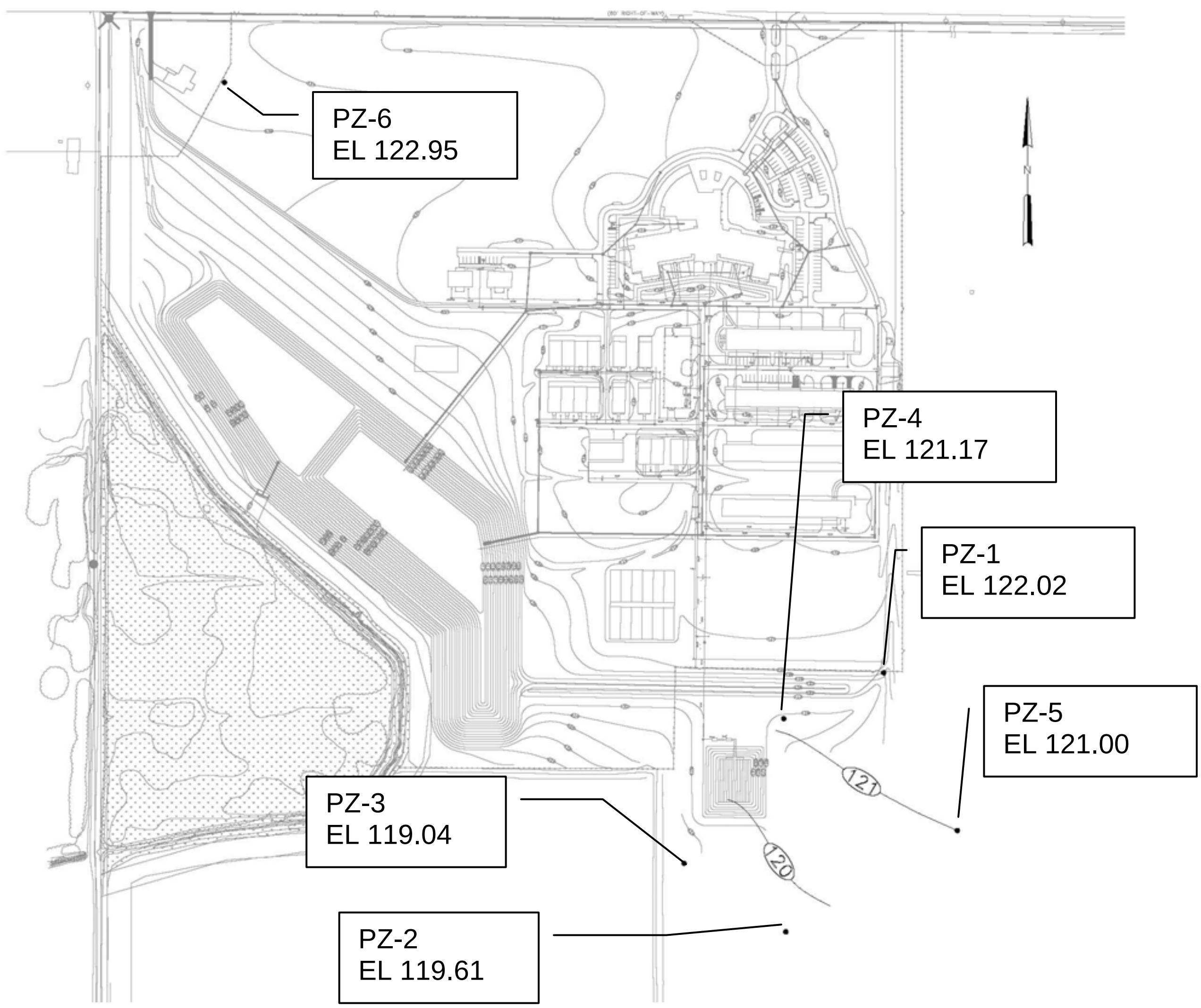


Figure 3. Piezometer Locations and Water Table Elevations on March 26, 2009

Summary

Based on the cost and time associated with rehabilitating the USF facility, it has become apparent that proceeding with construction of two test facility sites will be costly and time consuming. The current budget in the FOSNRS contract for construction of a test facility at USF does not appear to be sufficient for both the rehabilitation work and the testing facility construction. In addition, the USF Lysimeter station can only be used for pilot tests of treatment technologies and unsaturated zone work, since the water table is extremely deep at the site (>25 ft.) and sufficient area for plume delineation and monitoring is not available. Management of two facilities once operational will also be more difficult and expensive in future phases of the project.

The preliminary soils assessment, wastewater (STE) quality, and preliminary GW assessment appear to be conducive to performing the proposed work. While the flatwoods type soils at the site have a shallow groundwater that may be more likely to support *in-situ* denitrification, the soils of the Florida flatwoods land resource area make up approximately 55% of the area of the state, over 60% if the Everglades land resource area is excluded. In contrast, soils of the central Florida ridge land resource area make up approximately 17% of the area of the state (Ayres Associates, 1987). Also, a site conducive to *in-situ* denitrification is desirable from a groundwater modeling perspective. To include denitrification in the models developed in Task D, a study site where denitrification can be measured will be more likely to provide the needed inputs and calibration data for model development. If the mechanisms of *in-situ* denitrification can be identified at the site, then the models developed should be able to predict whether such denitrification is likely to occur at any given site. Additionally, the individual home field sites for Task C will be chosen to include soils of different types, including well drained fine sands typical of the central Florida ridge recharge areas, and the models developed will be tested at these sites.

Treatment technology pilot testing and both the saturated & unsaturated zone investigations could be performed at the GCREC. Therefore, the Project Team recommendation is to conduct all test facility work at the GCREC. This recommendation would include shifting the funds for test facility design and construction in Task A to the design and construction of the test facility for Task C, or vice versa. We would like to proceed with the GCREC site as the only FOSNRS Study testing facility, and request FDOH direction in this regard.

enc: NRCS letter

c: E. Roeder
P. Booher

File 44237-001

NRCS Natural Resources Conservation Service
1700 U.S. Hwy. 17 So., Suite 2 Bartow, FL 33830 Telephone (863) 533-2051 Ext. 3 Fax: (863) 533-1884

April 14, 2009

Hazen and Sawyer, P.C.
10002 Princess Palm Ave.
Suite 200
Tampa, Florida 33619

ATTN: Mr. Anderson
RE: Onsite Wastewater Treatment research

Dear Sir:

An on site soil investigation was conducted March 26, 2009 at the UF Gulf Coast Research and Education Center to determine the seasonal high water table and ascertain whether or not the soils were mapped correctly in the most recent NRCS soil survey documentation for Hillsborough County. The area of concern is located in section 29, T31S, R21E; Hillsborough County, Florida.

Soil borings were made at preselected sites or points to a depth of eighty inches. The mapping units were identified and the seasonal high water table determined. The Soil Survey of Hillsborough County, Florida and the Web based Soil Survey of Hillsborough County were used in this effort.

Five soil borings were made on site to a depth of eighty inches in the area of concern. The mapped soils in this area are Seffner fine sand (47), Zolfo fine sand (61), and Myakka fine sand. These soils are classified as poorly to somewhat poorly drained.

SB#1 was located five feet NW of PZ#1 and was identified as Zolfo fine sand. This profile had a well developed spodic at about 58 inches. There was also evidence of some sand fill noted at the surface. It was estimated at about 10 inches thick.

SB#2 was located 23 feet NW of PZ#1. This profile was identified as Zolfo fine sand. The well developed spodic was at 54 inches. There was about 10 inches of fill on the surface. The seasonal high water table was determined to be 30 inches plus or minus 6 inches.

SB#3 was located 200 feet east of the mound system's eastern edge. The soil mapped on site and identified in the field was Zolfo fine sand. The seasonal high water table indicators were found between 24 and 39 inches.

SB#4 was located 95 feet east of the field road edge and 95 feet north of the line of trees. This area is mapped Myakka fine sand based on the Soil Survey of Hillsborough County, Florida. The soil identified on site was Seffner fine sand. This soil differs from Myakka fine sand by being somewhat poorly drained rather than poorly drained. The seasonal high was determined to be 30 inches plus or minus 6 inches.

SB#5 was located on the east side of the Farm Manager residence inside the chain link fence. Zolfo fine sand was identified on site. The seasonal high was determined to be 30 inches plus or minus 6 inches.

Based on the soils found on site the soil mapping is representative. Water table depths determined on site were within the range of the mapped soils with only one exception. This occurred at SB#4 where Seffner fine sand was identified not Myakka fine sand.

In addition, the area identified as Haplaquents in the Soil Survey of Hillsborough County was not encountered in the area investigated. If present, this area must exist south of the drainage ditch that forms the southern boundary of the study area, which was not investigated.

Please call if you have any questions. Thank you very much.

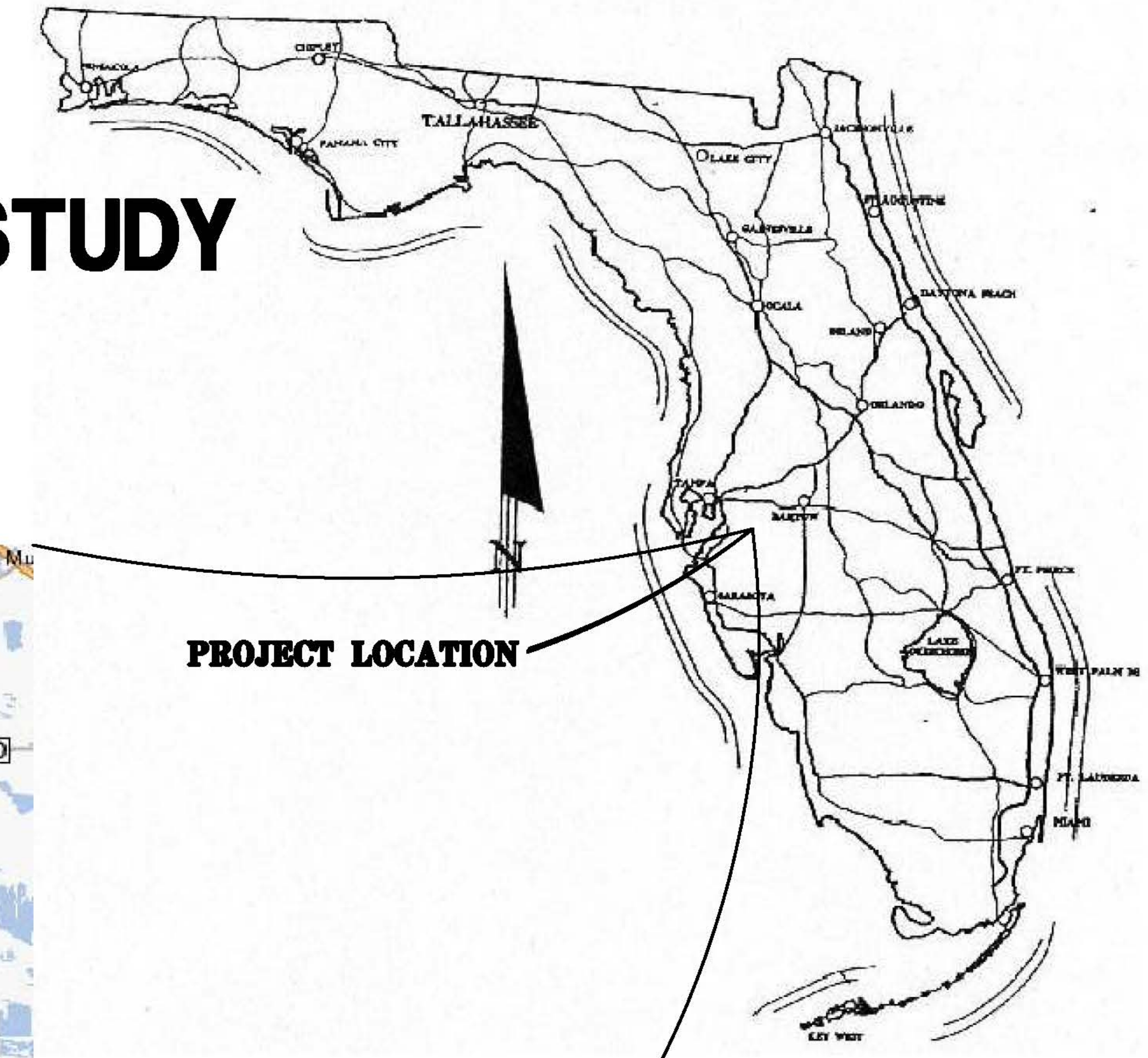
Yours truly,

Richard D. Ford
Resource Soil Scientist
cc: Juan Vega, District Conservationist

Appendix B

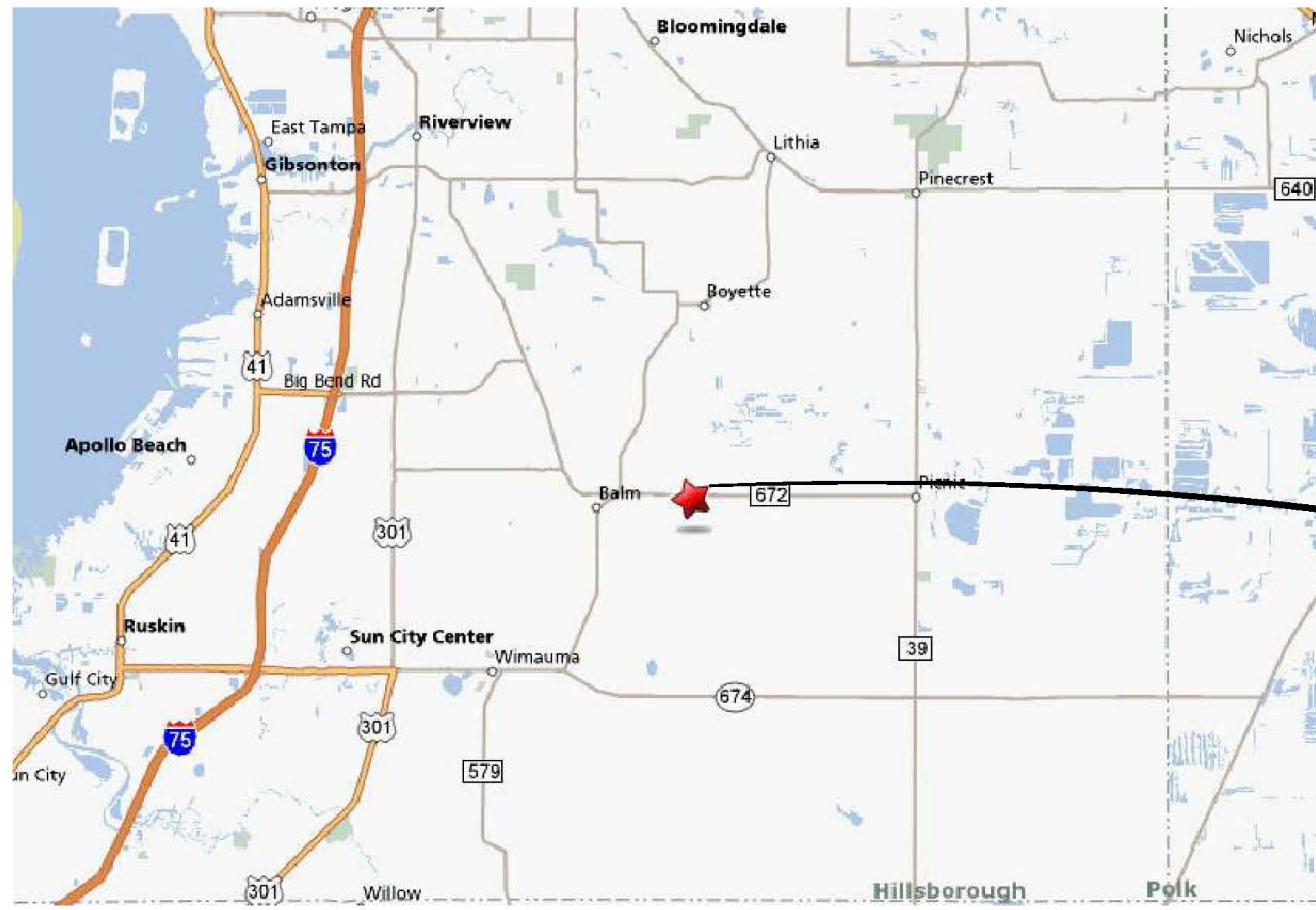
100% Test Design

FLORIDA ONSITE SEWAGE
NITROGEN REDUCTION STRATEGIES STUDY
100% DESIGN DOCUMENTS



LIST OF DRAWINGS

SHEET COUNT	SHEET NUMBER	SHEET TITLE
		GENERAL
1	G-1	COVER SHEET AND INDEX OF DRAWINGS
2	G-2	LEGENDS AND NOTES
		CIVIL
3	C-1	EXISTING ONSITE WASTEWATER TREATMENT SYSTEM
4	C-2	OVERALL PROPOSED SITE PLAN
5	C-3	PROCESS FLOW DIAGRAM
6	C-4	HYDRAULIC PROFILE PNRS II
7	C-5	PNRS II DETAILS
8	C-6	PNRS II DETAILS
9	C-7	TASK C NITROGEN FATE & TRANSPORT STUDY DETAILS
10	C-8	WASTEWATER SOURCE COMPONENTS DETAILS
11	C-9	MONITORING PLAN
		STRUCTURAL
12	S-1	PNRS II STRUCTURAL SITE PLAN
13	S-2	PNRS II STRUCTURAL SITE PLAN AND DETAILS
14	S-3	PNRS II STRUCTURAL SITE PLAN AND DETAILS
		MECHANICAL
15	M-1	YARD PIPING PLAN
		ELECTRICAL
16	E-1	ELECTRICAL SITE PLAN
17	E-2	ELECTRICAL SITE PLAN AND DETAILS
		INSTRUMENTATION
18	I-1	PANEL POWER
19	I-2	DI MODULE 1
20	I-3	DI MODULE 2
21	I-4	DI MODULE 3
22	I-5	DO MODULE 1
23	I-6	DO MODULE 2
24	I-7	PANEL ELEVATIONS
25	I-8	BILL OF MATERIALS



PROJECT LOCATION
UNIVERSITY OF FLORIDA
GULF COAST RESEARCH AND
EDUCATION CENTER
WIMAUMA, FL.

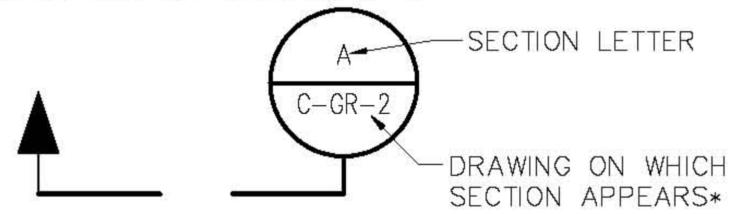
LOCATION MAP
N.T.S.

HAZEN AND SAWYER
Environmental Engineers & Scientists
10002 Princess Palm Ave., Suite 200
Tampa, Florida 33619
Certificate of Authorization Number: 2771

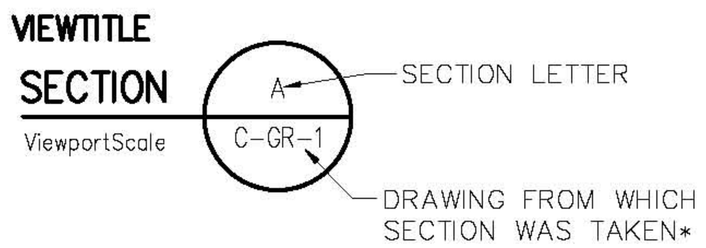
FLORIDA DEPARTMENT OF HEALTH
FLORIDA DEPARTMENT OF HEALTH
4052 BALD CYPRESS WAY, BIN A08
TALLAHASSEE, FLORIDA 32399-1713
(850)-245-4070

SECTION IDENTIFICATION

(1) SECTION CUT ON DRAWING G-1:

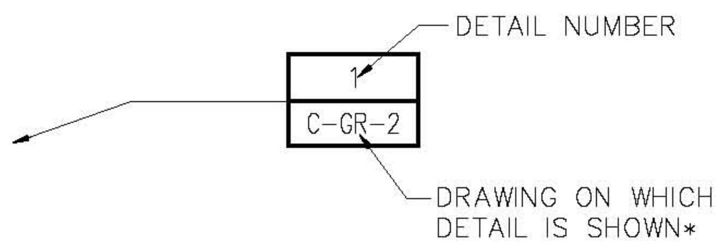


(2) ON DRAWING G-2 THIS SECTION IS IDENTIFIED AS:

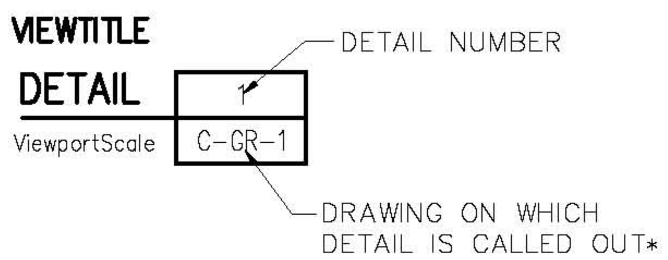


DETAIL IDENTIFICATION

(1) DETAIL CALL-OUT ON DRAWING G-1 AS:



(2) ON DRAWING G-2 THIS DETAIL IDENTIFIED AS:



SITE GENERAL NOTES

1. THE TOPOGRAPHIC INFORMATION SHOWN HEREON IS BASED ON A SURVEY AS PREPARED BY PHOTOGRAMMETRIC TECHNOLOGIES, INC. DATED FEBRUARY 2, 2003. THE BOUNDARY SURVEY IS AS PROVIDED BY U.F. I.F.A.S.

2. CONTRACTOR TO REVIEW GEOTECHNICAL REPORT AND BORINGS PRIOR TO BIDDING THE PROJECT AND FOLLOW OUTLINED CONSTRUCTION TECHNIQUES.

3. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATING APPLICABLE TESTING WITH THE SERVICES OF AN APPROVED TESTING LABORATORY AND SOILS ENGINEER, AS REQUIRED BY APPLICABLE REGULATORY AGENCIES AND AS MAY BE FOUND IN THE ENGINEERING CONSTRUCTION DRAWINGS. CONTRACTOR TO VERIFY ALL TESTING WITH THE OWNER PRIOR TO COMMENCING CONSTRUCTION. UPON COMPLETION OF THE WORK, THE SOILS ENGINEER MUST SUBMIT TO THE OWNER'S ENGINEER CERTIFICATIONS STATING THAT ALL REQUIREMENTS HAVE BEEN MET.

4. THE CONTRACTOR IS RESPONSIBLE FOR REPAIRING ANY DAMAGE TO EXISTING FACILITIES, ABOVE OR BELOW GROUND THAT MAY OCCUR AS A RESULT OF THE WORK PERFORMED BY THE CONTRACTOR.

5. IT IS THE CONTRACTOR'S RESPONSIBILITY TO BECOME FAMILIAR WITH THE PERMIT AND INSPECTION REQUIREMENTS OF THE VARIOUS GOVERNMENTAL AGENCIES. THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS PRIOR TO CONSTRUCTION, AND SCHEDULE INSPECTIONS ACCORDING TO AGENCY INSTRUCTIONS.

6. ALL WORK PERFORMED SHALL COMPLY WITH THE REGULATIONS AND ORDINANCES OF THE VARIOUS GOVERNMENTAL AGENCIES HAVING JURISDICTION OVER THE WORK INCLUDING LANDSCAPING.

7. REPAIR AND REPLACEMENT OF ALL PRIVATE AND PUBLIC PROPERTY AFFECTED BY THIS WORK SHALL BE RESTORED TO A CONDITION EQUAL TO OR BETTER THEN EXISTING CONDITIONS BEFORE COMMENCING CONSTRUCTION WORK UNLESS SPECIFICALLY EXEMPTED BY THE PLANS. ADDITIONAL COSTS ARE INCIDENTAL TO OTHER CONSTRUCTION AND NO EXTRA COMPENSATION WILL BE ALLOWED.

8. RECORD DRAWINGS:
THE CONTRACTOR SHALL BE RESPONSIBLE FOR RECORDING INFORMATION ON A SET OF THE APPROVED PLANS CONCURRENTLY WITH CONSTRUCTION PROGRESS. WITHIN TWO WEEKS FOLLOWING FINAL INSPECTIONS THE CONTRACTOR SHALL SUBMIT ONE SET OF DRAWINGS TO THE ENGINEER OF RECORD. THE FINAL RECORD DRAWINGS SHALL COMPLY WITH THE FOLLOWING REQUIREMENTS:

A. DRAWING TO BE LEGIBLY MARKED TO RECORD ACTUAL CONSTRUCTION.

B. DRAWINGS SHALL SHOW ACTUAL LOCATION OF ALL UTILITIES AND RELATED ITEMS, BOTH ABOVE AND BELOW GROUND. ALL CHANGES TO PIPING LOCATION INCLUDING HORIZONTAL AND VERTICAL LOCATIONS OF UTILITIES SHALL BE CLEARLY SHOWN AND REFERENCED TO PERMANENT SURFACE IMPROVEMENTS. DRAWINGS SHALL ALSO SHOW ACTUAL INSTALLED PIPE MATERIAL.

