

# FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATEGIES (FOSNRS) STUDY

RRAC Meeting Presentation  
June 10, 2010



# Agenda

- FOSNRS Study Background
- PNRS II
- Proposed Project Scope – Phase II and III
- Tour of the GCREC Facility

# FOSNRS Study Background

- Recent concerns over impacts of nitrogen from Onsite Sewage Treatment and Disposal Systems (OSTDS):
  - Florida Keys
  - Wekiva Study Area
  - Wakulla County
  - Florida's Freshwater Springs
  - Proposed Numeric Nutrient Criteria
- Laws of Florida, 2008-152, directed FDOH to conduct a study to further develop more **“passive”** & cost-effective nitrogen reduction strategies for OSTDS
- RFP identified four primary tasks for the study; to be controlled by FDOH Research Review & Advisory Committee

# What are “Passive” nitrogen reduction systems?

- Most N-removing onsite systems used in FL are mechanical treatment units utilizing an activated sludge biological process
- “Passive” nitrogen removal OSTDS are similar to conventional onsite systems in their operation and maintenance
- Previous FDOH Study: Florida Passive Nitrogen Removal Systems (PNRS I) Study (Smith et. al., 2008) defined passive systems:
  - Passive nitrogen removal systems are those that *use only one pump and a “reactive media” for denitrification*
  - PNRS I demonstrated effluent TN <10 mg/L

# FOSNRS Study Overview

## Four Primary Study Areas

- **Task Series A:** Technology evaluation for field testing, Test facility design & construction, Pilot testing of Passive nitrogen removal systems (PNRS II)
- **Task Series B:** Field testing of full-scale treatment technologies, Performance & cost documentation
- **Task Series C:** Evaluation of nitrogen reduction provided by Florida soils & shallow groundwater
- **Task Series D:** Nitrogen fate and transport modeling, Development of decision support tools for OSTDS planning & management

# FOSNRS Study Overview

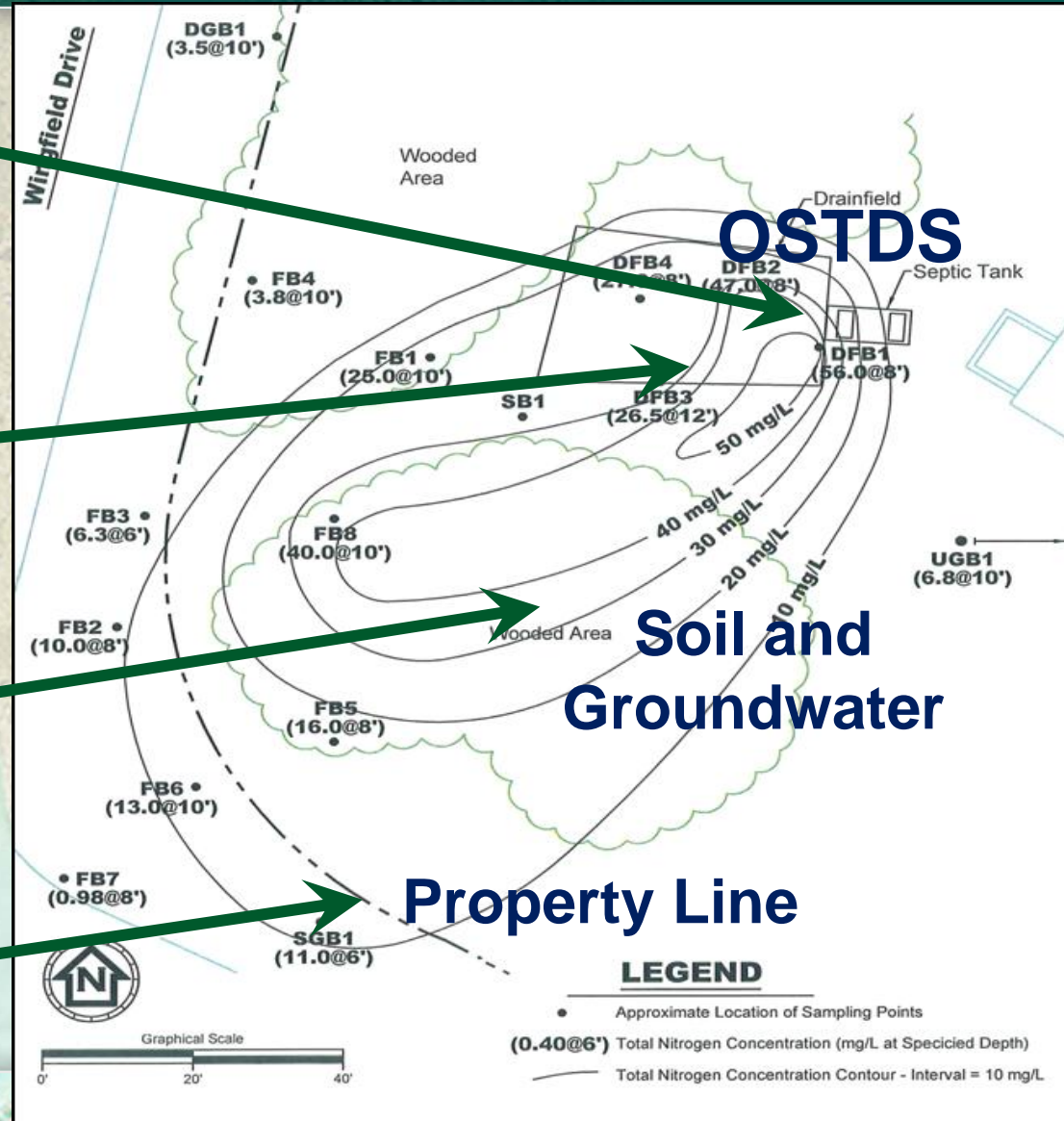
## How do tasks relate to N-removal strategies?