C. DRAWINGS SHALL CLEARLY SHOW ALL FIELD CHANGES OF DIMENSION AND DETAIL.

D. DRAWINGS SHALL CLEARLY SHOW ALL DETAILS NOT ON ORIGINAL CONTRACT DRAWINGS BUT CONSTRUCTED IN THE FIELD. ALL EQUIPMENT AND PIPING RELOCATIONS SHALL BE CLEARLY SHOWN.

E. LOCATIONS OF ALL MANHOLES, HYDRANTS, VALVES AND VALVE BOXES SHALL BE SHOWN.

F. THE CONTRACTOR SHALL PROVIDE CERTIFIED RECORD DRAWING, SIGNED AND SEALED BY A PROFESSIONAL LAND SURVEYOR. THE RECORD DRAWINGS SHALL SHOW FINAL GRADES AND LOCATIONS ON ALL UTILITIES INCLUDING THE SANITARY SEWER, WATER, PRODUCT PIPING, AND STORM WATER COLLECTION SYSTEM (I.E. PIPES, INLETS, AND PONDS). THE CONTRACTOR SHALL PROVIDE TEN COPIES OF THE CERTIFIED RECORD DRAWINGS TO THE OWNER.

9. IT SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO COMPLY WITH AND ENFORCE ALL APPLICABLE SAFETY REGULATIONS.

10. ALL DELETERIOUS MATERIAL (I.E. MUCK, PEAT, BURIED DEBRIS) IS TO BE EXCAVATED IN ACCORDANCE WITH THESE PLANS OR AS DIRECTED BY THE OWNER'S ENGINEER OR OWNER'S SOIL TESTING COMPANY. DELETERIOUS MATERIAL IS TO BE STOCKPILED AND REMOVED FROM THE CAMPUS AREA AND PLACED ON-SITE AS DIRECTED BY THE OWNERS REPRESENTATIVE. EXCAVATED AREAS ARE TO BE BACKFILLED WITH APPROVED MATERIALS AND COMPACTED AS SHOWN ON THESE AREAS.

11. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTING EXCAVATIONS AGAINST COLLAPSE AND SHALL PROVIDE BRACING, SHEETING OR SHORING AS NECESSARY. TRENCHES SHALL BE KEPT DRY WHILE PIPES ARE BEING PLACED. DEWATERING SHALL BE USED AS REQUIRED, AND PERMITTED THROUGH LOCAL GOVERNMENTAL AGENCIES AND WATER MANAGEMENT DISTRICT PER CURRENT REGULATIONS AT THE SOLE COST OF THE CONTRACTOR.

CONSTRUCTION NOTES

1. ALL MATERIALS AND WORK SHALL COMPLY WITH REQUIREMENTS OF CHAPTER 64E-6, FLORIDA ADMINISTRATIVE CODE (FAC), AND REQUIREMENTS, OF PERMITS ISSUED FOR THIS CONSTRUCTION. SHOP DRAWINGS FOR ALL COMPONENTS SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL PRIOR TO ORDERING SYSTEM COMPONENTS.

2. CONTRACTOR SHALL BE RESPONSIBLE FOR APPLYING FOR AND OBTAINING APPROPRIATE PERMITS AND FOR SCHEDULE/COORDINATING INSPECTIONS, REVIEWS, AND APPROVALS

3. LOCATIONS SHOWN ON THESE DRAWINGS ARE APPROXIMATE AND MAY BE FIELD ADJUSTED WITH APPROVAL OF OWNER AND HEALTH DEPARTMENT.

4. ENGINEER OF RECORD IS REQUIRED TO DO AN INITIAL INSPECTION. CONTRACTOR TO CALL (48) HOURS PRIOR TO INSPECTION TO REQUEST AN INSPECTOR.

WATER AND WASTEWATER GENERAL NOTES

1. ALL WATER AND WASTEWATER INSTALLATION CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS ON DRAWINGS AND INCLUDED DETAILS.

2. IF THE VERTICAL CLEARANCE AT CROSSING POINTS OF WATER AND SANITARY SEWER LINES IS LESS THAN 18" (IN), THE SANITARY SEWER LINE SHALL THEN BE ENCASED IN A WATER TIGHT CARRIER PIPE FOR 10' (FT) EACH SIDE OF THE CROSSING POINT.

3. CONTRACTOR SHALL SUBMIT FOR REVIEW TO THE OWNER AND OWNER'S ENGINEER SHOP DRAWINGS ON ALL PRECAST AND MANUFACTURED ITEMS TO BE USED ON THIS SITE. FAILURE TO OBTAIN APPROVAL BEFORE INSTALLATION MAY RESULT IN REMOVAL AND REPLACEMENT AT CONTRACTOR'S EXPENSE. ENGINEER'S APPROVAL OF A SHOP DRAWING DOES NOT RELIEVE THE CONTRACTOR'S RESPONSIBILITY FOR THE PERFORMANCE OF THE ITEM.

4. THE CONTRACTOR IS RESPONSIBLE FOR ANY NECESSARY UTILITY FIELD LOCATIONS, RELOCATIONS AS REQUIRED, SHALL BE COORDINATED BY THE CONTRACTOR.

5. THE HORIZONTAL SEPARATION BETWEEN WATER MAINS AND PERMANENT STRUCTURES, TREES AND SANITARY SEWER MAINS SHALL BE 10' (FT) MINIMUM.

6. THE HORIZONTAL SEPARATION BETWEEN SEWER MAINS AND PERMANENT STRUCTURES AND TREES SHALL BE 15' (FT) MINIMUM.

7. WATER MAIN MATERIALS SHALL BE:
   4" – 12" MAINS SHALL BE PER AWWA, C900, DR18, CLASS 150.
   2" AND SMALLER LINES SHALL BE PVC SCHEDULE 80 WITH PRESSURE RATING OF 200.

8. SANITARY SEWER PIPE MATERIALS SHALL BE:
   4" – 8" SEWER SHALL BE PVC, SDR26 MEETING ASTM D3034.
   4" AND SMALLER LINES SHALL BE PVC SCHEDULE 80 WITH PRESSURE RATING OF 200.
   MINIMUM SLOPE FOR LATERALS SHALL BE 1.00%.

9. PROJECT IS LOCATED IN THE HILLSBOROUGH FIRE DISTRICT, STATION NO. 3.

SUMMARY OF TANKAGE

TANK	TANK DESCRIPTION	SIZE
TANK 1	NEW STE TWO COMPARTMENT DOSING TANK	1050 GAL
TANK 2	EXISTING STAGE 2 SEPTIC TANK	1250 GAL
TANK 3	NEW DENITE FEED TANK	30 GAL
TANK 4	NEW STE DRIP STORAGE TANK	150 GAL
TANK 5	NEW NO3 DRIP STORAGE TANK	150 GAL

SUMMARY OF PUMPS

PUMP	PUMP LOCATION	TYPE	MANUFACTURER/MAKE	MODEL
P1	TANK 1	SUBMERSIBLE	GOULDS BLASTER	33EB05
P2	TANK 2	SUBMERSIBLE	LITTLE GIANT	5-MSP
P3	TANK 2	SUBMERSIBLE	LITTLE GIANT	5-MSP
P4	TANK 2	SUBMERSIBLE	LITTLE GIANT	5-MSP
P5	DOSES INSITU STAGE 1 BIOFILTERS	PERISTALTIC	ISMATEC	R-78002-10
P6	RECIRCULATION DOSE TANK 1	SUBMERSIBLE	LITTLE GIANT	5-MSP
P7	RECIRCULATION DOSE TANK 2	SUBMERSIBLE	LITTLE GIANT	5-MSP
P8	RECIRCULATION DOSE TANK 3	SUBMERSIBLE	LITTLE GIANT	5-MSP
P9	RECIRCULATION DOSE TANK 4	SUBMERSIBLE	LITTLE GIANT	5-MSP
P10	DOSES STAGE 2 BIOFILTERS	PERISTALTIC	ISMATEC	R-78002-10
P11	DOSES STAGE 2 BIOFILTERS	PERISTALTIC	ISMATEC	R-78002-10
P12	TANK 4	SUBMERSIBLE	GOULDS BLASTER	20EB05
P13	TANK 5	SUBMERSIBLE	GOULDS BLASTER	20EB05
P14	TANK 2	SUBMERSIBLE	LITTLE GIANT	5-MSP
P15	TANK 4	SUBMERSIBLE	LITTLE GIANT	5-MSP

LEGEND

EXISTING	SITE PLAN
EXISTING ELEVATION CONTOUR	NEW BUILDING
EXISTING SPOT ELEVATION	NEW SHELL GRAVEL
EXISTING FENCE	NEW GRAVITY LINE
EXISTING SANITARY SEWER LINE & MANHOLE	NEW PRESSURE LINE
EXISTING WATER LINE & VALVE	NEW FLOW METER
EXISTING STORM LINE & STRUCTURE	NEW CHECK VALVE
EXISTING ELECTRIC LINE	NEW BALL VALVE NORMALLY CLOSED
EXISTING OVERHEAD POWER LINE	NEW BALL VALVE NORMALLY OPEN
EXISTING GAS LINE	NEW PINCH VALVE (PNEUMATIC) NORMALLY CLOSED
EXISTING LIGHT	NEW PINCH VALVE (PNEUMATIC) NORMALLY OPEN
EXISTING UTILITY POLE	NEW RECIRCULATION VALVE
EXISTING WOOD POWER POLE	NEW WATER MAIN WITH GATE VALVE & BOX
EXISTING TELEPHONE PEDESTAL	NEW SILT FENCE LINE
EXISTING GUY ANCHOR	NEW ELEVATION CONTOUR
EXISTING WELL	NEW STORM STRUCTURE IDENTIFICATION
EXISTING WATER METER	NEW SPOT ELEVATION
EXISTING FIRE HYDRANT	DIRECTION OF SURFACE DRAINAGE FLOW
EXISTING UNDERGROUND TELEPHONE LINE	
EXISTING TREE (SIZE & TYPE)	
EXISTING STRUCTURE	
PROJECT BENCHMARK	

ELECTRICAL LEGEND

- EQUIPMENT CONNECTION OUTLET – VERIFY LOCATION
- JUNCTION BOX
- TRANSFORMER
- DISTRIBUTION SWITCHBOARD OR PANELBOARD
- BRANCH CIRCUIT PANELBOARD
- CONDUIT
- 1L1-1,3 HOMERUN TO PANELBOARD. "L1" INDICATES THE PANELBOARD NUMBER. "1,3" INDICATES THE BRANCH CIRCUIT NUMBERS. HATCH MARKS DENOTE NUMBER OF CONDUCTORS EXCLUDING GROUND CONDUCTOR. NO HATCH MARKS DENOTES TWO #12 CONDUCTORS AND ONE #12 GROUNDING CONDUCTOR
- U — UNDERGROUND CONDUIT
- CONDUIT STUB-UP
- 1L1 — PANELBOARD NUMBER

ELECTRICAL ABBREVIATIONS

A	AMPS
AFF	ABOVE FINISHED FLOOR
AICS	AMPS INTERRUPTING CAPACITY SYMMETRICAL
BKR	BREAKER
C	CONDUIT
CLG	CEILING
CKT	CIRCUIT
CU	COPPER
EF	EXHAUST FAN
EMT	ELECTRICAL METALLIC TUBING
FU	FUSE
FLR	FLOOR
GFI	GROUND FAULT INTERRUPTER
GRD	GROUND
HOA	HAND-OFF-AUTOMATIC
HP	HORSEPOWER
IMC	INTERMEDIATE METAL CONDUIT
K	KILO
LTG	LIGHTING
MTD	MOUNTED
NEC	NATIONAL ELECTRICAL CODE
OHP	OVERHEAD PRIMARY
P	POLE
PWR	POWER
UGE	UNDERGROUND ELECTRIC
UL	UNDERWRITERS LABORATORIES
UNO	UNLESS NOTED OTHERWISE
V	VOLTS
VA	VOLT-AMPERES
W	WATTS
WP	WEATHERPROOF
ø	PHASE

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LEGENDS AND NOTES

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER G-2

PLOT DATE: 12/31/2009 2:55 PM BY: CSCOTT
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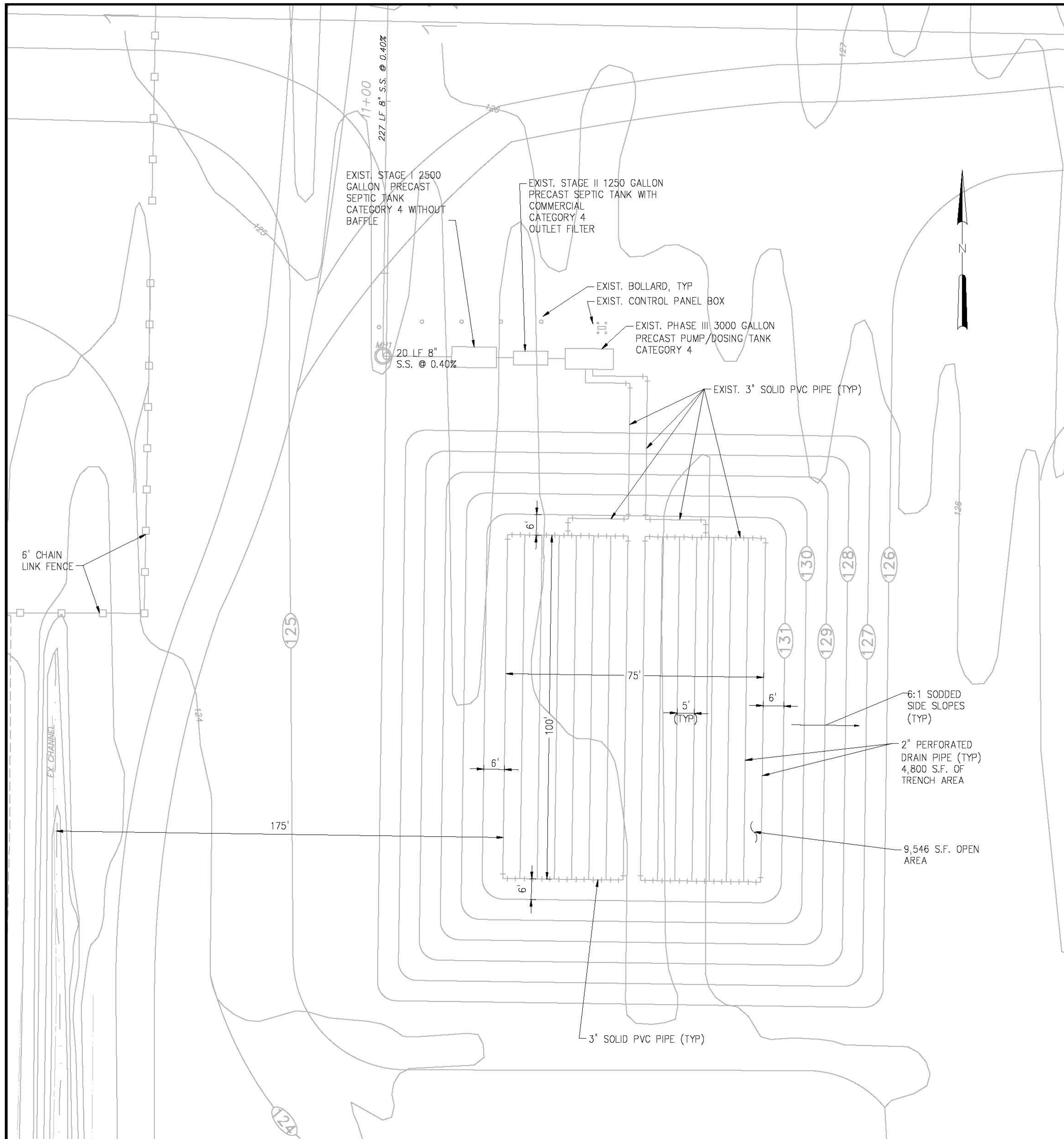


EXISTING ONSITE WASTEWATER TREATMENT SYSTEM

1"=20'

EXISTING DRAIN FIELD CALCULATION

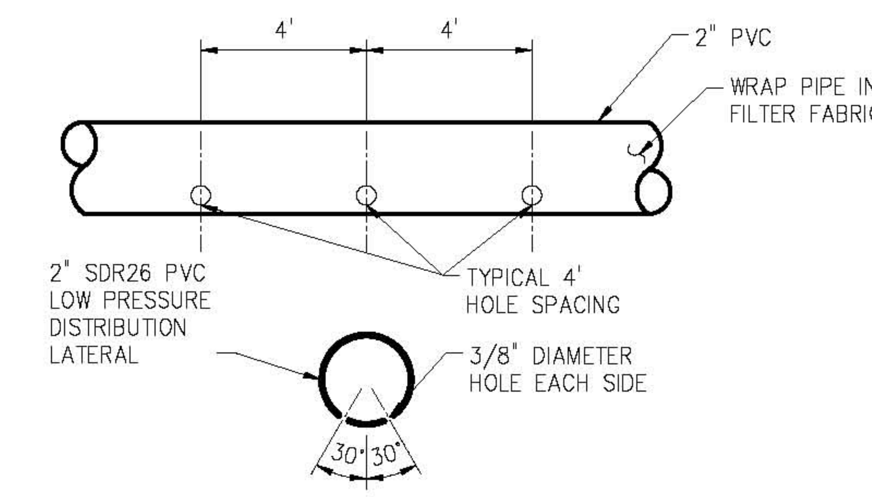
BASED ON UNSUITABLE SUBSURFACE CONDITIONS

LOAD RATE = 0.65
TRENCH AREA = 2828 GPD/0.65 = 4351 SF
OPEN AREA = 2 x 4351 SF = 8702 SF

EXISTING SYSTEM FLOW CALCULATION

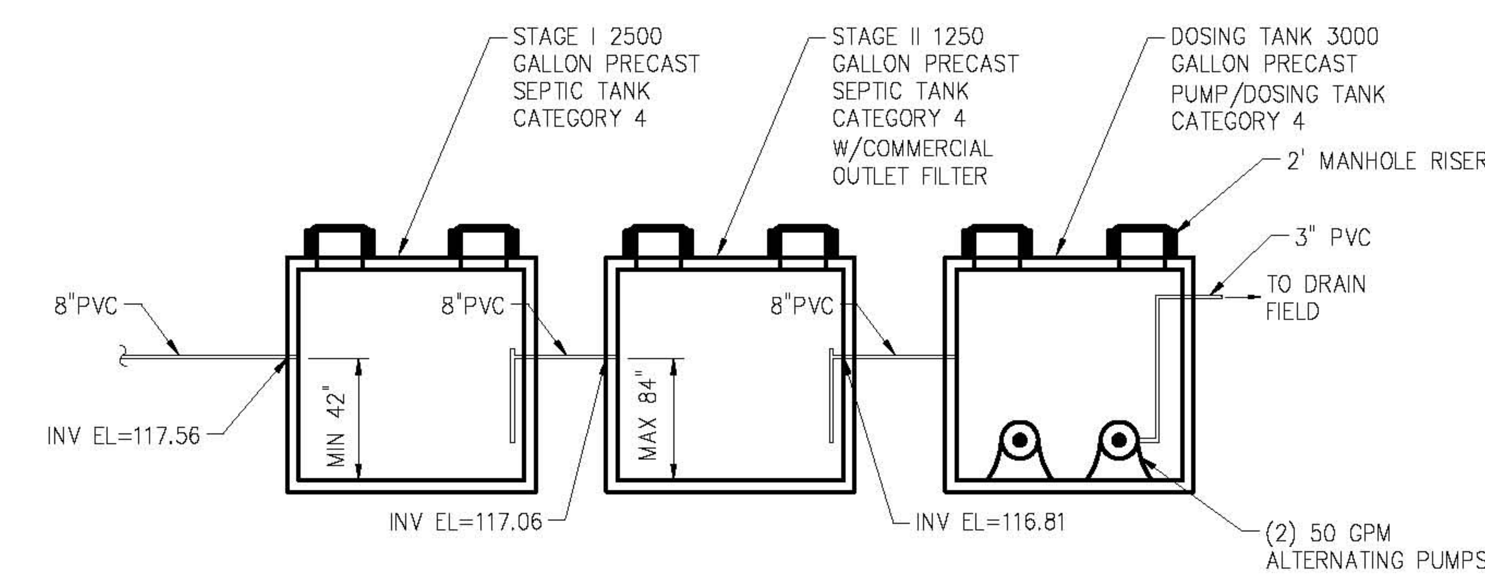
DESIGN FLOW (PER 64E-6.008(1b) TABLE 1)

ADMIN/STAFF (100x15)	= 1500 GPD
SCHOOL [STUDENT BOARDING TYPE] (16 x 75 GPD)	= 1200 GPD
ADD FOR SHOWERS (16 x 4)	= 64 GPD
ADD FOR CAFETERIA (16 x 4)	= 64 GPD
TOTAL	= 2828 GPD



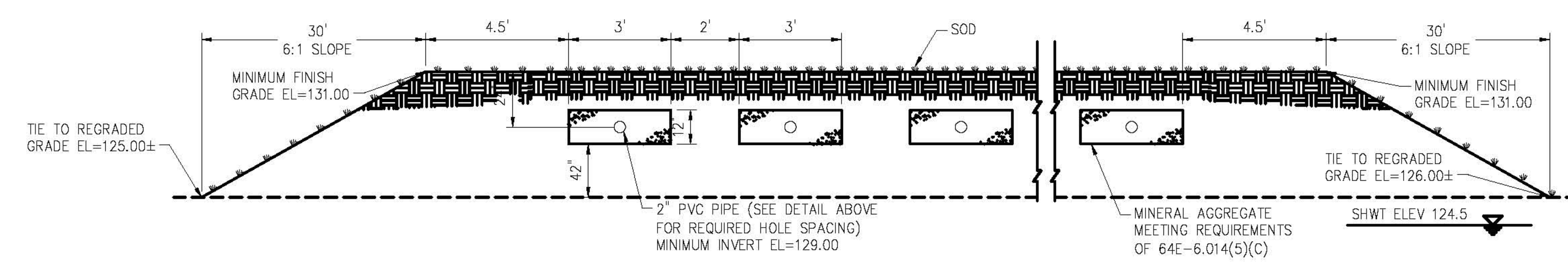
EXISTING HOLE SPACING DETAIL

N.T.S.



EXISTING SEPTIC TANK CROSS-SECTION

N.T.S.



TYPICAL SECTION THRU EXISTING DRAIN FIELD

N.T.S.

20 10 0 20'
1"=20'-0"

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EXISTING ONSITE WASTEWATER TREATMENT SYSTEM

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

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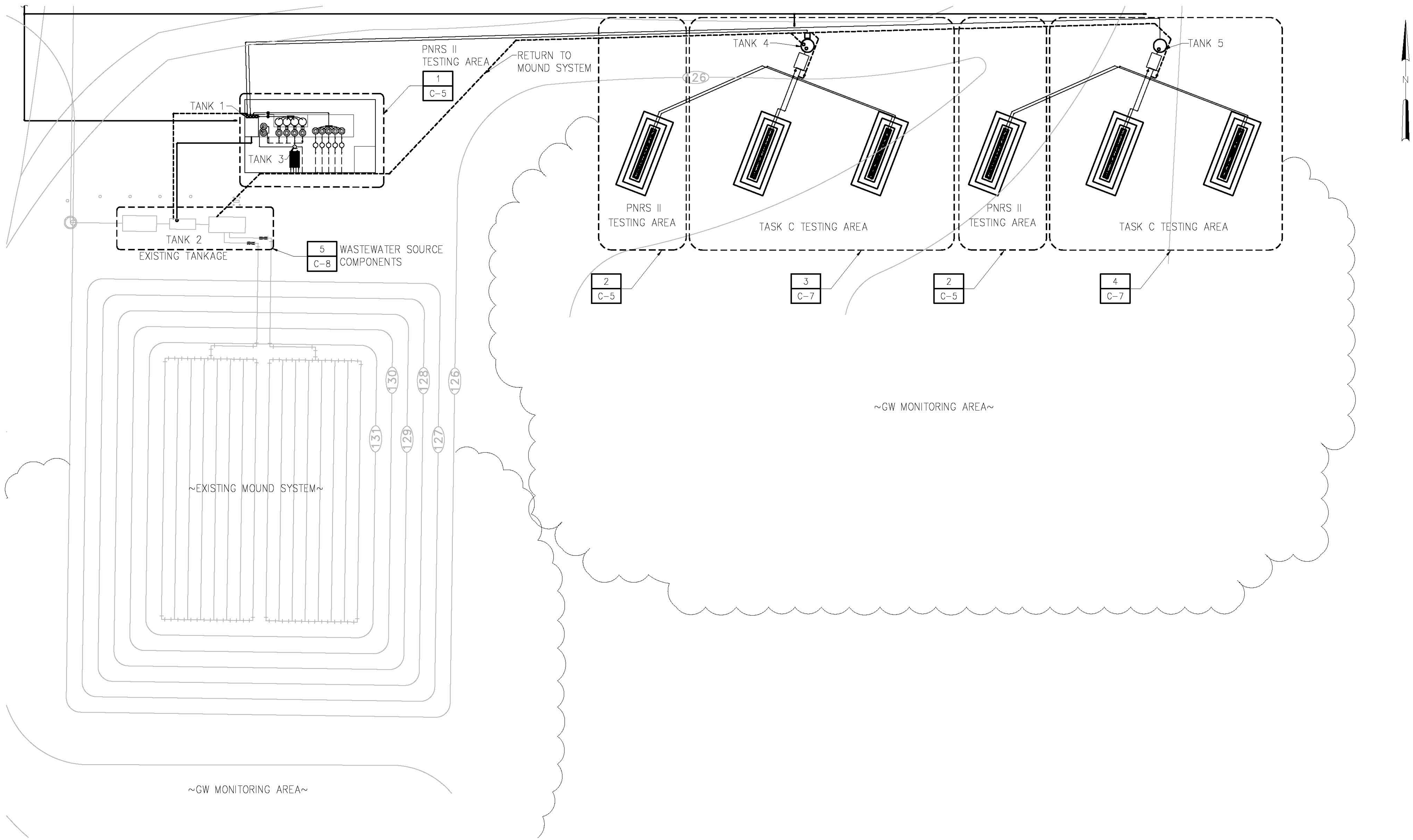

PROPOSED SITE PLAN

1"=20'

20 10 0 20'

1"=20'-0"

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OVERALL PROPOSED SITE PLAN

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
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CONTRACT NUMBER
DRAWING NUMBER C-2

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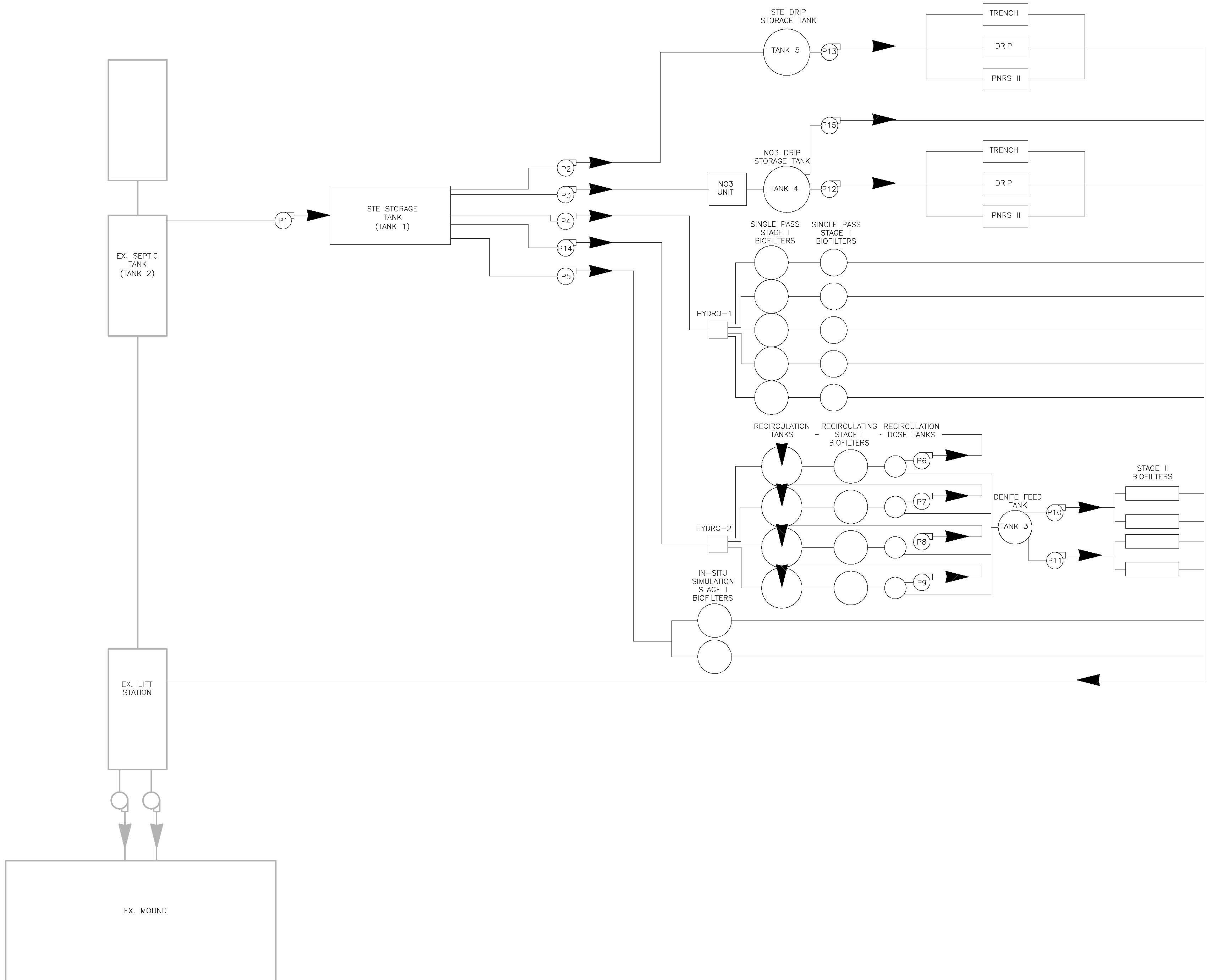

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PROCESS FLOW DIAGRAM

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

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DRAWING NUMBER C-3

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CONDITION	FLOW		A		B		C		D
			TANK 2		RECIRCULATION TANK		DOSE TANK		STAGE 2 DOSE TANK
AVERAGE FLOW	58.8 GPD		130.37		133.38		129.96		129.83

CONDITION	FLOW		A		B
			TANK 2		STAGE 2 TANK
AVERAGE FLOW	73.5 GPD		130.37		130.12

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HYDRAULIC PROFILE PNRS II

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

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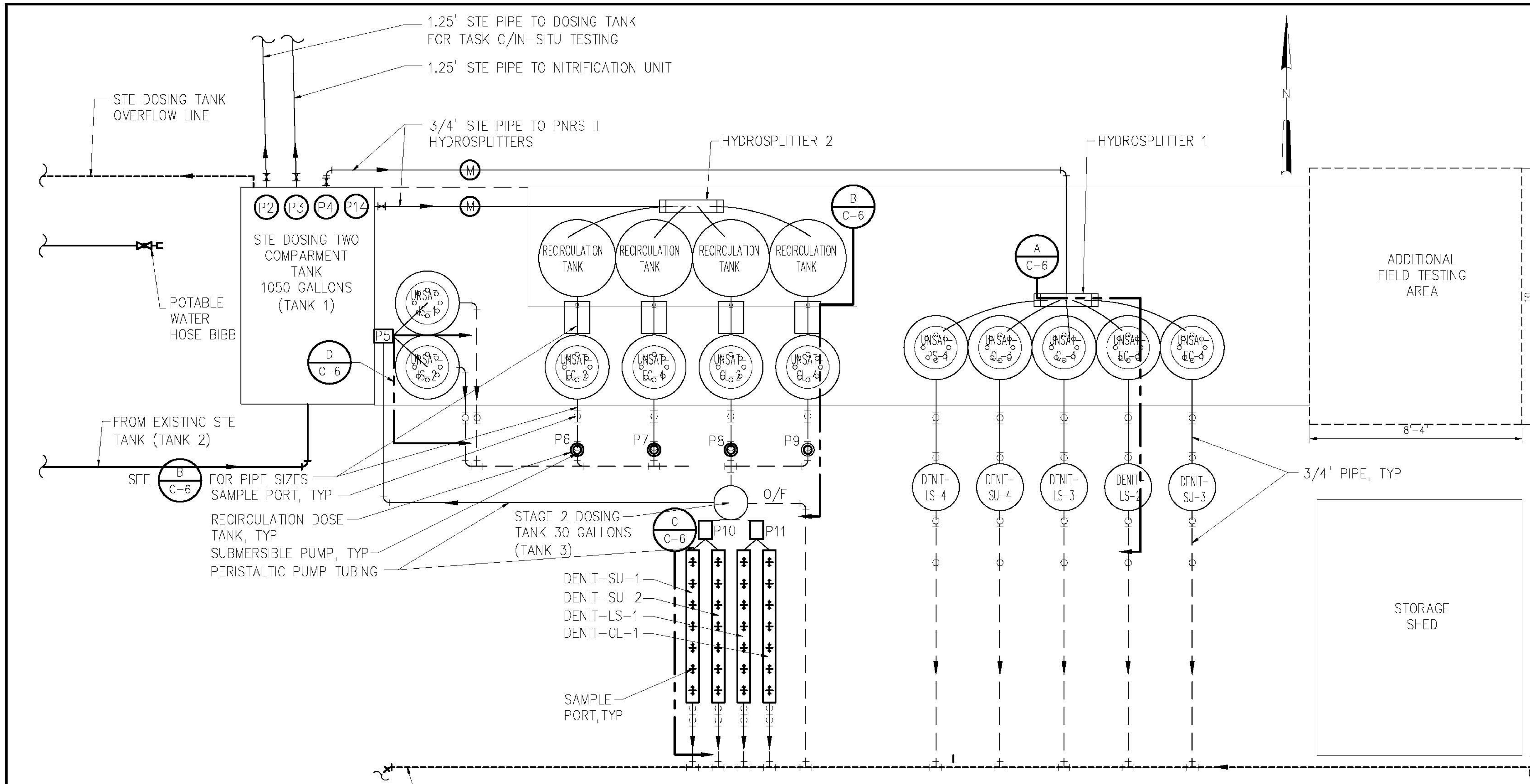
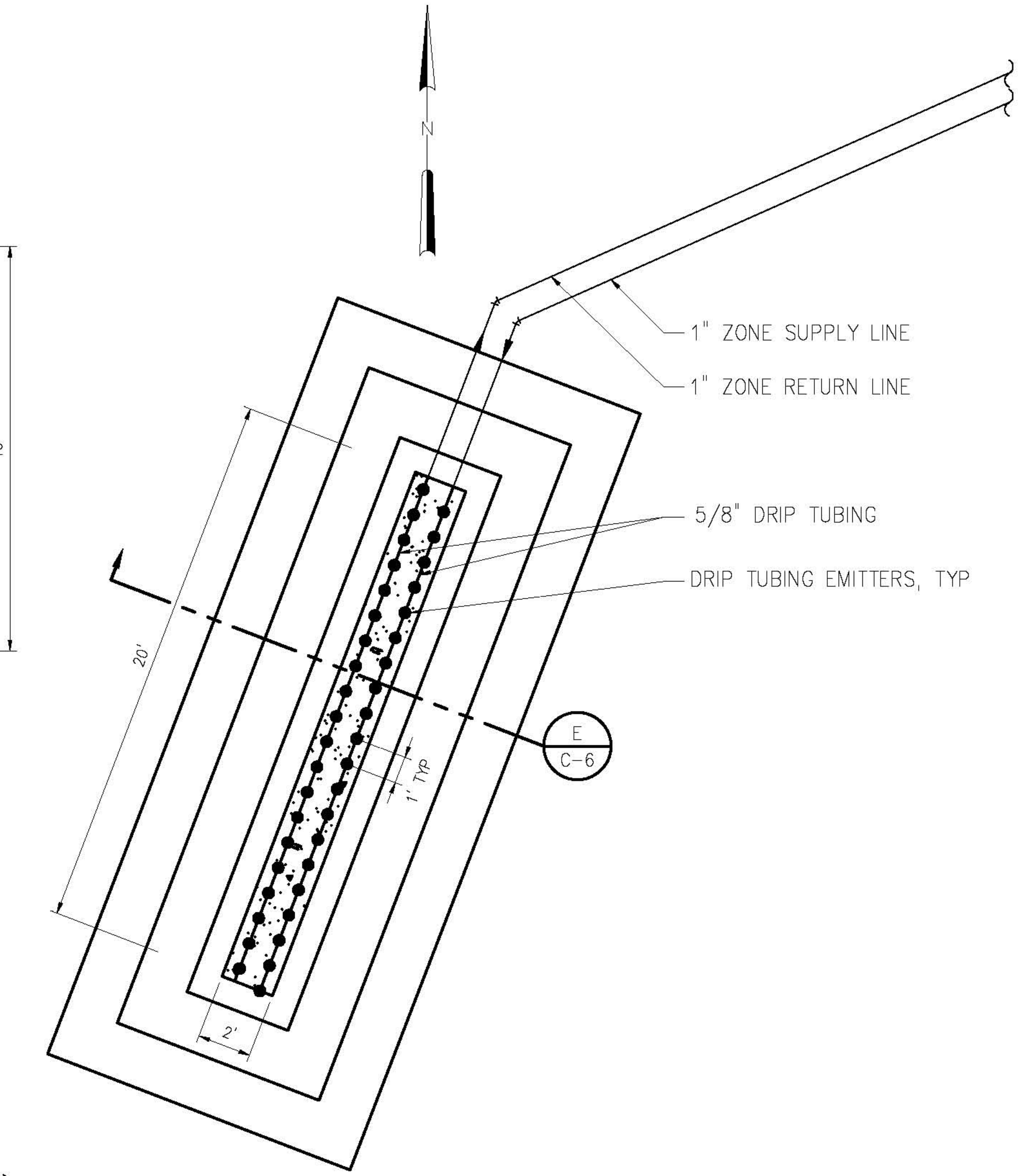


DETAIL 1 C-2
3/8"=1'-0"



PNRS II IN-SITU SIMULATOR

DETAIL 2 C-2
3/8"=1'-0"

		SUMMARY OF PNRS II BIOFILTERS					
		BIOFILTER	TANK SIZE	MEDIA DEPTH	INITIAL SURFACE LOADING RATE	INITIAL DOSE CYCLES	STAGE II BIOFILTER DIRECTLY CONNECTED
STAGE I BIOFILTER	(SINGLE PASS)	UNSAT-EC-1	30"ID X 36" H	15" EXPANDED CLAY	3 gal/day-ft2; 14.73 gpd	24	DENIT-SU-3
		UNSAT-EC-3	30"ID X 36" H	30" EXPANDED CLAY	3 gal/day-ft2; 14.73 gpd	24	DENIT-LS-2
		UNSAT-CL-1	30"ID X 36" H	15" CLINOPTILOLITE	3 gal/day-ft2; 14.73 gpd	24	DENIT-LS-3
		UNSAT-CL-3	30"ID X 36" H	30" CLINOPTILOLITE	3 gal/day-ft2; 14.73 gpd	24	DENIT-SU-4
		UNSAT-PS-1	30"ID X 36" H	30" POLYSTYRENE	3 gal/day-ft2; 14.73 gpd	24	DENIT-LS-4
	(WITH RECYCLE)	UNSAT-SAND-2	30"ID X 36" H	30" SAND	3 gal/day-ft2; 14.73 gpd	24	
		UNSAT-EC-4	30"ID X 36" H	30" EXPANDED CLAY	3 gal/day-ft2; 14.73 gpd	24	
		UNSAT-CL-2	30"ID X 36" H	15" CLINOPTILOLITE	3 gal/day-ft2; 14.73 gpd	24	
		UNSAT-CL-4	30"ID X 36" H	30" CLINOPTILOLITE	3 gal/day-ft2; 14.73 gpd	24	
		UNSAT-IS-1	30"ID X 36" H	24" MIX	0.8 gal/day-ft2; 3.92 gpd	6	
		UNSAT-IS-2	30"ID X 36" H	24" MIX	0.8 gal/day-ft2; 3.92 gpd	6	
STAGE II BIOFILTER	(CONNECTED)	DENIT-SU-3	22"ID X 34" H	80% SU; 20% OS	4.7 gal/day-ft2; 12.41 gpd	CONTINUOUS	
		DENIT-SU-4	22"ID X 34" H	80% SU; 20% NS	4.7 gal/day-ft2; 12.41 gpd	CONTINUOUS	
		DENIT-LS-2	22"ID X 34" H	50% LS; 50% EC	4.7 gal/day-ft2; 12.41 gpd	CONTINUOUS	
		DENIT-LS-3	22"ID X 34" H	50% LS; 50% SAND	4.7 gal/day-ft2; 12.41 gpd	CONTINUOUS	
		DENIT-LS-4	22"ID X 34" H	30% LS; 70% EC	4.7 gal/day-ft2; 12.41 gpd	CONTINUOUS	
	(COMMON TANK)	DENIT-SU-1	6"ID X 72" L	80% SU; 20% OS	10 gal/day-ft2; 1.96 gpd	24	
		DENIT-SU-2	6"ID X 72" L	80% SU; 20% NS	10 gal/day-ft2; 1.96 gpd	24	
		DENIT-LS-1	6"ID X 72" L	50% LS; 50% EC	10 gal/day-ft2; 1.96 gpd	24	
		DENIT-GL-1	6"ID X 72" L	100% EC	10 gal/day-ft2; 1.96 gpd	24	

SU: ELEMENTAL SULFUR, LS: LIGNOCELLULOSIC, GL: GLYCEROL, OS: OYSTER SHELL, NS: SODIUM SESQUICARBONATE, EC: EXPANDED CLAY

3/8"=1'-0" 12" 0 1 2 4'

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PNRS II DETAILS

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

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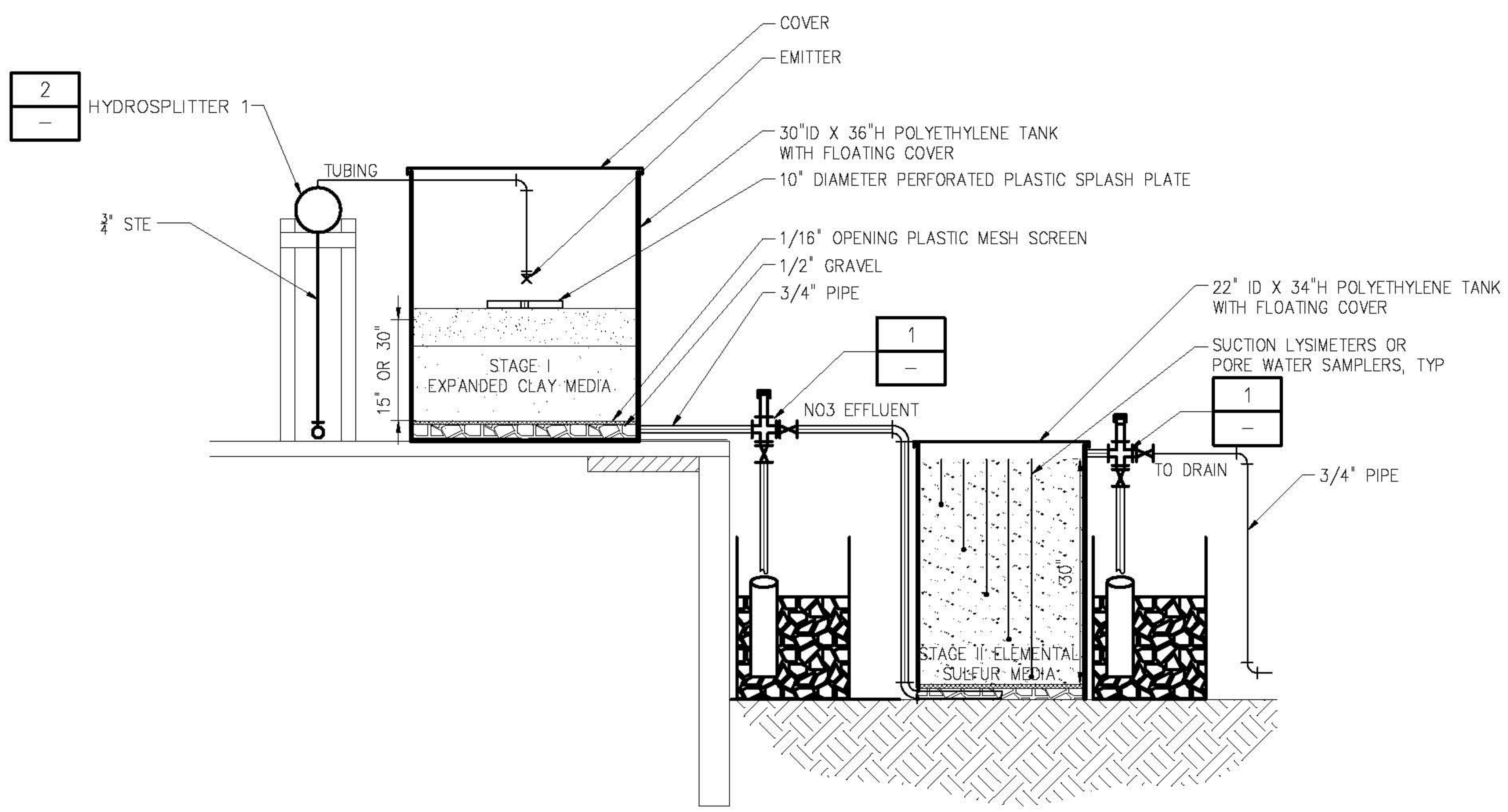
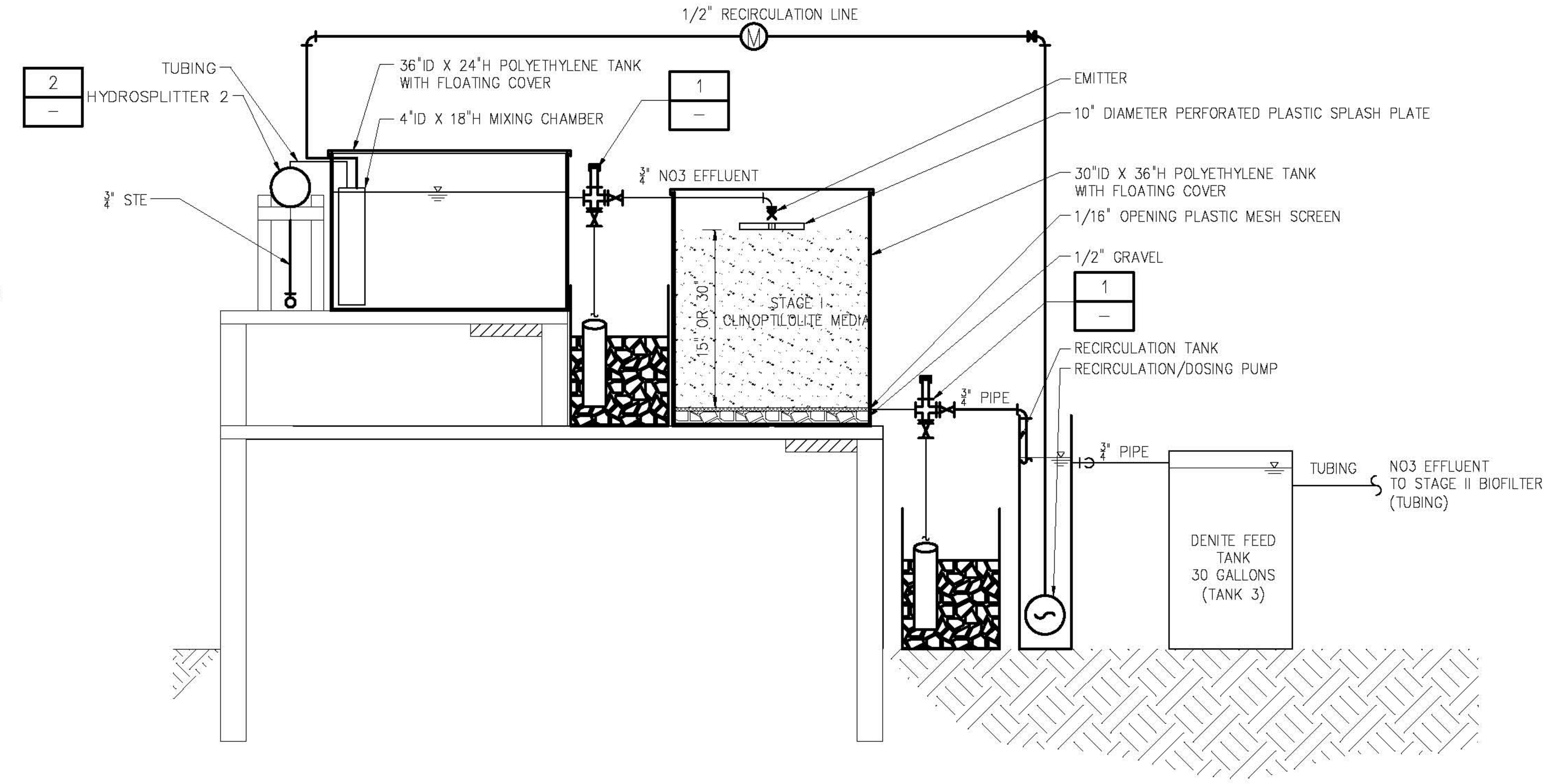


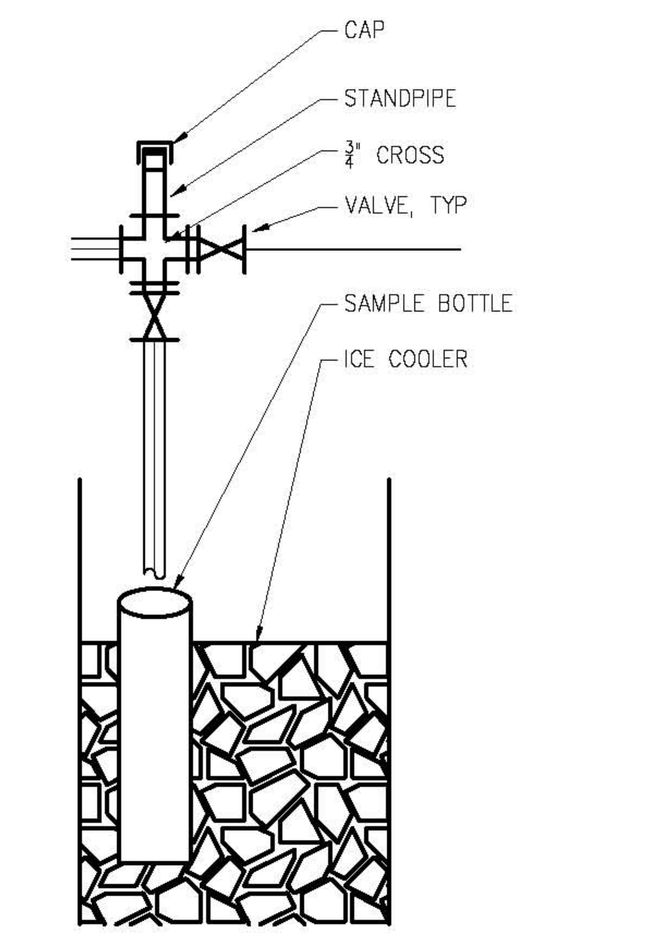
PNRS II TWO-STAGE BIOFILTER SINGLE PASS (TYPICAL)

SECTION A C-5
NTS



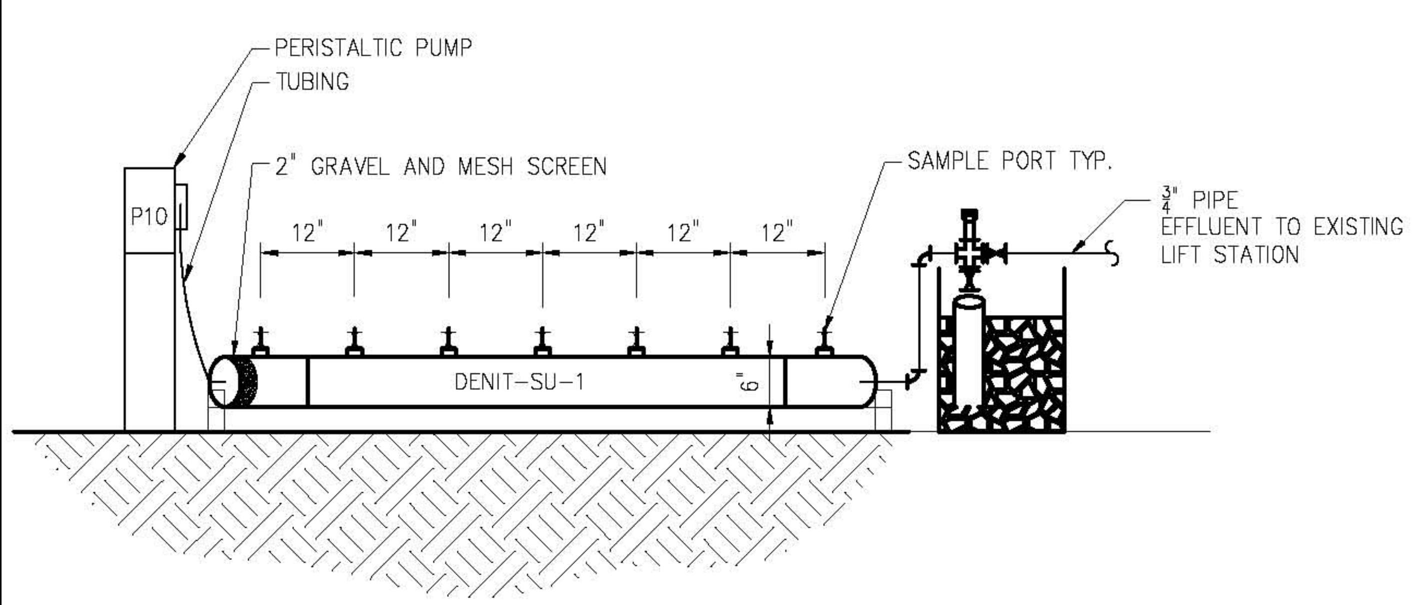
PNRS II TWO-STAGE BIOFILTER WITH RECYCLE (TYPICAL)

SECTION B C-5
NTS



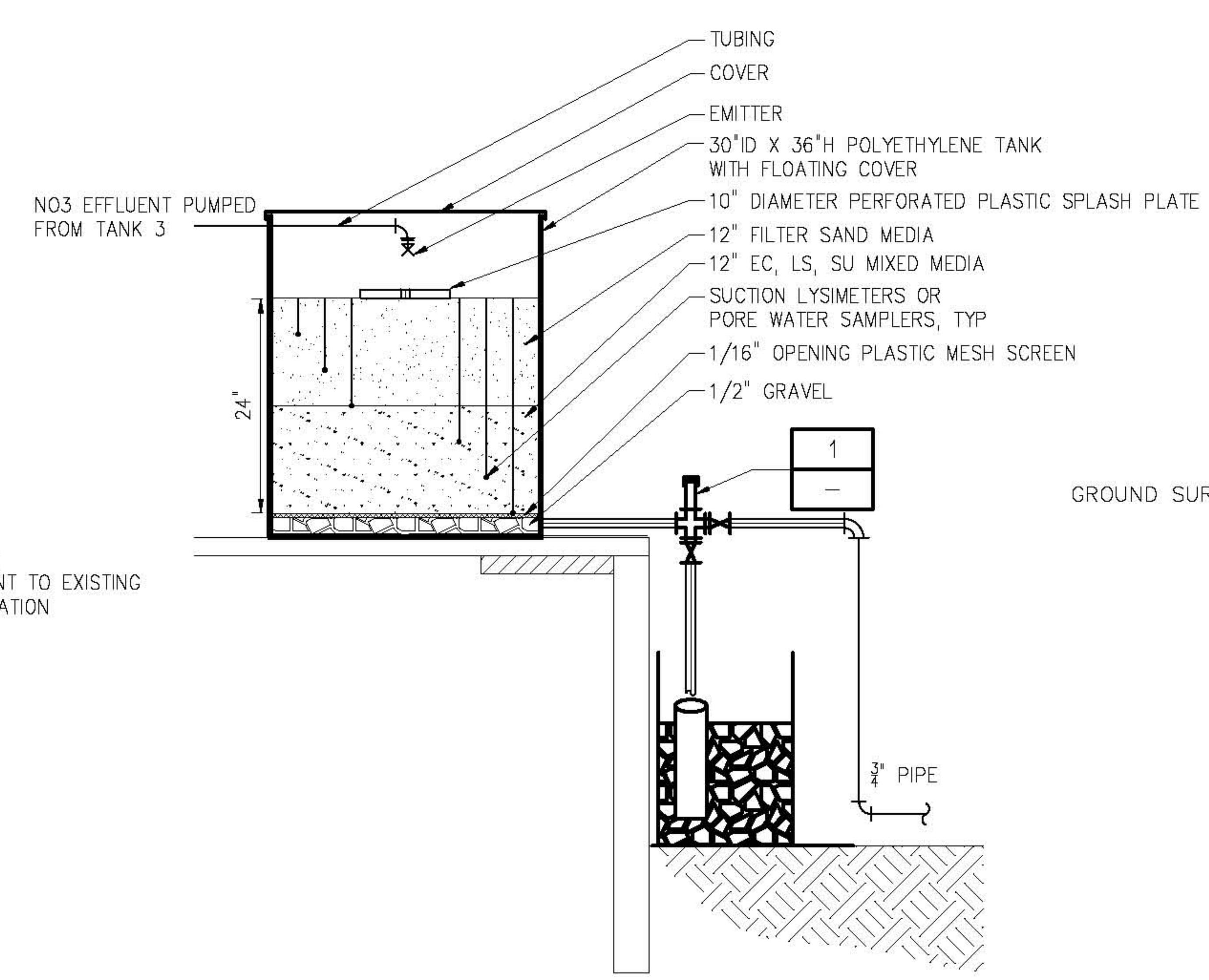
TYPICAL SAMPLE PORT

DETAIL 1 –
NTS



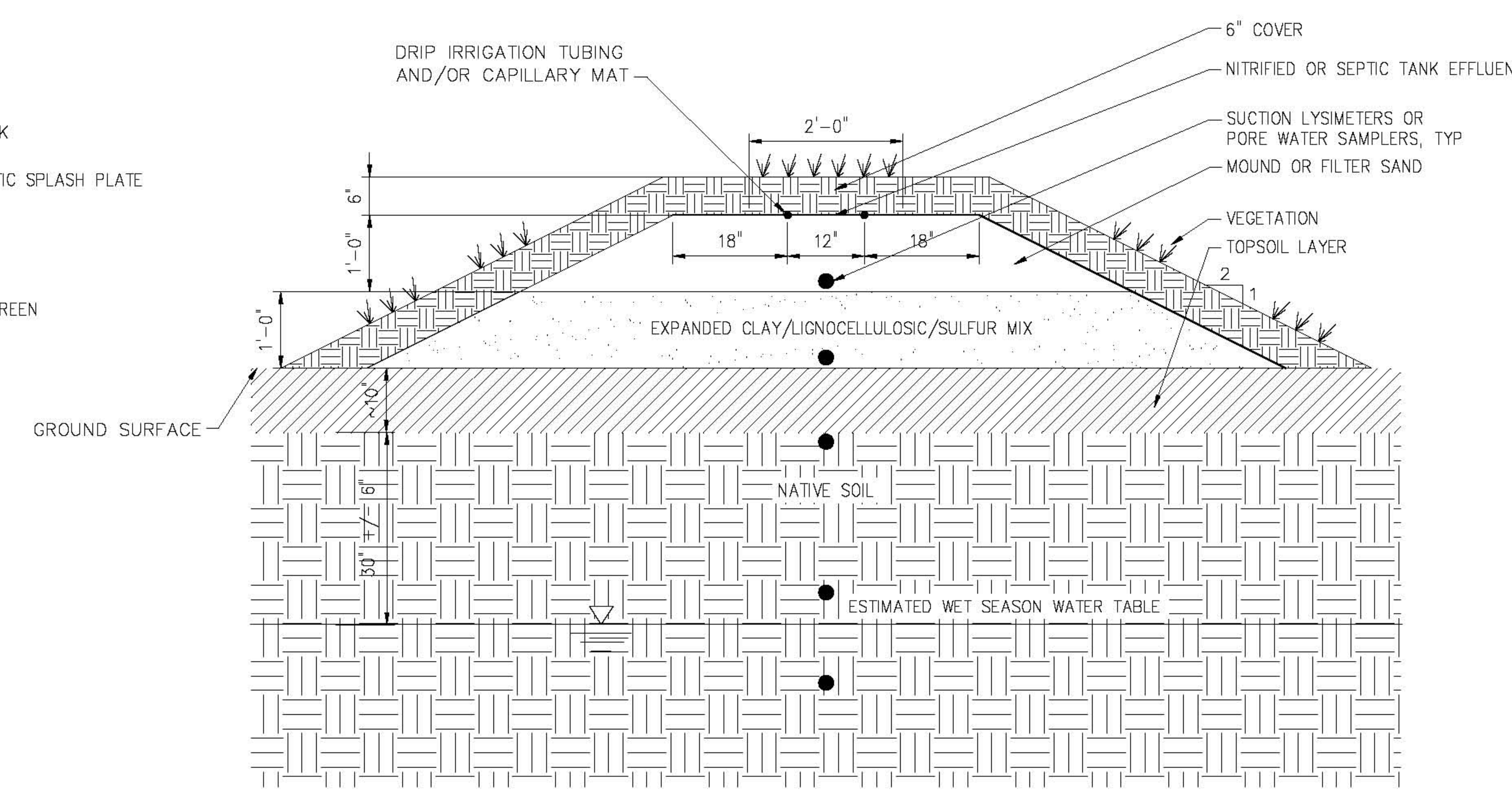
PNRS II STAGE II BIOFILTER FED FROM TANK 3

SECTION C C-5
NTS



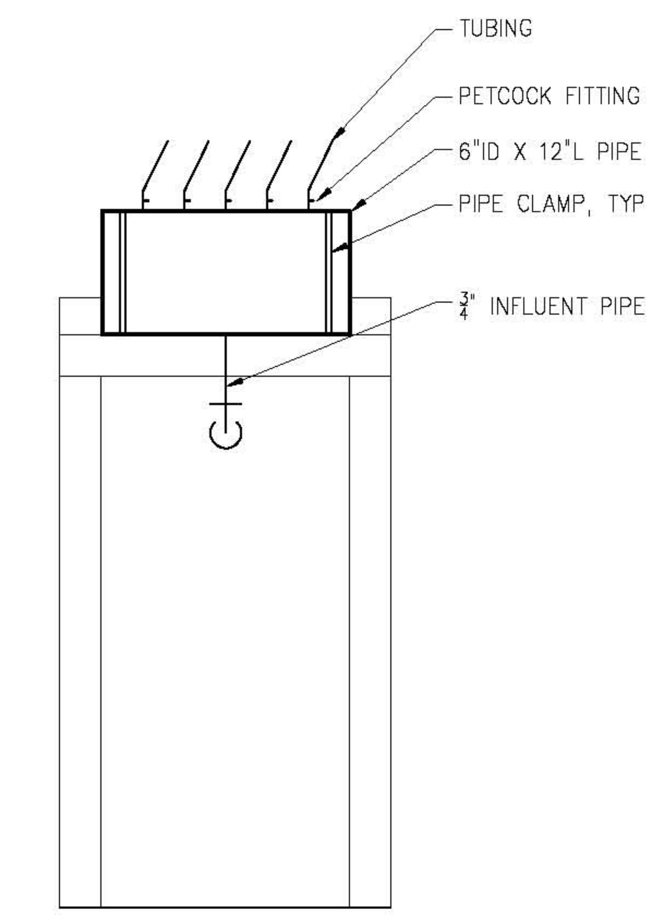
PNRS II STAGE I IN-SITU BIOFILTER SIMULATOR

SECTION D C-5
NTS



PNRS II INSITU SYTEM

SECTION E C-5
NTS



HYDROSPLITTER

DETAIL 2 –
NTS

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PNRS II DETAILS

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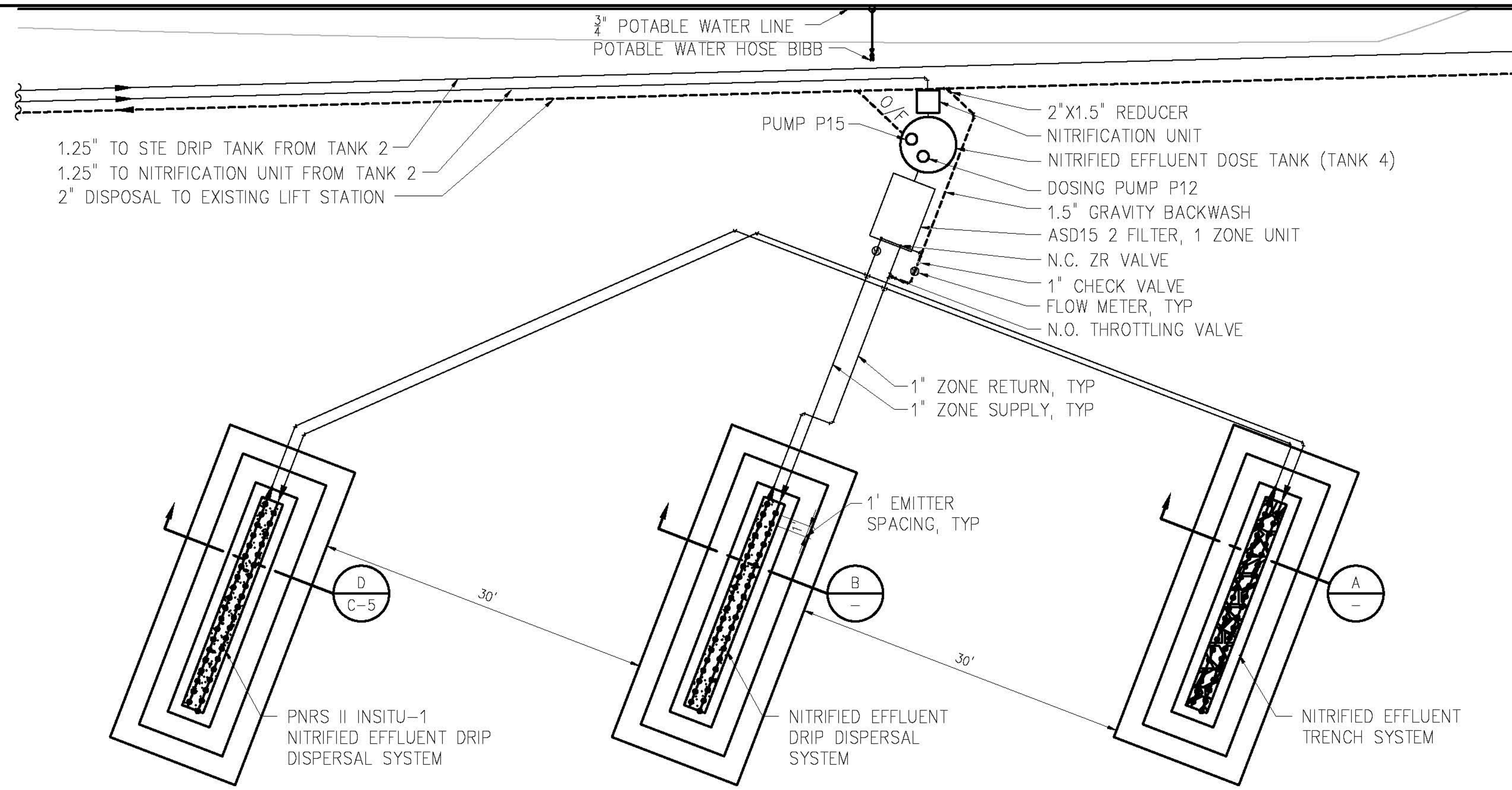
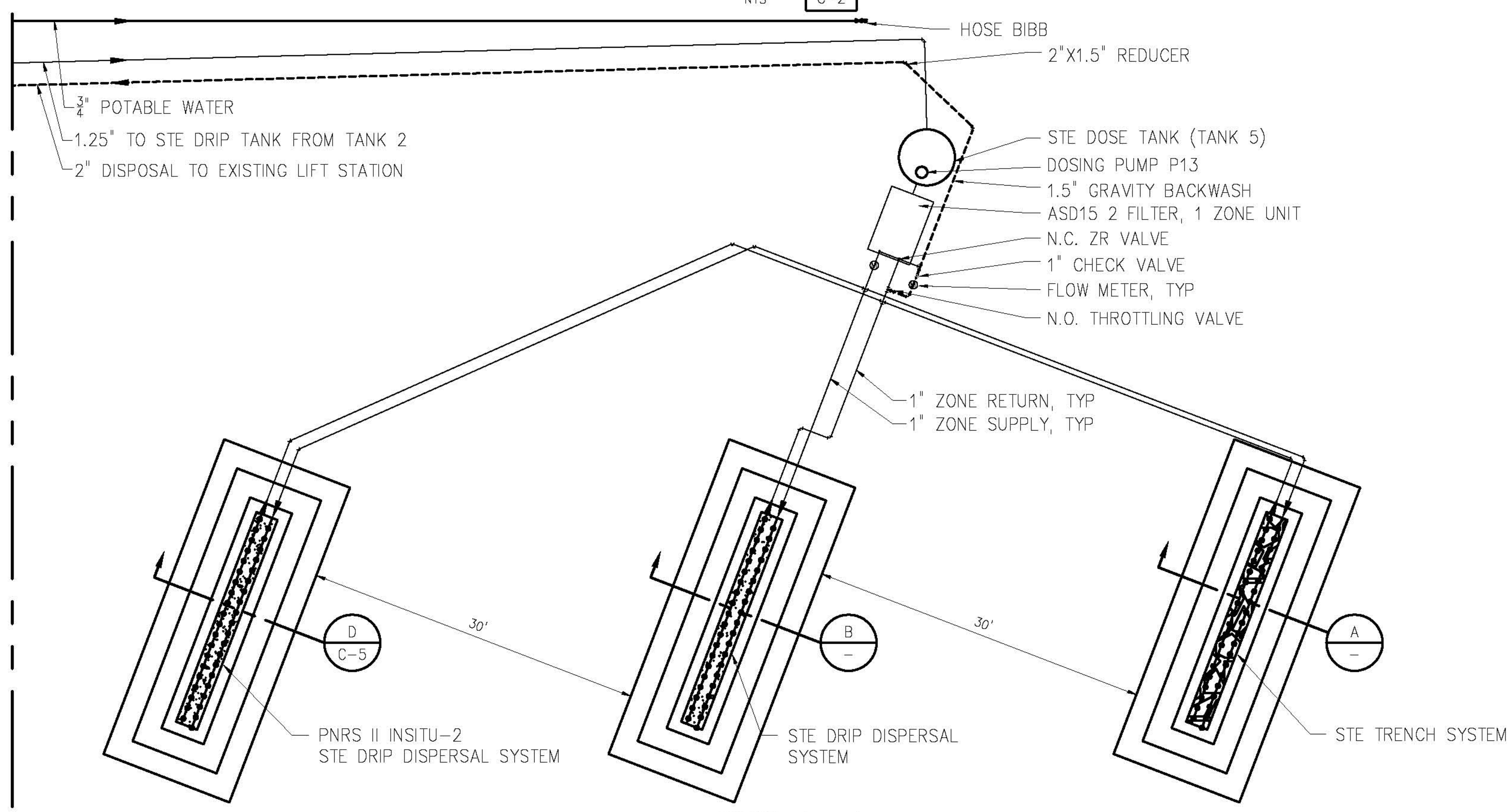
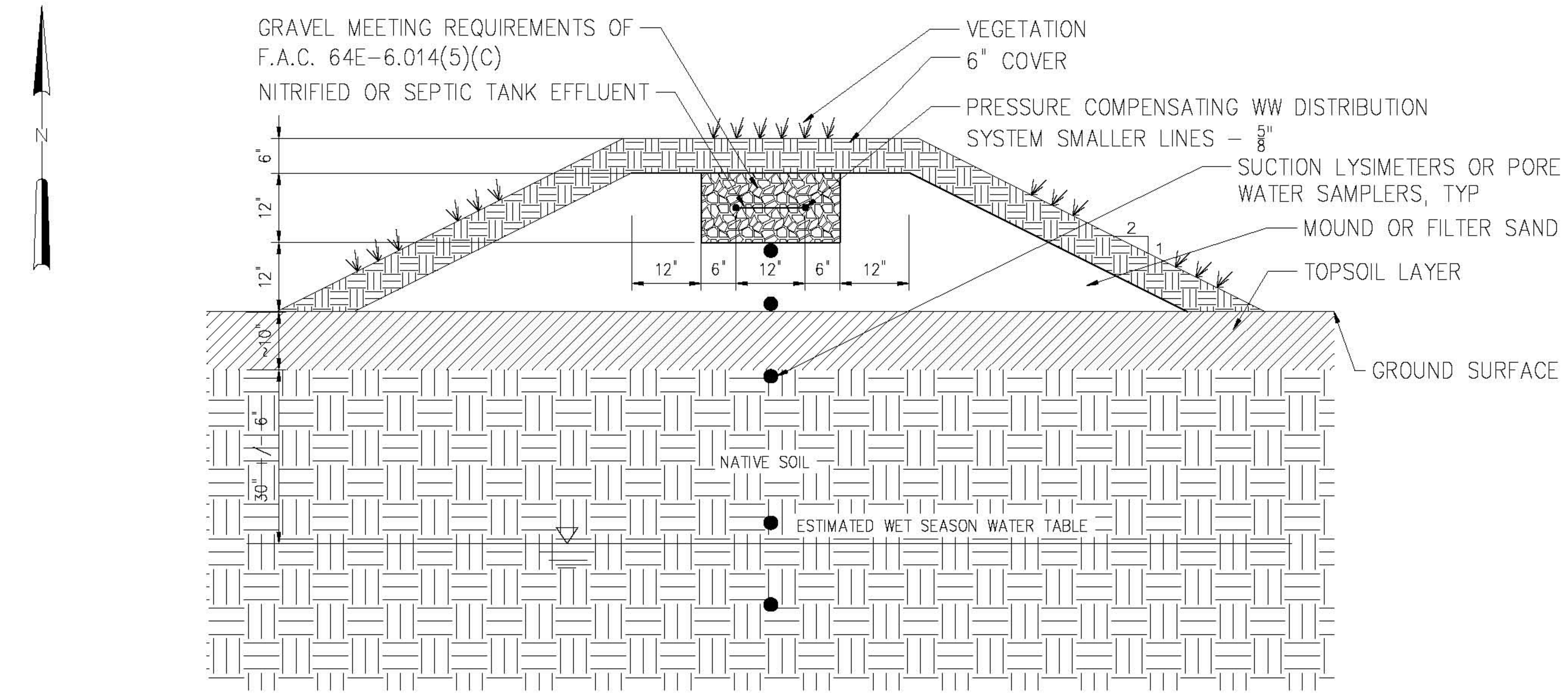


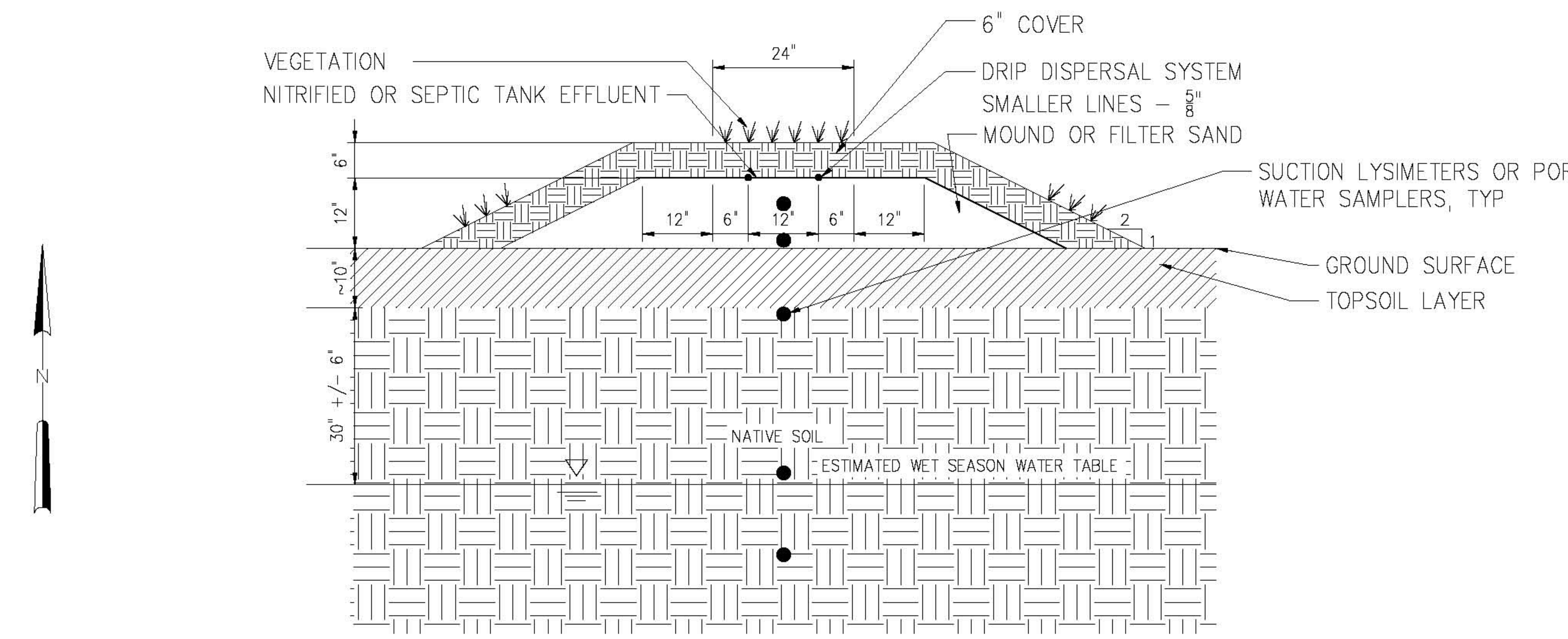
DETAIL 3
NTS C-2



DETAIL 4
NTS C-2



SECTION A –
NTS



SECTION B –
NTS

NOTES

1. PROPOSED NITRIFICATION UNIT AT THIS FACILITY REFERS TO A MANUFACTURED WASTEWATER TREATMENT SYSTEM WHICH MAY UTILIZE SPECIAL EQUIPMENT AND MATERIALS SUPPLIED AS A SINGLE PACKAGE WHERE INDICATED. THIS SYSTEM WILL BE PROVIDED BY OTHERS.
2. TWO PERC-RITE DRIP DISPERSAL SYSTEMS WITH THREE ZONES EACH SHALL BE PROVIDED AS INDICATED. THE SYSTEMS SHALL INCLUDE A PRESSURE REGULATOR AND FLOW METER ON THE RETURN LINE. THE INSTALLATION OF THIS SYSTEM SHALL BE IN ACCORDANCE WITH SPECIFICATIONS AND PROCEDURES AS SUPPLIED BY THE MANUFACTURER OF THE EQUIPMENT.
3. THE DRIP TUBING SHALL BE INSTALLED USING A VIBRATORY PLOW OR TRENCHER. INSTALL ALL TUBING ALONG CONTOUR.
4. ALL PVC PIPING AND FITTINGS SHALL BE PVC SCH 40 TYPE 1 RATED FOR PRESSURE APPLICATIONS. ALL GLUED JOINTS SHALL BE CLEANED AND PRIMED WITH PURPLE (DYED) PVC PRIMER PRIOR TO BEING GLUED.
5. ALL CUTTING OF PVC PIPE, FLEXIBLE PVC AND DRIPPER TUBING OF SIZE 1.5" OR SMALLER SHALL BE ACCOMPLISHED WITH PIPE CUTTERS APPROVED BY AMERICAN MANUFACTURING COMPANY, INC. NO SAWING OF PVC, FLEXIBLE PVC, OR DRIPPER TUBING OF SIZE 1.5" OR SMALLER IS ALLOWED.
6. ALL PVC PIPE, FLEXIBLE PVC AND DRIPPER TUBING IN THE WORK AREA SHALL HAVE THE ENDS COVERED WITH DUCT TAPE TO PREVENT CONSTRUCTION DEBRIS FROM ENTERING THE PIPE. PRIOR TO GLUING, ALL JOINTS SHALL BE INSPECTED FOR AND CLEARED OF ANY CONSTRUCTION DEBRIS.
7. ALL AUTOMATIC VALVES (ZONE VALVES & FIELD FLUSH RETURN VALVES) SHALL BE INSTALLED WITH ISOLATION VALVES, BYPASS VALVES, AND DISCONNECTS (I.E. UNIONS, FLANGES) FOR MANUAL FIELD OPERATION DURING FIELD MAINTENANCE EVENTS. ALL VALVES MUST BE PROVIDED WITH AT-GRADE ACCESS.
8. NO ACTIVITY ON DRAINFIELD AREA OTHER THAN MINIMUM IS REQUIRED TO INSTALL SYSTEMS. DO NOT PARK EQUIPMENT, DRIVE LARGE EQUIPMENT OVER OR STORE MATERIALS ON DRAINFIELD AREAS.
9. NO WET WEATHER INSTALLATION IS PERMITTED.
10. ALL FORCE MAINS SHALL BE TESTED FOR LEAKS PRIOR TO DRIP TUBING INSTALLATION AND PRIOR TO SYSTEM STARTUP. UNCOVERED FORCE MAINS SHALL BE VISIBLY INSPECTED FOR LEAKS. IF A LEAK IS SUSPECTED IN COVERED FORCE MAINS THEN THE FORCE MAIN SHALL BE RE-TESTED AT A MINIMUM PRESSURE OF AT LEAST 50 PERCENT ABOVE THE DESIGN OPERATING PRESSURE, FOR AT LEAST 30 MINUTES. THERE SHALL BE NO DISCERNIBLE LEAKAGE.
11. THE CONTRACTOR IS ADVISED THAT THE NITRIFICATION UNIT AND DRIP DISPERSAL SYSTEMS AND POSSIBLY OTHER DONATED EQUIPMENT WILL BE DELIVERED AND STORED AT THE PROJECT SITE. EXCEPT WHERE INDICATED IN CONTRACT DOCUMENTS ALL SHIPMENTS WILL BE ARRANGED BY FDOH AND THE ENGINEER. MANUFACTURERS REPRESENTATIVES WILL BE AVAILABLE FOR TECHNICAL GUIDANCE AT THE TIME OF INSTALLATION.

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3	100% SUBMITTAL	12/09	–
2	75% SUBMITTAL	12/09	–
1	50% SUBMITTAL	08/09	–

DESIGNED –
DRAWN –
CHECKED –
PROJ. ENGR. –
APPROVED –

Name: Date:
Florida Professional Engineer's Registration Number: –

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FLORIDA DEPARTMENT OF HEALTH
FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATIGIES STUDY

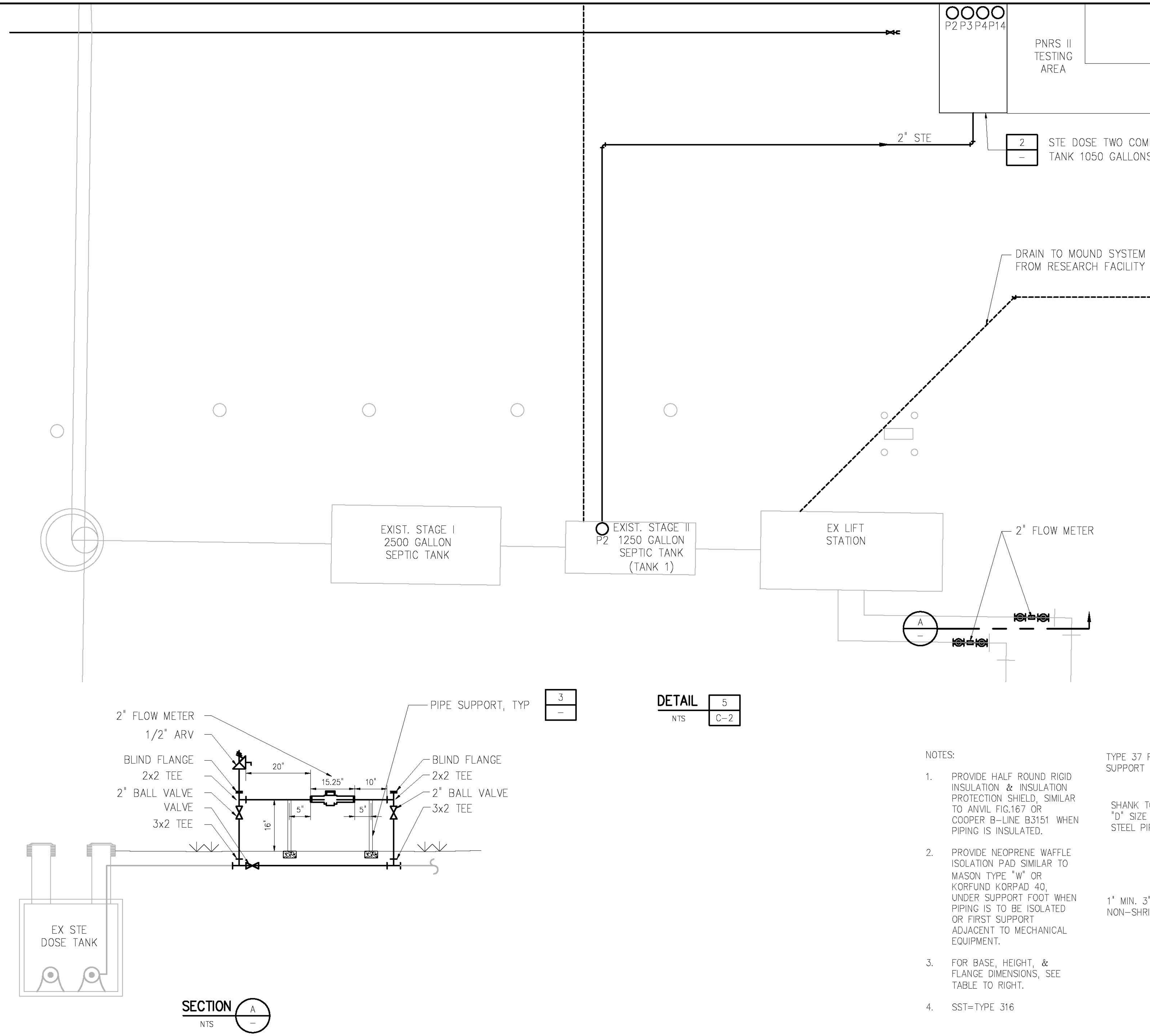
TASK C NITROGEN FATE & TRANSPORT STUDY DETAILS

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER C-7

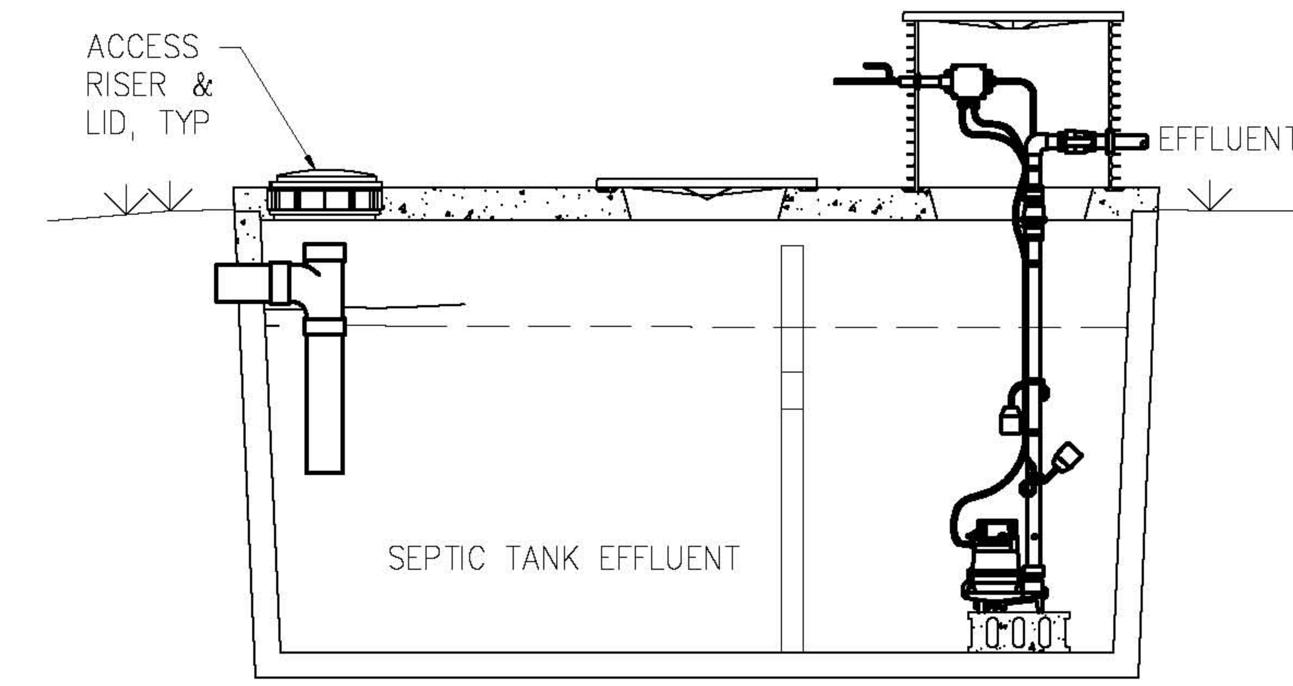
PLOT DATE: 12/21/2009 2:57 PM BY: CSCOTT

File = G:\44237-001-TPA\44237-001\Drawings\100% Design – C.12\Civil\C-7 TASK C NITROGEN FATE & TRANSPORT STUDY OVERVIEW-SITE PLAN Saved by jameby Save date = 12/21/2009 2:24 PM



DETAIL 5 / C-2
NTS

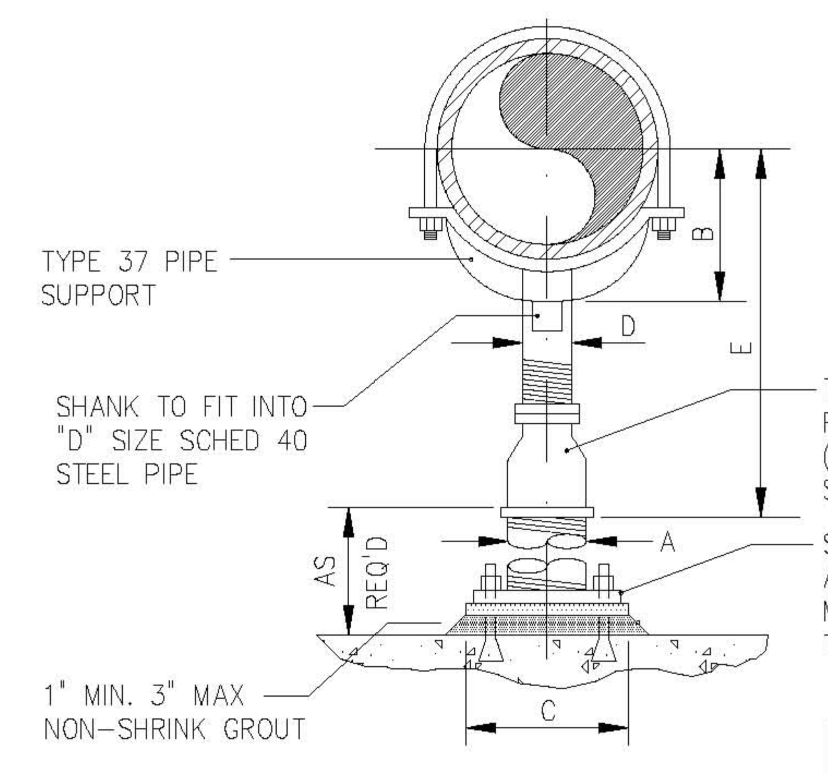
SECTION A / –
NTS



TANK 2
DETAIL 2 / –
NTS

NOTES:

1. PROVIDE HALF ROUND RIGID INSULATION & INSULATION PROTECTION SHIELD, SIMILAR TO ANVIL FIG.167 OR COOPER B-LINE B3151 WHEN PIPING IS INSULATED.
2. PROVIDE NEOPRENE WAFFLE ISOLATION PAD SIMILAR TO MASON TYPE "W" OR KORFUND KORPAD 40, UNDER SUPPORT FOOT WHEN PIPING IS TO BE ISOLATED OR FIRST SUPPORT ADJACENT TO MECHANICAL EQUIPMENT.
3. FOR BASE, HEIGHT, & FLANGE DIMENSIONS, SEE TABLE TO RIGHT.
4. SST=TYPE 316



PIPE SUPPORT
N.T.S.

PIPE SIZE	A	B	C	D	E MIN.	E MAX.
2	2-1/2	3-1/4	9	1-1/2	7 -3/4	12-3/4
2-1/2	2-1/2	3-1/2	9	1-1/2	8	13
3	2-1/2	3-3/4	9	1-1/2	8-1/4	13-1/4
3-1/2	2-1/2	4	9	1-1/2	8-1/2	13-1/2
4	3	4-1/4	9	2-1/2	9-1/4	14

DETAIL 3 / STD
NTS

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WASTEWATER SOURCE COMPONENTS DETAILS

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

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H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER C-8

MONITORING PLAN

1"=50'

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1	50% SUBMITTAL	08/09	–

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DRAWN –
CHECKED –
PROJ. ENGR. –
–.
APPROVED

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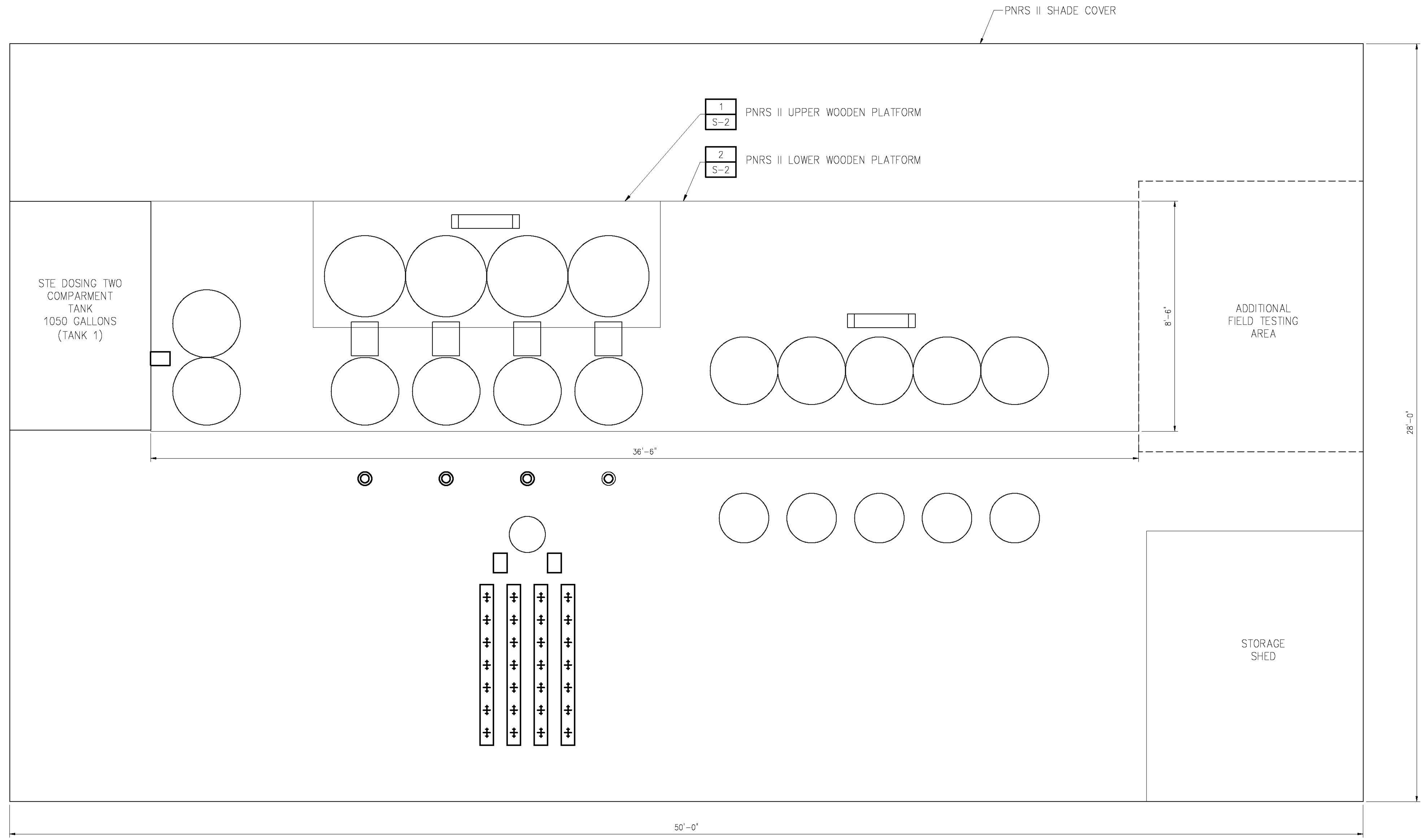
MONITORING PLAN

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER C-9



PROPOSED SITE PLAN

1/2"=1'-0"

NO.	ISSUED FOR	DATE	BY
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2	75% SUBMITTAL	12/09	–
1	50% SUBMITTAL	08/09	–

DESIGNED –
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PNRS II STRUCTURAL SITE PLAN

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
H & S JOB NUMBER 44237-001
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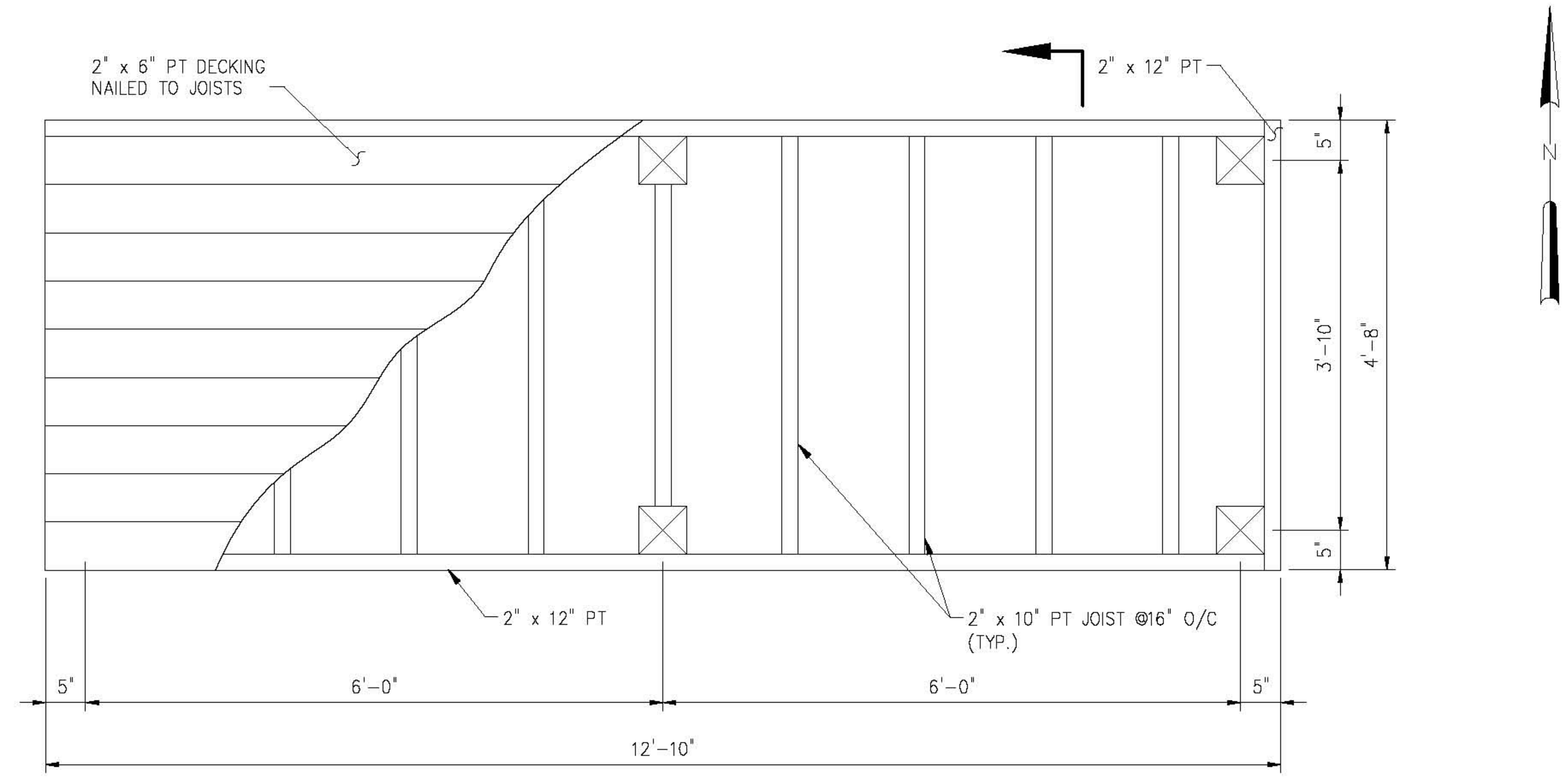
DRAWING NUMBER S-1

PLOT DATE: 12/31/2009 2:58 PM BY: CSCOTT



PNRS II UPPER PLAN

DETAIL 1 / S-1

3/4"=1'-0"

PNRS II PLAN

DETAIL 2 / S-1

3/4"=1'-0"

3/4"=1'-0" 6" 0 1 2'

NO.	ISSUED FOR	DATE	BY
3	100% SUBMITTAL	12/09	–
2	75% SUBMITTAL	12/09	–
1	50% SUBMITTAL	08/09	–

DESIGNED A.V.F.
DRAWN G.P.B.
CHECKED A.F.H.
PROJ. ENGR. S.J.
APPROVED

Name: SHAJAN JOYKUTTY, PE Date:
Florida Professional Engineer's Registration Number: 43323

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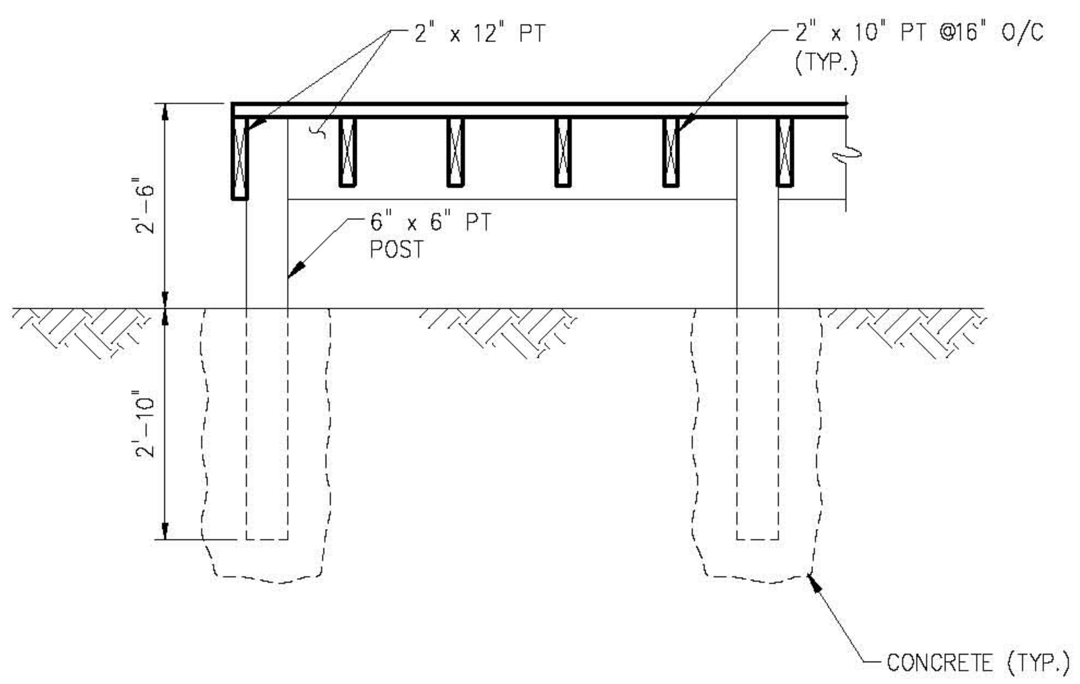
PNRS II STRUCTURAL SITE PLAN AND DETAILS

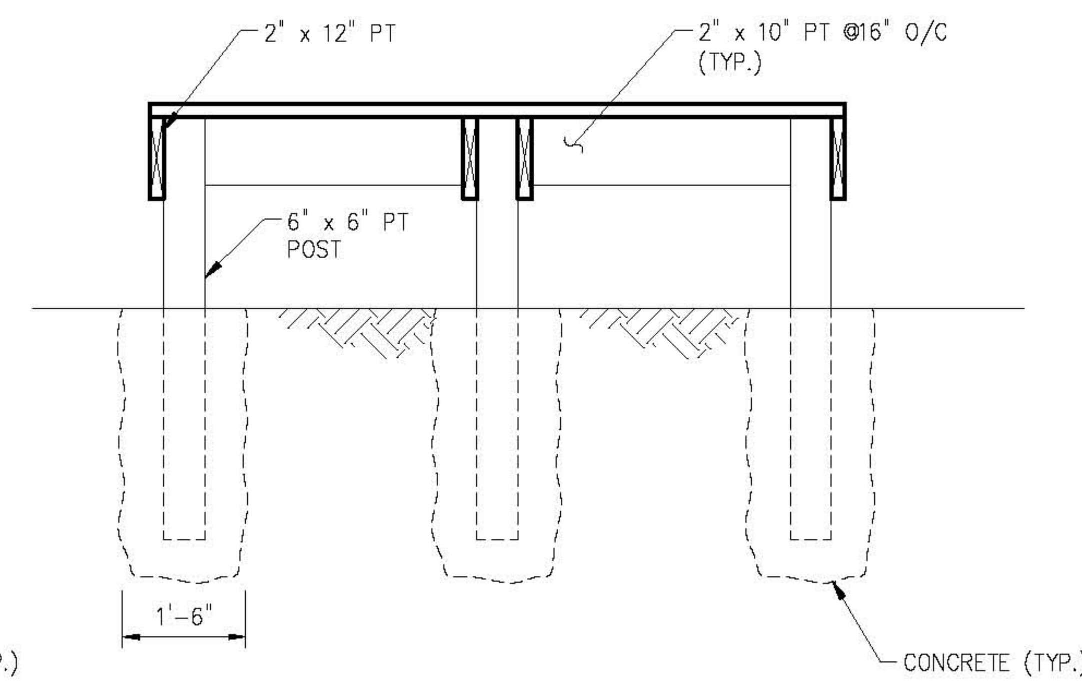
THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER S-2

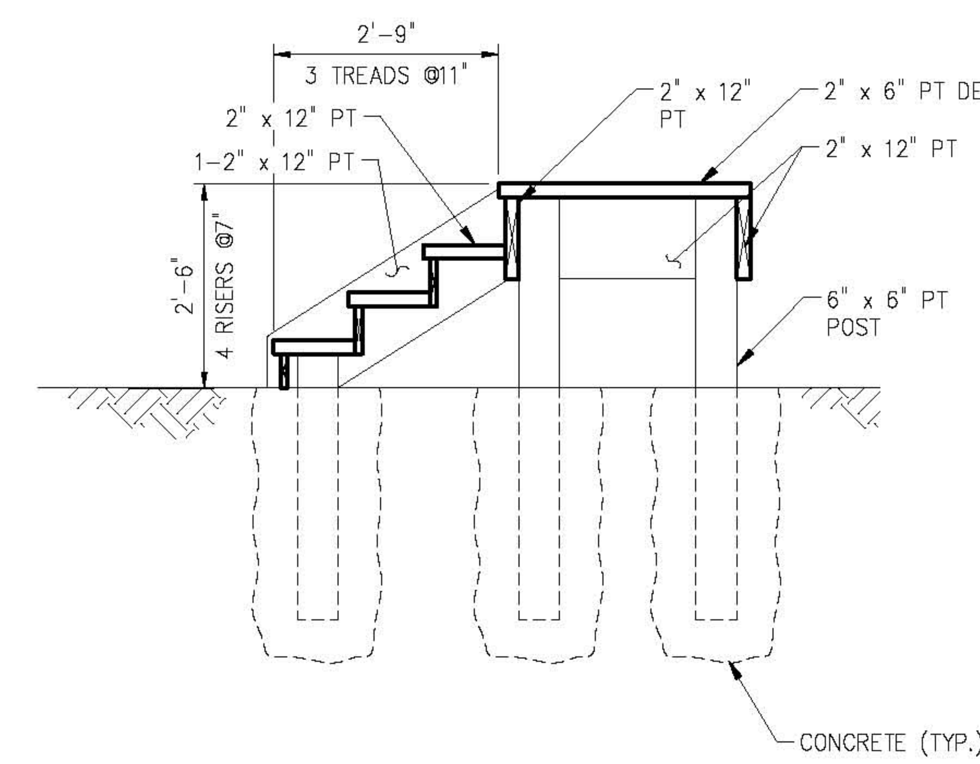
PLOT DATE: 12/21/2009 2:58 PM BY: CSCOTT



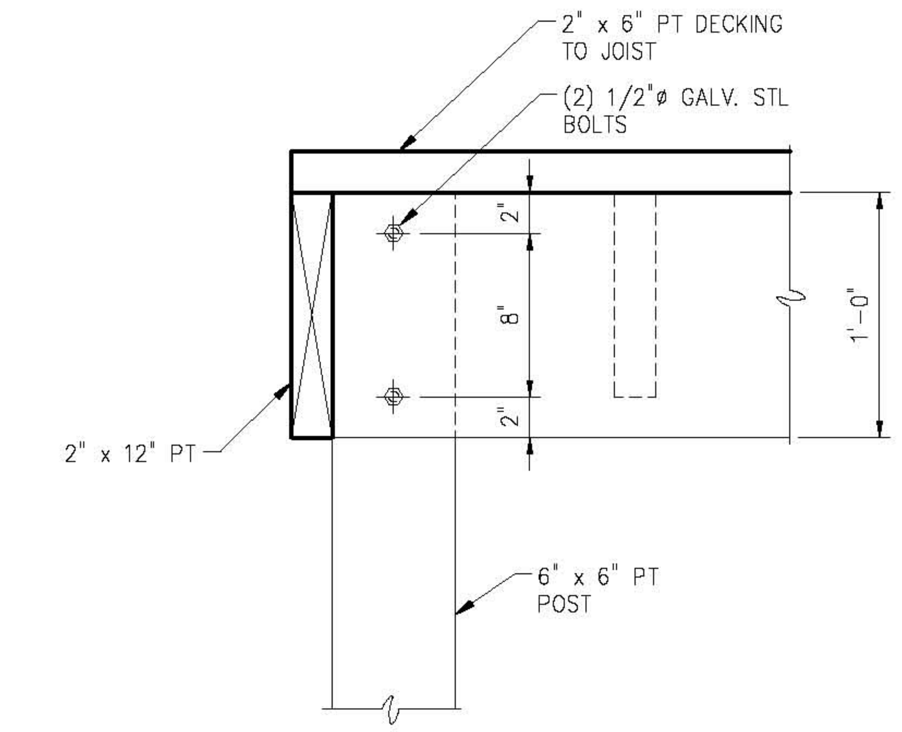
SECTION A
1/2"=1'-0"



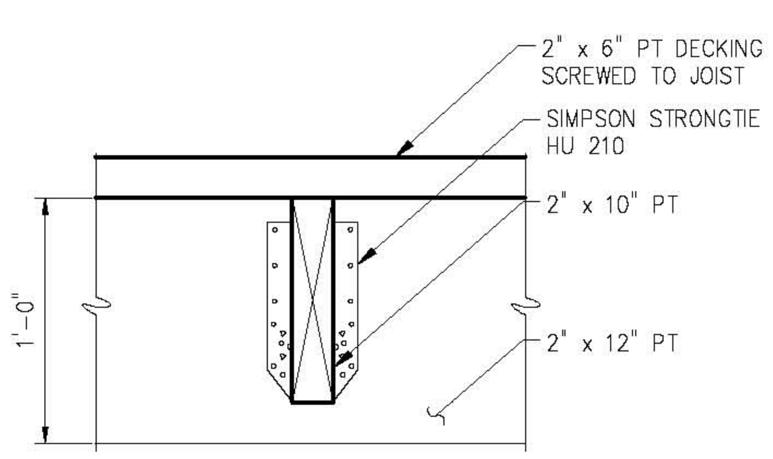
SECTION B
1/2"=1'-0"



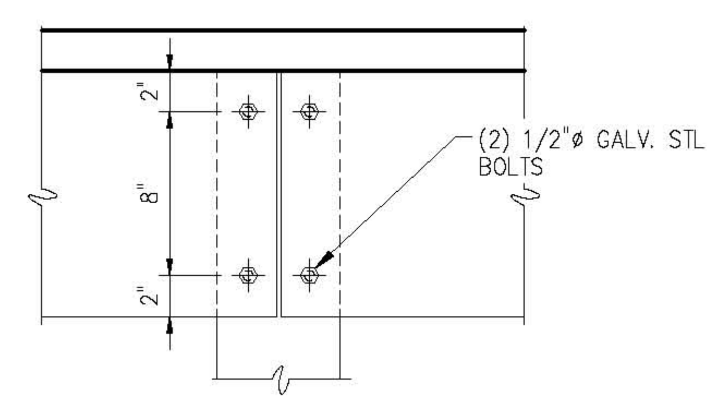
SECTION C
1/2"=1'-0"



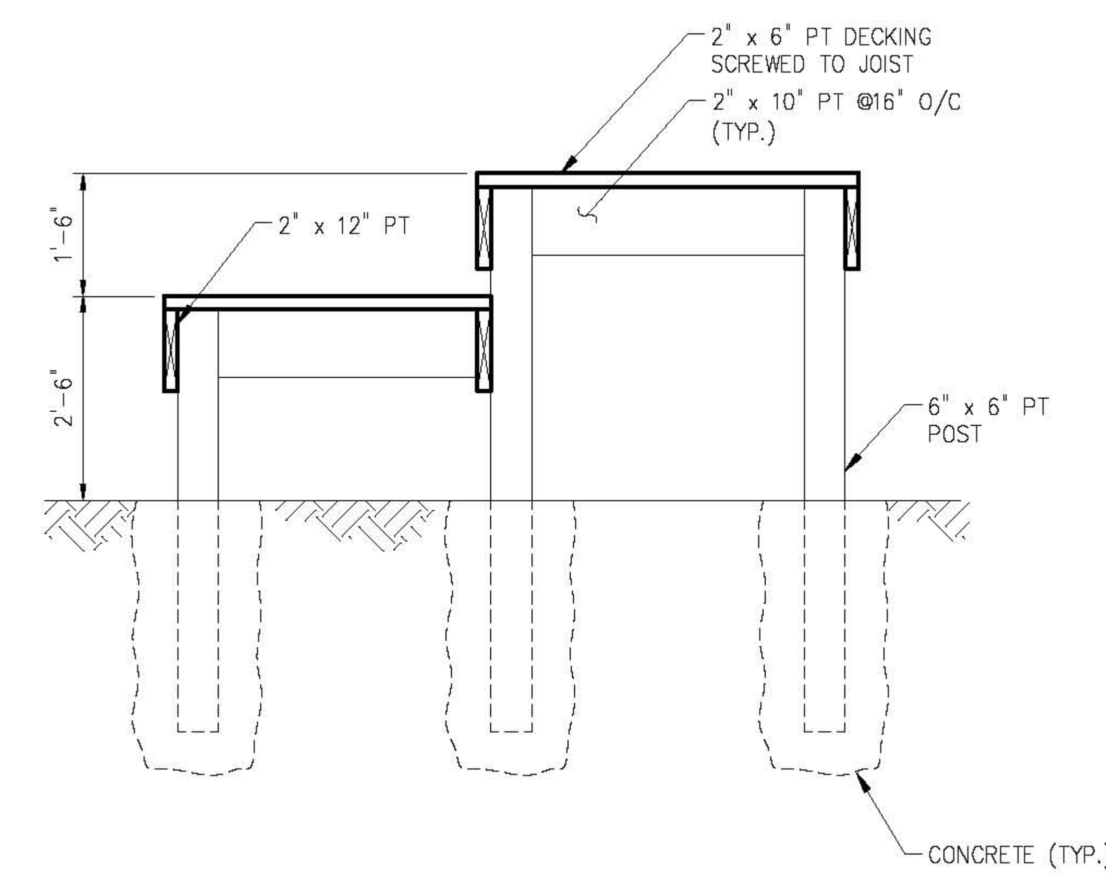
SECTION D
1-1/2"=1'-0"



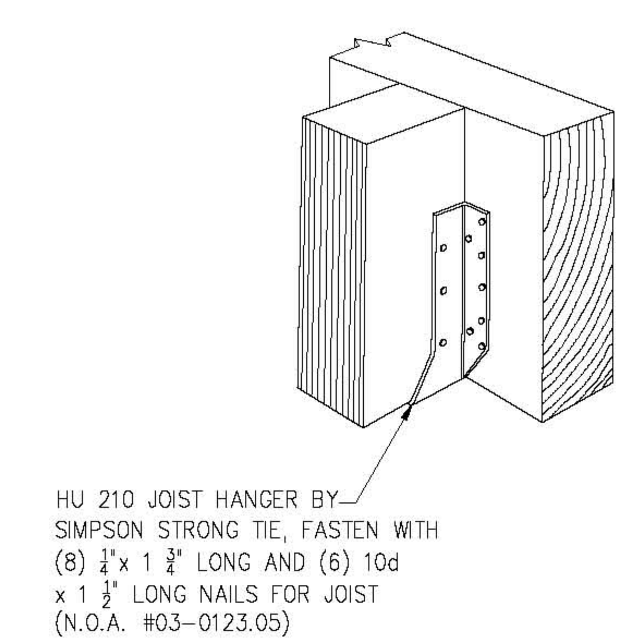
SECTION E
1-1/2"=1'-0"



SECTION F
1-1/2"=1'-0"



SECTION G
1/2"=1'-0"



DETAIL 1
N.T.S.

1 1/2"=1'-0" (4" 0 1')

1/2"=1'-0" (12" 0 1 3')

NO.	ISSUED FOR	DATE	BY
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2	75% SUBMITTAL	12/09	–
1	50% SUBMITTAL	08/09	–

DESIGNED A.V.F.
DRAWN G.P.B.
CHECKED A.F.H.
PROJ. ENGR. S.J.
APPROVED

Name: SHAJAN JOYKUTTY, PE Date:
Florida Professional Engineer's Registration Number: 43323

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FLORIDA DEPARTMENT OF HEALTH
FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATIGIES STUDY

PNRS II STRUCTURAL SITE PLAN AND DETAILS

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
H & S JOB NUMBER 44237–001
CONTRACT NUMBER
DRAWING NUMBER S–3

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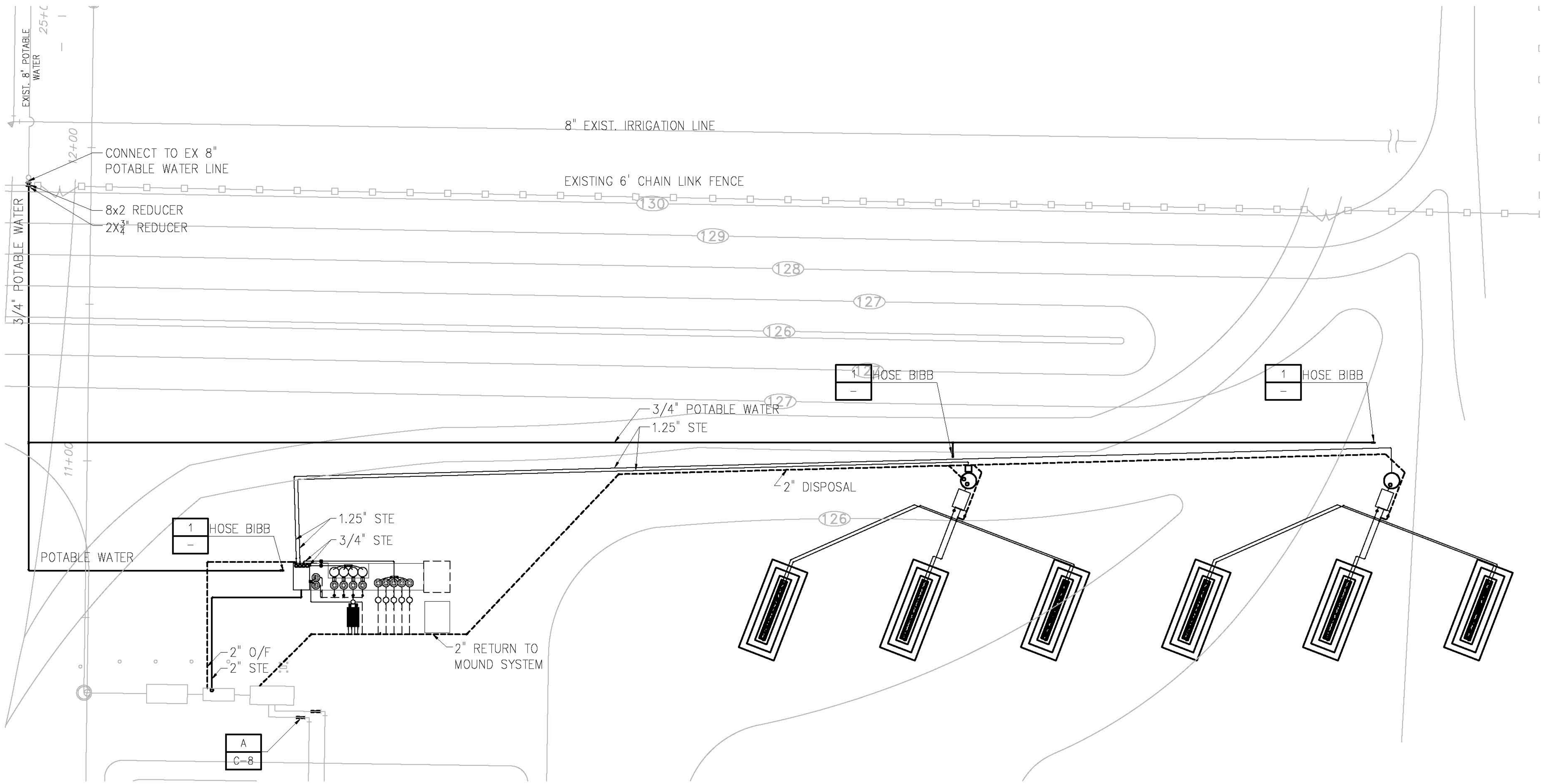
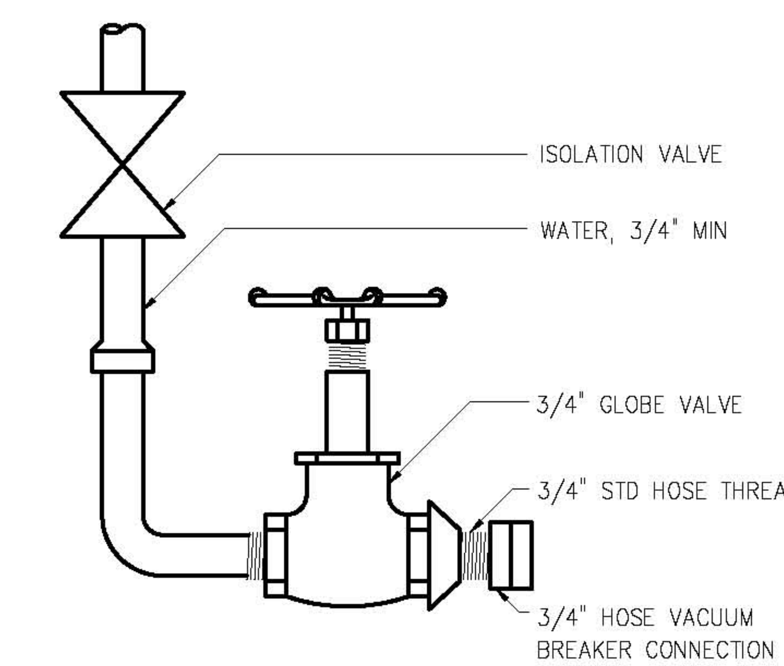


YARD PIPING PLAN

1"=20'



HOSE BIBB

DETAIL 1 – NTS

NOTES

1. ALL YARD PIPING, UNLESS OTHERWISE SHOWN SHALL BE SOLVENT WELDED PVC LAID AT EXISTING SITE GRADE AND COVERED WITH FILL MATERIAL.

   PVC PIPING SHALL BE LAID WHERE POSSIBLE IN COMMON TRENCHES AND MARKED WITH PIPE NUMBERS IN PERMANENT MARKINGS AT 10' INTERVALS.

2. MAINTAIN SLOPE AND GRADE OF GRAVITY LINES AS INDICATED ON THE DRAWINGS.

1"=20'-0" 20 10 0 20'

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FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATIGIES STUDY

YARD PIPING PLAN

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER M-1

ELECTRICAL NOTES

COORDINATE LOCATIONS OF ELECTRICAL EQUIPMENT, DEVICES, OUTLETS, FIXTURES, ETC. WITH CIVIL, STRUCTURAL, MECHANICAL, AND INSTRUMENTATION DRAWINGS PRIOR TO ROUGH-IN WORK. DO NOT SCALE ELECTRICAL

ALL WIRE SHALL BE COPPER.

PROVIDE INSULATED GROUNDING CONDUCTOR FROM EACH EQUIPMENT CONNECTION AND OUTLET TO GROUNDING BAR IN PANELBOARDS.

PROVIDE AN INSULATED GROUNDING CONDUCTOR IN ALL FEEDER AND BRANCH CIRCUITS.

CONTRACTOR SHALL PROVIDE ADDITIONAL JUNCTION BOXES, CONDUCTORS AND OTHER MATERIALS AND LABOR NECESSARY TO CONNECT PARALLEL FEEDER RUNS WHERE SUCH FEEDERS EXCEED CONNECTION CAPACITY OF CIRCUIT BREAKERS, PANELBOARDS AND OTHER CONNECTION POINTS.

RISER DIAGRAMS SHOW ONLY THE GENERAL CONFIGURATION OF THE SYSTEM. REFER TO THE APPROPRIATE DRAWINGS FOR EXACT DEVICE, QUANTITIES AND LOCATIONS.

ALL ELECTRICAL EQUIPMENT, DEVICES, ETC. LOCATED OUTDOORS SHALL BE WEATHERPROOF.

REFER TO STRUCTURAL DRAWINGS FOR CONCRETE WORK.

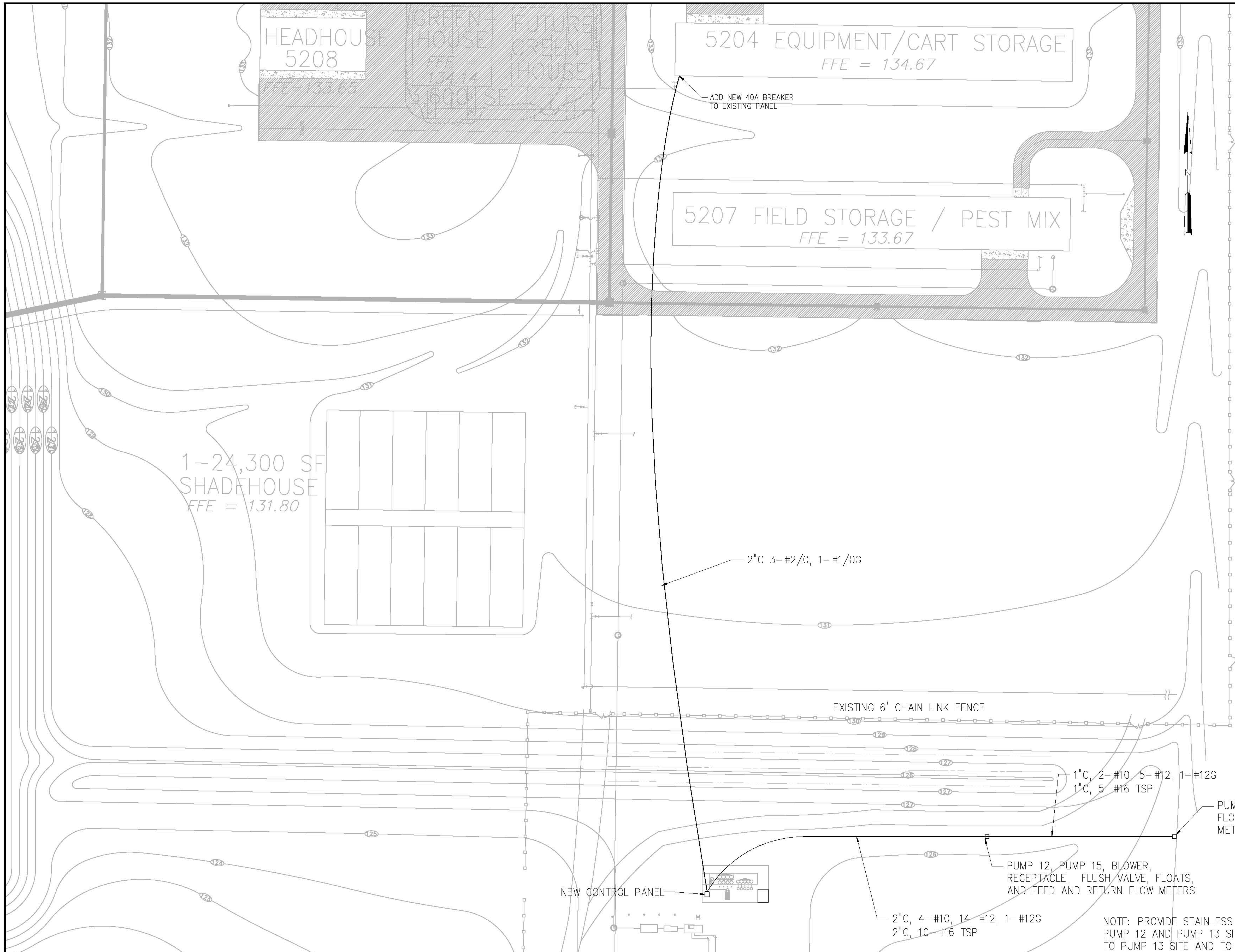
EXISTING UTILITIES AND OTHER UNDERGROUND OR CONCEALED ITEMS ARE SHOWN FOR REFERENCE ONLY. ADDITIONAL ITEMS NOT SHOWN MAY BE PRESENT AND LOCATIONS MAY DIFFER FROM THAT SHOWN. CONTRACTOR SHALL EXCAVATE AND CONDUCT DEMOLITION SO AS TO AVOID DAMAGE TO EXISTING ITEMS, SHALL NOTIFY OWNER AND ENGINEER AT ONCE OF ALL DAMAGE AND SHALL REPAIR DAMAGE TO ORIGINAL CONDITION TO THE SATISFACTION OF OWNER AND ENGINEER AT NO CHANGE IN CONTRACT AMOUNT.

ELECTRICAL SPECIFICATIONS

1. THE CONTRACTOR SHALL FURNISH ALL LABOR, MATERIALS AND EQUIPMENT NECESSARY FOR THE INSTALLATION OF A COMPLETE ELECTRICAL SYSTEM AS INDICATED WITHIN THESE DRAWINGS.
2. ALL WORK SHALL BE INSTALLED IN STRICT ACCORDANCE WITH ALL APPLICABLE CODES AND ORDINANCES AND WITH MANUFACTURERS RECOMMENDATIONS. ALL WORK, MATERIALS AND EQUIPMENT SHALL COMPLY WITH THE NATIONAL ELECTRICAL CODE 2002 EDITION.
3. ALL MATERIALS AND EQUIPMENT SHALL BE INSTALLED IN A NEAT, FIRST CLASS, WORKMANLIKE MANNER, TO THE APPROVAL OF THE ENGINEER AND GOVERNING AUTHORITIES.
4. GUARANTEES AND SERVICE: IN ADDITION TO THE MANUFACTURERS STANDARD GUARANTEES, THE CONTRACTOR SHALL GUARANTEE ALL MATERIALS, EQUIPMENT AND WORKMANSHIP AGAINST DEFECTS FOR ONE YEAR FROM THE DATE OF FINAL ACCEPTANCE, AND SHALL CORRECT ANY DEFECTS AT NO ADDITIONAL COST TO THE OWNER. ALL LAMPS SHALL BE GUARANTEED FOR 30 DAYS.
5. CONDUIT AND WIRING: THE CONTRACTOR SHALL PROVIDE COPPER CONDUCTORS IN METALLIC RACEWAY. CONDUITS SHALL CONTAIN AN INSULATED GREEN GROUND CONDUCTOR. FOLLOW RULES AND REGULATIONS OF THE NEC FOR PROPER INSTALLATION REGARDING INSTALLATION AND SUPPORT.

   CONDUIT SHALL BE INSTALLED AS NOTED. IF NOT SPECIFICALLY ADDRESSED THE FOLLOWING SHALL APPLY: (A) PROVIDE RIGID ALUMINUM IN EXPOSED LOCATIONS, (B) PROVIDE PVC (POLY VINYL CHLORIDE) UNDERGROUND. (C) PROVIDE LIQUID-TITE FLEXIBLE METALLIC CONDUIT FOR EQUIPMENT CONNECTIONS WHERE POSSIBILITY OF VIBRATION EXISTS. PROVIDE FITTINGS AS MANUFACTURED FOR CONDUIT USED.

   PROVIDE COPPER CONDUCTORS WITH DUAL RATED THWN-THHN TYPE INSULATION.



NOTE: PROVIDE STAINLESS STEEL JUNCTION BOXES AT PUMP 12 AND PUMP 13 SITES TO CONTINUE CONDUITS ON TO PUMP 13 SITE AND TO CONNECT TO COMPONENTS AT EACH SITE. MOUNT RECEPTACLE 2 FEET ABOVE GRADE ADJACENT TO TANK.

ELECTRICAL SITE PLAN
1"=40'

NO.	ISSUED FOR	DATE	BY
3	100% SUBMITTAL	12/09	–
2	75% SUBMITTAL	12/09	–
1	50% SUBMITTAL	08/09	–

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PROJ. ENGR. –
–.
APPROVED

–
Name: Date:
Florida Professional Engineer's Registration Number: –

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ELECTRICAL SITE PLAN

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER E-1

PLOT DATE: 12/31/2009 2:59 PM BY: CSCOTT

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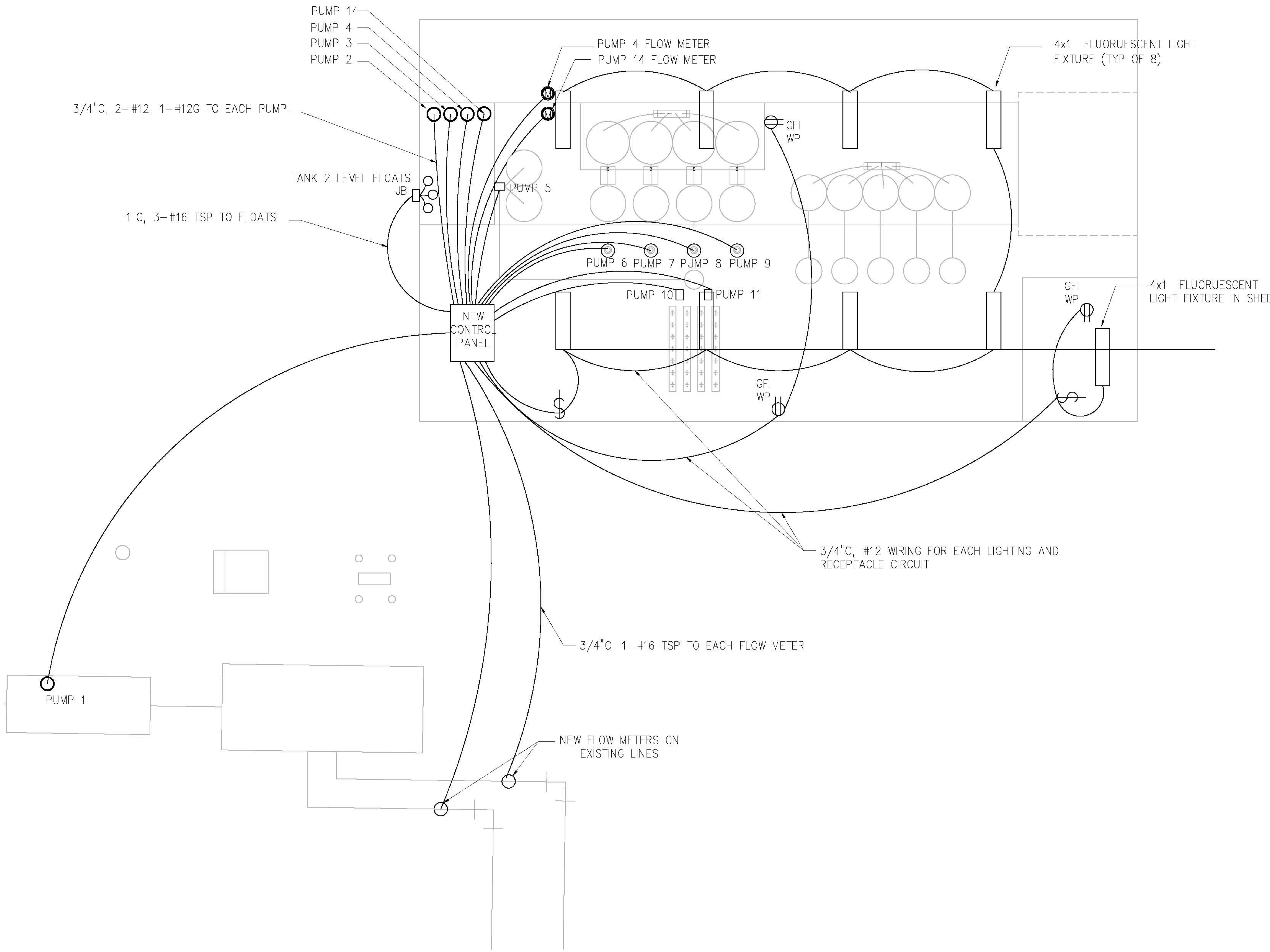

ELECTRICAL SITE PLAN

1/4"=1'-0"

NO.	ISSUED FOR	DATE	BY
3	100% SUBMITTAL	12/09	–
2	75% SUBMITTAL	12/09	–
1	50% SUBMITTAL	08/09	–

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ELECTRICAL SITE PLAN AND DETAILS

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
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CONTRACT NUMBER
DRAWING NUMBER E-2

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PANEL POWER

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER I-1

WIRING SPECIFICATIONS:

AC WIRING

POWER
HOT-12AWG THHN BLACK
NEUTRAL-12AWG THHN WHITE
GROUND-12AWG THHN GREEN

CONTROL
IN PANEL-16AWG MTW RED
FIELD-16AWG THHN RED

FIELD
FIELD POWERED CONTROL
(CONTROL WIRING THAT IS HOT WHEN MAIN DISCONNECT IS OPENED) .- 14AWG MTW- YELLOW

SIGNAL
IN PANEL-16AWG. TWISTED PAIR (BLUE/GRAY)
FIELD-16AWG. TWISTED SHIELDED PAIR (BLACK/CLEAR)

DC WIRING

POWER
24V(+)-16AWG MTW PURPLE
24V(-)-16AWG MTW ORANGE

CONTROL
16AWG MTW BLUE

NO.	ISSUED FOR	DATE	BY
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2	75% SUBMITTAL	12/09	–
1	50% SUBMITTAL	08/09	–

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FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATIGIES STUDY

DI MODULE 1

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
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DRAWING NUMBER I-2

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APPROVED

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FLORIDA DEPARTMENT OF HEALTH
FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATIGIES STUDY

DI MODULE 2

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER I-3

NO.	ISSUED FOR	DATE	BY
3	100% SUBMITTAL	12/09	–
2	75% SUBMITTAL	12/09	–
1	50% SUBMITTAL	08/09	–

DESIGNED –
DRAWN –
CHECKED –
PROJ. ENGR. –
APPROVED –.

Name: Date:
Florida Professional Engineer's Registration Number: –

HAZEN AND SAWYER
Environmental Engineers & Scientists
10002 Princess Palm Avenue
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Certificate of Authorization Number: 2771

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DI MODULE 3

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER I-4

PLOT DATE: 12/31/2009 3:00 PM BY: CSCOTT

NO.	ISSUED FOR	DATE	BY
3	100% SUBMITTAL	12/09	–
2	75% SUBMITTAL	12/09	–
1	50% SUBMITTAL	08/09	–

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CONTRACT NUMBER
DRAWING NUMBER I-5

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DO MODULE 2

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DATE DECEMBER 2009
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER I-6

PLOT DATE: 12/31/2009 3:00 PM BY: CSCOTT

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2	75% SUBMITTAL	12/09	–
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PANEL ELEVATIONS

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE DECEMBER 2009
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER I-7

PLOT DATE: 12/21/2009 3:06 PM BY: CSCOTT

BILL OF MATERIALS

ITEM	QTY	DESCRIPTION	MFR	PART NO.
1	1	ENCLOSURE, 74" X 36" X 24", NEMA 4X, 316 S.S.	HOFFMAN	A-74H3624SSLP
	1	INNER PANEL, 68" X 33"	HOFFMAN	TBD
	2	INNER PANEL, 68" X 20"	HOFFMAN	TBD
	1	DEAD FRONT PANEL DOOR	HOFFMAN	TBD
	1	PRINT POCKET	HOFFMAN	TBD
	9	QUICK RELEASE LATCHES	HOFFMAN	TBD
	1	PAD LOCKABLE HASP	HOFFMAN	TBD
2	2	FLUORESCENT LIGHT KIT	HOFFMAN	X-LF116D18
3	A/R	WIREWAY (SIZED AS SHOWN)	PANDUIT	- - - - - -
4		PLC CONSISTING OF:		
	1	13 SLOT CHASSIS, SLC 500	ALLEN BRADLEY	1746-A13
	1	POWER SUPPLY, 24VDC	ALLEN BRADLEY	1746-P3
	1	SLC 5/05 PROCESSOR	ALLEN BRADLEY	1747-L552
	3	16-POINT DISCRETE INPUT MODULE	ALLEN BRADLEY	1746-IB16
	2	16-POINT DISCRETE OUTPUT MODULE	ALLEN BRADLEY	1746-OW16
	11	CARD SLOT FILLER	ALLEN BRADLEY	1746-N2
	1	COMMUNICATIONS CARD	ALLEN BRADLEY	TBD
5		NOT USED		
6		TBP CONSISTING OF (TAG "TBP"):		
	5	TERMINAL BLOCK	ALLEN BRADLEY	1492-W4
	3	GROUND TERMINAL BLOCK	ALLEN BRADLEY	1492-WG4
	2	FUSED TERMINAL BLOCK, W/BLOWN FUSE INDICATOR	ENTRELEC	111 043.15
	2	FUSE INDICATOR	ENTRELEC	167 075.25
	6	FUSE, 1 AMP (TAG "FU-XX")	LITTLEFUSE	313001
	18	FUSE, 5 AMP (TAG "FU-XX")	LITTLEFUSE	313005
	1	JUMPER BAR	ENTRELEC	173 510.20
	1	END PLATE	ENTRELEC	118 503.27
	2	END CLAMP	ALLEN BRADLEY	1492-EA35
	1	PARTITION PLATE	ALLEN BRADLEY	1492-PP3
	2	CIRCUIT BREAKER, 15 AMP, SINGLE-POLE (TAG "CB-X")	SQUARE-D	QUO-115B
	1	CIRCUIT BREAKER, 30 AMP, SINGLE-POLE (TAG "CB-X")	SQUARE-D	QUO-130B
7		TB1 CONSISTING OF (TAG "TB1"):		
	24	SIGNAL SURGE SUPPRESSER (TAG "SP-X")	EDCO	TBD
8		TB2 CONSISTING OF (TAG "TB2"):		
	145	TERMINAL BLOCK (NUMBERED BLOCKS)	ALLEN BRADLEY	1492-W4
	1	END PLATE	ALLEN BRADLEY	1492-EB3
	2	END CLAMP	ALLEN BRADLEY	1492-EA35
9		TB3 CONSISTING OF (TAG "TB3"):		
	2	END PLATE	ALLEN BRADLEY	1492-EB3
	4	END CLAMP	ALLEN BRADLEY	1492-EA35
	34	RELAY, 120VAC, 2PDT (TAG "CR-XX")	IDEC	RH2B-UL-AC120V
	34	RELAY SOCKET	IDEC	SH2B-05
10	1	POWER LINE PROTECTOR (TAG "PANEL SURGE PROTECTOR")	EDCO	EMC-240B
11		GROUND BUS CONSISTING OF:		
	1	BUS BAR	WEIDMULLER	34890
	30	SMALL TYPE CLAMP	WEIDMULLER	31650
	2	LARGE TYPE CLAMP	WEIDMULLER	31660
	2	END COVER	WEIDMULLER	29986
12	1	POWER SUPPLY, 24VDC, 10A (TAG "DC POWER SUPPLY")	MEAN WELL	S-240-24
13	2	GFCI DUPLEX RECEPTACLE W/FACE PLATE	PASS&SEYMOUR	1591
	2	SINGLE GANG BOX	STEEL CITY	5836 1 1/2
14	1	UNINTERRUPTIBLE POWER SUPPLY	LIEBERT	POWERSURE 700

BILL OF MATERIALS (CONT'D)

ITEM	QTY	DESCRIPTION	MFR	PART NO.
15	1	PANEL NAMEPLATE (SEE SCHEDULE TO RIGHT)	TDC	CUSTOM
16	1	SIMPLEX RECEPTACLE W/FACE PLATE	HUBBELL	5261
	1	SINGLE GANG BOX	STEEL CITY	5836 1 1/2
17	1	WIRELESS MODEM	TBD	TBD
18	1	MOUNTING BRACKET	-	CUSTOM
19	1	UPS SHELF	-	CUSTOM
20	1	24VDC POWER SUPPLY MTG. BRACKET	-	CUSTOM
21	1	EDCO AC SURGE PROTECTOR MTG. BRACKET	-	CUSTOM
22	1	3-POSITION SELECTOR SWITCHES (ON DEAD FRONT)	A/B	BULLETIN 800
23	1	CLOSED-LOOP PANEL A/C UNIT	MC CLEAN	TBD

PANEL TAG SCHEDULE

FIRST LINE	SECOND LINE	TYPE	SIZE
PER BOM	PER BOM (IF NEEDED)	WHT W/BLK LETTERS	1/2" x 1" (MIN)

PANEL TAGS
MATERIAL : ADHESIVE BACK, LAMINATED PLASTIC.
LETTERS : 1/4-INCH MINIMUM, HELVETICA MEDIUM, UNLESS OTHERWISE NOTED.

PANEL NAMEPLATE

TYPE	BLK W/WHT LETTERS
SIZE	1" X 3"
1ST.LINE	FDOH DEMONSTRATION PROJECT
2ND.LINE	CONTROL PANEL

PANEL NAMEPLATE
MATERIAL : ADHESIVE BACK, LAMINATED PLASTIC.
LETTERS : 1/2-INCH HELVETICA MEDIUM

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BILL OF MATERIALS

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DATE DECEMBER 2009
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER I-8

PLOT DATE: 12/31/2009 3:00 PM BY: CSCOTT

FUNCTIONAL CONTROL DESCRIPTIONS

1.01 THE REQUIREMENT

A. Furnish, test, install and place in satisfactory operation all PLC control strategies, operator interface programming, and related programming as noted herein.

B. The PLC programming and operator interface is to be fully tested at the manufacturer's shop prior to shipping. Once delivered, the programming is to be checked out prior to operation of the system and is to be demonstrated to the Engineer that the programs perform all functions as intended.

C. All control functions are to be performed by the PLC. The operator interface is to be used for manual override of equipment, adjustment of setpoints, and to download stored data from the PLC.

1.02 OPERATOR INTERFACE

A. The PLC shall communicate wirelessly with a laptop computer which shall function as the operator interface. The laptop computer shall be supplied with the PLC control panel and be set up to provide full access to the PLC for operator manual override of all equipment, ability to make adjustments to setpoints, download stored data from the PLC, and make modifications to the PLC program itself as needed.

B. The PLC shall include a data storage module capable of storing up to a month of data as described herein. The operator interface laptop will be used to download the data on a periodic basis. Data shall be transferable in MS Excel spreadsheet format.

C. The following displays shall be created and stored on the laptop for operator interface:

Menu Bar – menu bar across the top of each display to provide quick access to any display.

Control Display – tabular display of all pumps, blower, and valves. For each device, provide an ON / OFF / AUTO button (OPEN / CLOSE / AUTO for valves) for point and click control of the equipment. For each device, provide a RED run indicator (open indicator for valves) that is grey when not running (or valve closed). For each pump and blower, provide the totalized runtime value calculated by the PLC (in hours and tenths of hours up to 999,999.9). For each pump with an associated flow meter, provide the totalized flow value calculated by the PLC. For each pump, blower, or valve on timer control, provide indication of time remaining until (or time HH:MM of) next start or, if running, time remaining until the equipment stops (or closes). For each pump whose normal sequence can be interrupted, provide indication of the override (low level shutoff or Pump "X" running interrupt).

Setpoint Display – tabular display(s) for all control setpoints as described herein with simple point and click access to each setpoint that allows value changes by typing in a numeric value and pressing the ENTER key.

Timer Setpoint Display – For all timer setpoints, provide a 24-hour, bar graph format display to show the relative on and off times of each pump and blower.

1.03 PUMP 1 – EXISTING SEPTIC TANK 2 to STE STORAGE TANK 1

A. Control Description: Pump shall start on LOW level in STE STORAGE TANK 1 and stop on HIGH level in STE STORAGE TANK 1. If PUMP 13 is running as part of its normal timed sequence, delay start of PUMP 1 until that sequence is complete.

B. Data Storage: Record totalized runtime, daily pump runtime, and number of starts per day.

1.04 PUMP 2 – STE STORAGE TANK 1 TO ste drip storage tank 5

A. Control Description: Pump shall start on LOW level in STE DRIP STORAGE TANK 5 and stop on HIGH level in STE DRIP STORAGE TANK 5. Pump shall stop on LOW LOW level in STE STORAGE TANK 1 and remain off until LOW level in STE STORAGE TANK 1 is reached. If PUMP 14 is running as part of its normal timed sequence, delay start of PUMP 2 until that sequence is complete.

B. Data Storage: Record totalized runtime, daily pump runtime, and number of starts per day.

1.05 PUMP 3 – STE STORAGE TANK 1 TO NITRIFICATION UNIT

A. Control Description: Pump shall start up to 8 times a day and run for a set amount of time. Provide 8 individual start times based on a 24-hour clock format (HH:MM). Provide 1 global cycle duration timer for all 8 start times. The 8 start times and the 1 cycle duration time setpoint shall be adjustable from the operator interface. Pump shall stop on LOW LOW level in STE STORAGE TANK 1 and remain off until LOW level in STE STORAGE TANK 1 is reached.

B. Data Storage: Record totalized runtime and daily pump runtime.

1.06 PUMP 4 – STE STORAGE TANK 1 TO Hydrosplitter System 1

A. Control Description: Pump shall start a set number of times a day (up to 24 times) and run for a set amount of time. The number of start times a day and the cycle duration time setpoint shall be adjustable from the operator interface. The PLC shall divide the number of start times a day entered into 1,440 minutes (24 hours) to determine the start times of the pump starting from midnight. For example, if 18 times a day were selected, the pumps would start every 80 minutes (00:00, 01:20, 02:40 .... 21:20, 22:40). For uneven values, the PLC shall round to the nearest minute. Pump shall stop on LOW LOW level in STE STORAGE TANK 1 and remain off until LOW level in STE STORAGE TANK 1 is reached.

B. Data Storage: Record totalized runtime and daily pump runtime. Receive pulse input from flow meter and record totalized daily volume pumped. One pulse equals one gallon.

1.07 PUMP 5 – STE STORAGE TANK 1 TO in-situ system

A. Control Description: Pump shall start up to 6 times a day and run for a set amount of time. Provide 6 individual start times based on a 24-hour clock format (HH:MM). Provide 1 global cycle duration timer for all 6 start times. The 6 start times and the 1 cycle duration time setpoint shall be adjustable from the operator interface.

B. Data Storage: Record totalized runtime and daily pump runtime. Calculate totalized daily volumes pumped based on pump flow rate entered by operator (calculated from pump maximum capacity, frequency, and stroke length set at pump).

1.08 PUMPS 6 through 9 – Hydrosplitter System 2 Recirculation pumps

A. Control Description: Pumps shall start when PUMP 14 starts and each pump shall run for a set amount of time. Provide 1 global cycle duration timer for all 4 pumps. The cycle duration time setpoint shall be adjustable from the operator interface.

B. Data Storage: Record totalized runtime and daily pump runtimes.

1.09 PUMPS 10 and 11 – Denite Feed from Tank 3

A. Control Description: Each pump shall start a set number of times a day (up to 24 times) and run for a set amount of time. The number of start times a day and the cycle duration time setpoint shall be adjustable from the operator interface and both pumps shall run off these same setpoints. The PLC shall divide the number of start times a day entered into 1,440 minutes (24 hours) to determine the start times of the pump starting from 15 minutes after midnight. For example, if 13 times a day were selected, the pumps would start every 110.77 minutes (00:15, 02:06, 03:57 .... 20:33, 22:24). For uneven values, the PLC shall round to the nearest minute as indicated in example.

B. Data Storage: Record totalized runtime and daily pump runtimes. Calculate totalized daily volumes pumped based on pump flow rate entered by operator (calculated from pump maximum capacity, frequency, and stroke length set at pump).

1.10 PUMP 12 – NO3 DRIP STORAGE TANK 4 TO NO3 DRIP System

A. Control Description: Pump shall start up to 6 times a day and run for a set amount of time. Provide 6 individual start times based on a 24-hour clock format (HH:MM). Provide 1 global cycle duration timer for all 6 start times. The 6 start times and the 1 cycle duration time setpoint shall be adjustable from the operator interface. Pump shall stop on LOW LOW level in NO3 DRIP STORAGE TANK 4 and remain off until LOW level in NO3 DRIP STORAGE TANK 4 is reached. Pump shall also start with flush cycle (see VALVE 1 controls).

B. Data Storage: Record totalized runtime. Record separate daily runtimes for the timed sequence described above and for the flush sequence. Receive pulse inputs from the supply and return flow meters and record totalized daily volume pumped as supply only (subtract return flow from supply flow). One pulse equals one gallon.

1.11 PUMP 13 – STE DRIP STORAGE TANK 5 TO STE DRIP System

A. Control Description: Pump shall start up to 6 times a day and run for a set amount of time. Provide 6 individual start times based on a 24-hour clock format (HH:MM). Provide 1 global cycle duration timer for all 6 start times. The 6 start times and the 1 cycle duration time setpoint shall be adjustable from the operator interface. Pump shall stop on LOW LOW level in STE DRIP STORAGE TANK 5 and remain off until LOW level in STE DRIP STORAGE TANK 5 is reached. Pump shall also start with flush cycle (see VALVE 2 controls).

B. Data Storage: Record totalized runtime. Record separate daily runtimes for the timed sequence described above and for the flush sequence. Receive pulse inputs from the supply and return flow meters and record totalized daily volume pumped as supply only (subtract return flow from supply flow). One pulse equals one gallon.

1.12 PUMP 14 – STE STORAGE TANK 1 TO Hydrosplitter System 2

A. Control Description: Pump shall start a set number of times a day (up to 24 times) and run for a set amount of time. The number of start times a day and the cycle duration time setpoint shall be adjustable from the operator interface. The PLC shall divide the number of start times a day entered into 1,440 minutes (24 hours) to determine the start times of the pump starting from 30 minutes after midnight. For example, if 16 times a day were selected, the pumps would start every 90 minutes (00:30, 02:00, 03:30 .... 21:30, 23:00). For uneven values, the PLC shall round to the nearest minute. Pump shall stop on LOW LOW level in STE STORAGE TANK 1 and remain off until LOW level in STE STORAGE TANK 1 is reached.

B. Data Storage: Record totalized runtime and daily pump runtime. Receive pulse input from flow meter and record totalized daily volume pumped. One pulse equals one gallon.

1.13 PUMP 15 – NO3 DRIP STORAGE TANK 4 TO GRAVITY SUMP

A. Control Description: Pump shall start on HIGH level in NO3 DRIP STORAGE TANK 4 and stop on LOW level in NO3 DRIP STORAGE TANK 4. If PUMPs 3 or 13 are running as part of their normal timed sequences, delay start of PUMP 15 until those sequences are complete.

B. Data Storage: Record totalized runtime, daily pump runtime, and number of starts per day.

1.14 BLOWER – NO3 SYSTEM

A. Control Description: Blower shall start based on a repeat cycle ON / OFF timer. Separate ON and OFF times, in minutes, shall be provided that are adjustable from the operator interface. If 0 minutes are entered for ON time, the blower shall never run. If 0 minutes are entered for OFF time, the blower shall run continuously.

B. Data Storage: Record totalized runtime.

1.15 VALVE 1 – NO3 DRIP System FLUSH

A. Control Description: Once per day, as determined by a flush time setting (HH:MM), the valve shall open. Once the valve is confirmed open, Pump 12 shall start and run for a set amount of time. Once timed out, the pump shall stop first, then the valve shall be closed. If Pump 12 is already running as part of its normal timed sequence, start of the flush cycle shall be delayed until that sequence is complete and the pump has shut off. The flush start time and cycle duration setpoint shall be adjustable from the operator interface.

1.16 VALVE 2 – STE DRIP System Flush

A. Control Description: Once per day, as determined by a flush time setting (HH:MM), the valve shall open. Once the valve is confirmed open, Pump 13 shall start and run for a set amount of time. Once timed out, the pump shall stop first, then the valve shall be closed. If Pump 13 is already running as part of its normal timed sequence, start of the flush cycle shall be delayed until that sequence is complete and the pump has shut off. The flush start time and cycle duration setpoint shall be adjustable from the operator interface.

1.17 POWER DISTRIBUTION CALCULATION

A. Control Description: Odd numbered pumps 1-15 and Valve 1 are powered from one pole of the main power feed to the panel. Even numbered pumps, the blower, and Valve 2 are powered from the other pole. Pumps 1, 12, and 13 draw 11 amps. Pumps 2, 3, 4, 6, 7, 8, 9, 14, and 15 draw 5 amps. Pumps 5, 10, and 11, the blower, and the two valves draw less than 1 amp. Logic described above for permissives and selected time settings should minimize the number of pumps running at one time. However, the PLC shall calculate the estimated amp draw (sum of the values listed above) for each pole for the equipment running at any time. If the estimated value exceeds 30 amps, the PLC shall delay start of any additional equipment until the amp draw decreases below 30 amps.

B. Data Storage: Record highest estimated daily amp draw.

1.18 TIME OF DAY RESET

A. Control Description: Provide means for operator to enter the hour and minute of the day and then reset the PLC clock to match this time. Display of actual PLC time is to be shown on the Control Display.

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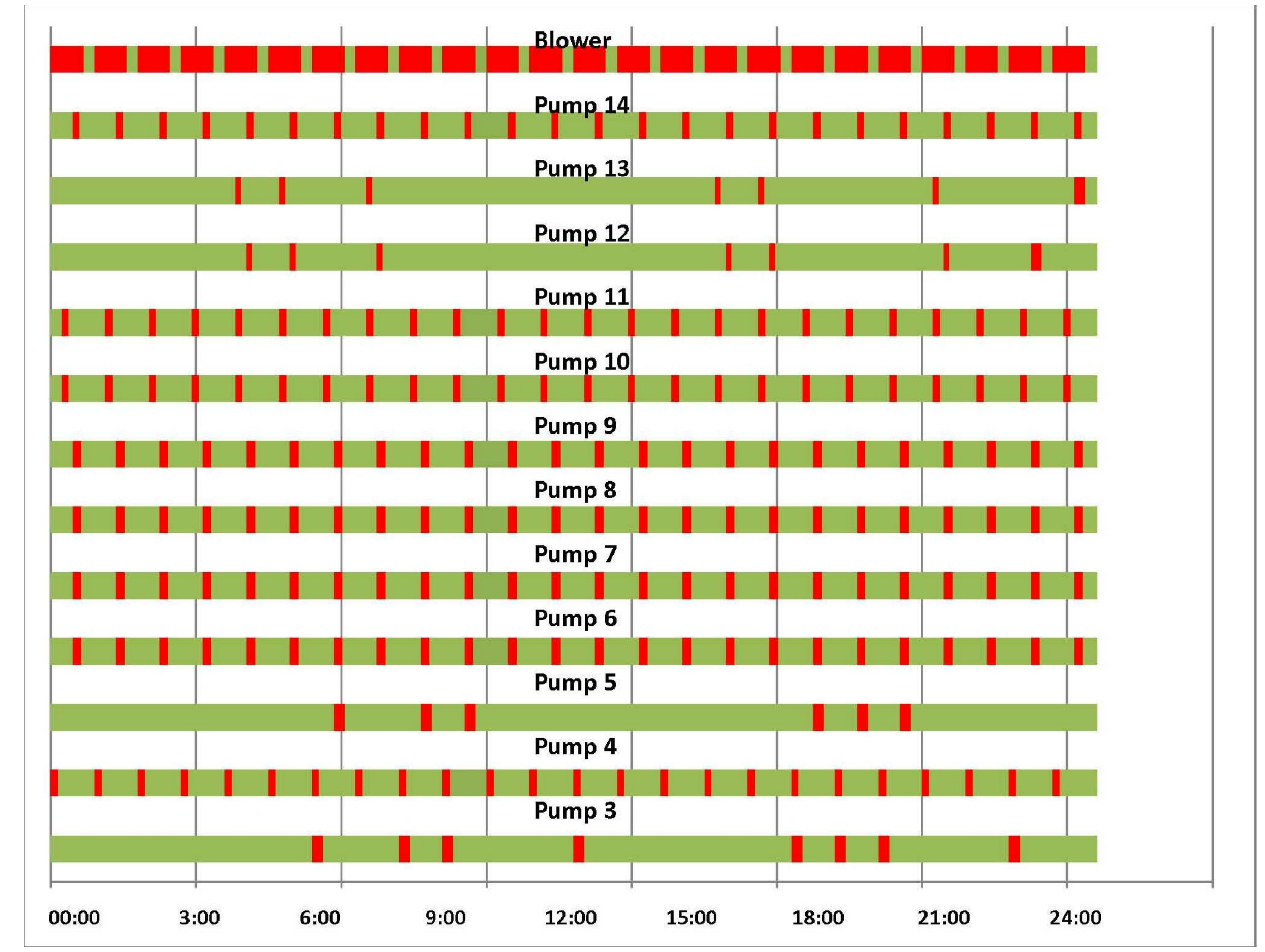
CONTROL DISPLAY

		Device Control			Status	Total Runtime	Totalized Flow (gal)	Time to Next Start	Cycle Interruption
PUMP 1	Septic Tank 2 to STE Storage Tank 1	ON	OFF	AUTO	RUNNING	005,480.0			No
PUMP 2	STE Storage Tank 1 to STE Drip Storage Tank 5	ON	OFF	AUTO	STOPPED	005,480.0			No
PUMP 3	STE Storage Tank 1 to NO3 Drip Storage Tank 4	ON	OFF	AUTO	STOPPED	000,340.0		06:00	No
PUMP 4	STE Storage Tank 1 to Hydrosplitter System 1	ON	OFF	AUTO	STOPPED	000,080.7	524,453	02:40	No
PUMP 5	STE Storage Tank 1 to In-Situ System	ON	OFF	AUTO	STOPPED	000,111.3	103,024	08:15	
PUMP 6	Hydrosplitter System 2 Recirculation	ON	OFF	AUTO	RUNNING	000,148.5		10.3 min	
PUMP 7	Hydrosplitter System 2 Recirculation	ON	OFF	AUTO	RUNNING	000,148.5		10.3 min	
PUMP 8	Hydrosplitter System 2 Recirculation	ON	OFF	AUTO	RUNNING	000,148.5		10.3 min	
PUMP 9	Hydrosplitter System 2 Recirculation	ON	OFF	AUTO	RUNNING	000,148.5		10.3 min	
PUMP 10	Feed from Denite Feed Tank 3	ON	OFF	AUTO	RUNNING	000,030.0	010,231	03:57	
PUMP 11	Feed from Denite Feed Tank 3	ON	OFF	AUTO	RUNNING	000,030.0	010,231	03:57	
PUMP 12	NO3 Drip Storage Tank 4 to NO3 Drip System	ON	OFF	AUTO	STOPPED	005,480.0	705,480	09:45	Low Level
PUMP 13	STE Drip Storage Tank 5 to STE Drip System	ON	OFF	AUTO	STOPPED	000,340.0	685,301	09:45	No
PUMP 14	STE Storage Tank 1 to STE Hydrosplitter System 2	ON	OFF	AUTO	RUNNING	000,080.7	705,480	10.3 min	No
PUMP 15	NO3 Drip Storage Tank 4 to Gravity Sump	ON	OFF	AUTO	STOPPED	000,111.3			No
BLOWER	NO3 System Air Supply Blower	ON	OFF	AUTO	RUNNING	102,533.6		24.5 min	
VALVE 1	NO3 Drip Storage Tank 4 Flush Valve	OPEN	CLOSE	AUTO	CLOSED			22:30	
VALVE 2	STE Drip Storage Tank 5 Flush Valve	OPEN	CLOSE	AUTO	CLOSED			23:000	

11:43 PLC TIME — **Existing System Flows:** Meter 1 685,301 Meter 2 685,301

TIMECHART



SETPOINT DISPLAY

		Start Times (HH:MM)	Cycle Time (min)
PUMP 3	STE Storage Tank 1 to NO3 Drip Storage Tank 4	06 : 00	15
		08 : 00	
		09 : 00	
		12 : 00	
		17 : 00	
		18 : 00	
		19 : 00	
		22 : 00	

		Number of Starts / Day	Cycle Time (min)
PUMP 4	STE Storage Tank 1 to Hydrosplitter System 1	24	10
PUMPS 10 & 11	Feed from Denite Feed Tank 3	24	10
PUMP 14	STE Storage Tank 1 to STE Hydrosplitter System 2	24	10

		Start Times (HH:MM)	Cycle Time (min)
PUMP 5	STE Storage Tank 1 to In-Situ System	06 : 30	15
		08 : 30	
		09 : 30	
		17 : 30	
		18 : 30	
		19 : 30	

		On Time (min)	Off Time (min)
BLOWER	NO3 System Air Supply Blower	45	15

		Cycle Time (min)
Pumps 6 - 9	Hydrosplitter System 2 Recirculation	12

		Start Times (HH:MM)	Cycle Time (min)
PUMP 12	NO3 Drip Storage Tank 4 to NO3 Drip System	04 : 30	8
		05 : 30	
		07 : 30	
		15 : 30	
		16 : 30	
		20 : 30	

		Start Times (HH:MM)	Cycle Time (min)
PUMP 13	STE Drip Storage Tank 5 to STE Drip System	04 : 15	8
		05 : 15	
		07 : 15	
		15 : 15	
		16 : 15	
		20 : 15	

		Start Time (HH:MM)	Cycle Time (min)
VALVE 1	NO3 Drip Storage Tank 4 Flush Valve	22 : 30	15
VALVE 2	STE Drip Storage Tank 5 Flush Valve	23 : 30	15

Pump 5 Feed Rate: 05 gph

Pump 10 Feed Rate: 03 gph

Actual Time of Day: 11 (HH) : 43 (MM) RESET TIME

Pump 11 Feed Rate: 03 gph

PLOT DATE: 12/31/2009 3:00 PM BY: CSCOTT

NO.	ISSUED FOR	DATE	BY
3	100% SUBMITTAL	12/09	–
2	75% SUBMITTAL	12/09	–
1	50% SUBMITTAL	08/09	–

DESIGNED –
DRAWN –
CHECKED –
PROJ. ENGR. –
–.
APPROVED

–
Name: Date:
Florida Professional Engineer's Registration Number: –

HAZEN AND SAWYER
Environmental Engineers & Scientists
10002 Princess Palm Avenue
Registry One Building, Suite 200
Tampa, Florida 33619
Certificate of Authorization Number: 2771

FLORIDA DEPARTMENT OF HEALTH
4052 BALD CYPRESS WAY, BIN A08
TALLAHASSEE, FL 32399-1713
(850)-245-4070

FLORIDA DEPARTMENT OF HEALTH
FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATIGIES STUDY

FUNCTIONAL CONTROL DESCRIPTIONS

THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING.

DATE	DECEMBER 2009
H & S JOB NUMBER	44237–001
CONTRACT NUMBER	
DRAWING NUMBER	I–10

Appendix C

Activity Hazard Analysis

Appendix C
Activity Hazard Analysis

Job: FOSNRS Task C	**Occupation**: Drilling Crew and Field Personnel	**Date**: August 2009
Specific Work Location: Controlled Test Site / Home Sites	**Analyzed by:** K. S. Lowe	**Reviewed by**: D. L. Anderson
Tools Required:	**PPE Required**: Gloves, close-toed shoes, and eyewear.	

Job Activity	Potential Risks/Hazards	Control Measures
Contact: Damann Anderson, FOSNRS Project Manager: 813-630-4498 office, 813-340-7976 cell phone. Kathryn Lowe, Task C co-leader: 303-273-3685 office and 303-921-3174 cell phone.		
General	Slip, trip, and fall hazards	1. Work will be performed during daylight hours. 2. Personnel will visually survey the site and avoid hazardous areas to the degree feasible. 3. No smoking, eating or drinking at the drilling rig during operation. 4. Use ground fault circuit interrupts (GFCIs). 5. Use proper lifting techniques (use legs not back, do not exceed individual physical capability, use lifting devices where appropriate). 6. First aid kit will be available (access to shower will remain open). 7. Report all injuries to Damann Anderson (813-630-4498). 8. In case of emergency call 911.
Environmental Sample Collection	Spills/splashes/leaks Contact with wastewater Electrical	1. Check and address spills/leaks of wastewater. 2. Check and address potential contact of water/wastewater with electrical cords. 3. Decontaminate work areas and cleaned spills using 70% ethanol. 4. Recognize potential bacterial, virus or blood borne pathogens and eliminate exposure through adequate PPE and work practices. PPE: gloves, close-toed shoes, eyewear. Waste Management (WM): Clean spills/leaks. Segregate trash. Place contact waste bins. Excess effluent will be returned to the septic tank/holding basin. Excess groundwater will be discharged to the ground surface.
Sample Analyses	Spills/splashes Contact with wastewater and/or reactive chemicals (e.g., acids) Broken glass Hot surfaces	1. Clean all spills immediately. Ensure proper spill kits are available. Broken glass should be immediately swept. 2. Properly store incompatible materials and flammables (e.g., separate storage for acids and bases). 3. Close chemical containers when not in immediate use. PPE: lab coat, gloves, close-toed shoes, eyewear. WM: Clean spills/leaks. Segregate trash.

Job Activity	Potential Risks/Hazards	Control Measures
Piezometer Installation and Soil Coring with Direct Push Drilling Rig	General	PPE for all drilling related activities: Hard hat, hard-toed shoes, safety glasses, and work gloves. WM: Soils will be spread on the ground surface.
	Malfunction	1. Equipment will be inspected prior to use.
	Noise	1. Sound levels are expected to reach 95 dBA during hammering. Additional PPE: hearing protection with a minimum NRR of 17 will be used by the drilling operator(s) during operation and personnel within 30 ft of the rig.
	Rotating auger may snag clothing	1. Loose clothing is not to be worn by the drill rig operator or the operator's assistant. 2. No access within four feet of the rotating auger except to the operator and operator's assistant. 3. Kill switches shall be demonstrated to be operable prior to the first use.
	Overhead wires	1. Maximum voltage of overhead lines is 13.8 kV. 2. Minimum 10 ft distance to be maintained between the mast and wires. Ten ft plus 0.4-in. per kV over 50kV. 3. Spotter will be used if approaching the minimum distance.
	Underground utilities	1. A utilities locator survey will be preformed and kept on-site during drilling.
Soil Sample Collection/Handling	Handling heavy equipment and falling equipment	1. Do not exceed personnel physical lifting abilities. WM: Soils will be spread on the ground surface.
Emergencies	Heat stress	1. Breaks will be taken to minimize potential for heat stress. 2. Drinks and a cool location (i.e., truck) will be available near the work area. 3. The buddy system will be used. PPE: Gloves and other PPE to prevent direct contact with metal equipment and prevent exposure to weather conditions.
	Injuries	1. The fire department will be summoned for all injuries that need more than first aid by calling 911.
	Blood borne pathogens	1. One field member will be trained in first aid and blood borne pathogens, but will not provide first aid unless necessary to stabilize a serious injury. 2. If blood is present, the area will be controlled to prevent exposure to blood and potential blood borne pathogens. 3. All injuries and treatment will be documented as described above under General Field Activities.
	Fire	1. Call the fire department. 2. If personnel are trained in the use of fire extinguishers, and it is safe to do so, incipient stage fires may be extinguished using portable fire extinguishers.