**Task A** Nitrogen treatment and removal options for Florida

**Task B** Performance verification of nitrogen removal in full scale systems

**Task C** Evaluation of N reduction in Florida soil and groundwater

**Task D** Decision support tools for OSTDS planning & mgmt; N-removal goals for Florida



**OSTDS**

**Soil and Groundwater**

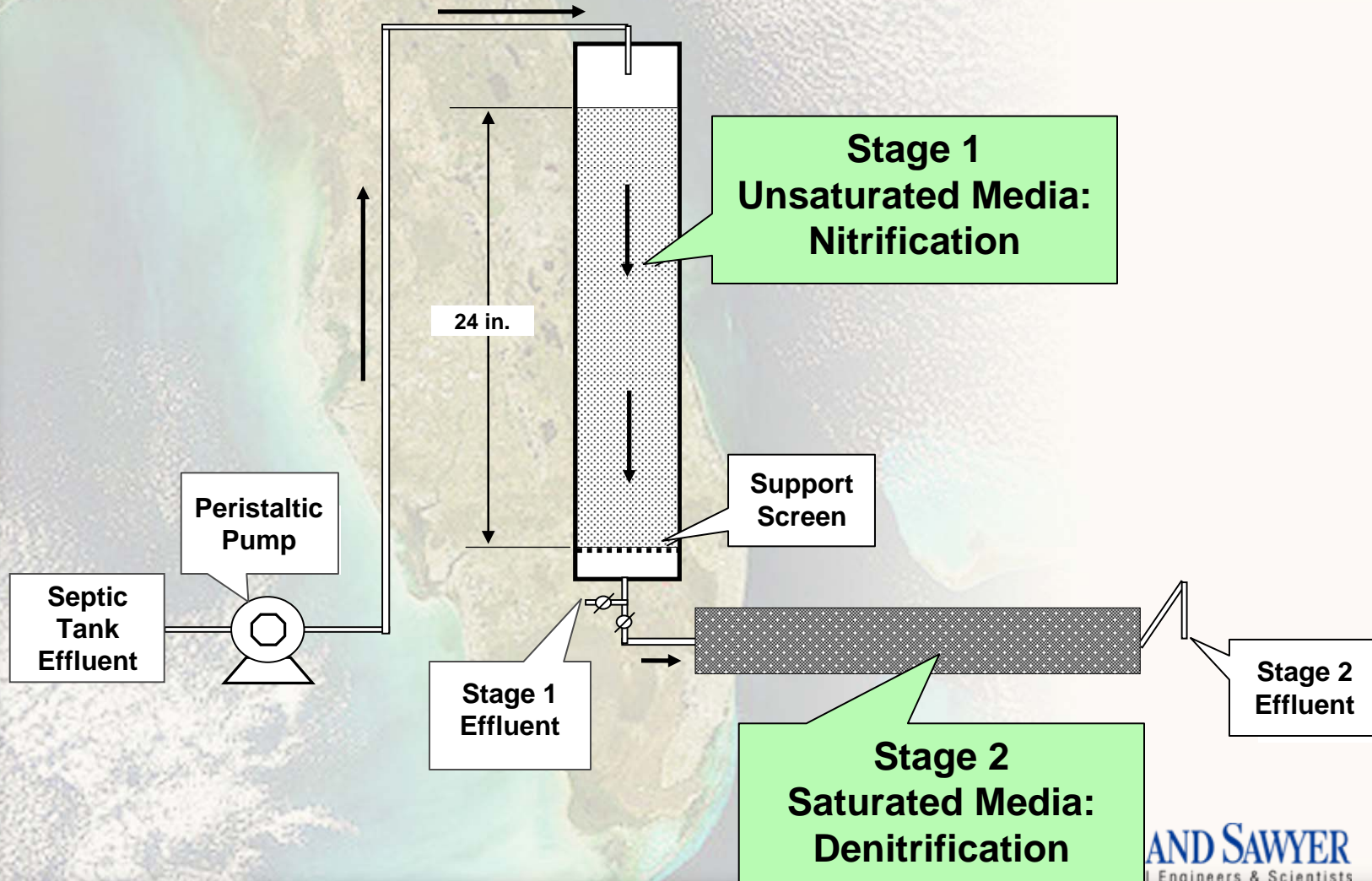
**Property Line**

# Project Status

- **Project began early 2009**
- **Sub-tasks completed to date**
  - Task A, C and D literature review reports (available at [www.doh.state.fl.us/environment/ostds/research/](http://www.doh.state.fl.us/environment/ostds/research/))
  - Task A
    - ▶ Draft technology classification, ranking criteria, and priority list for testing
    - ▶ PNRS II Quality Assurance Project Plan (QAPP)
    - ▶ PNRS II Test Facility Design & Construction
  - Task C: QAPP, Soil & Groundwater Test Facility Design
  - Task D: Selection of existing datasets for model calibration

# Passive Nitrogen Removal Study II PNRS II (Task A)

# PNRS I: Passive Two Stage Biofiltration (Smith et. al., 2008)



# Passive Nitrogen Removal Study I

## PNRS I Results

- 8 months operation of bench-scale units at Flatwoods Park, Hillsborough County
- Elemental sulfur as electron donor for denitrification
- 97% nitrogen reduction from septic tank effluent



**Stage 1  
vertical  
unsaturated**

**Stage 2  
horizontal  
saturated**

# Passive Nitrogen Removal Study I

## PNRS I Results

- Showed feasibility of passive two stage biofiltration
- One pump, no aerators, reactive media
- Continuous 24/7 operation for 8 months
- Proof of passive 2-stage biofiltration concept provided

# Passive Nitrogen Removal Study II

## PNRS II Objectives

- Follow up to PNRS I with larger, pilot scale units and various media
- Develop detailed performance data for passive biofiltration designs
- Produce scalable design data from pilot scale biofilters for subsequent full-scale testing in Task Series B

# Passive Nitrogen Removal Study II

## PNRS II Approach

- Establish test facility at Gulf Coast Education and Research Center (University of Florida IFAS)
- Test program for in-vessel and in-situ pilot systems
- Operate on septic tank effluent for 12 months
- Various nitrification and denitrification biofilters to be tested

# Gulf Coast Research and Education Center (GCREC)

## Gulf Coast Research and Education Center

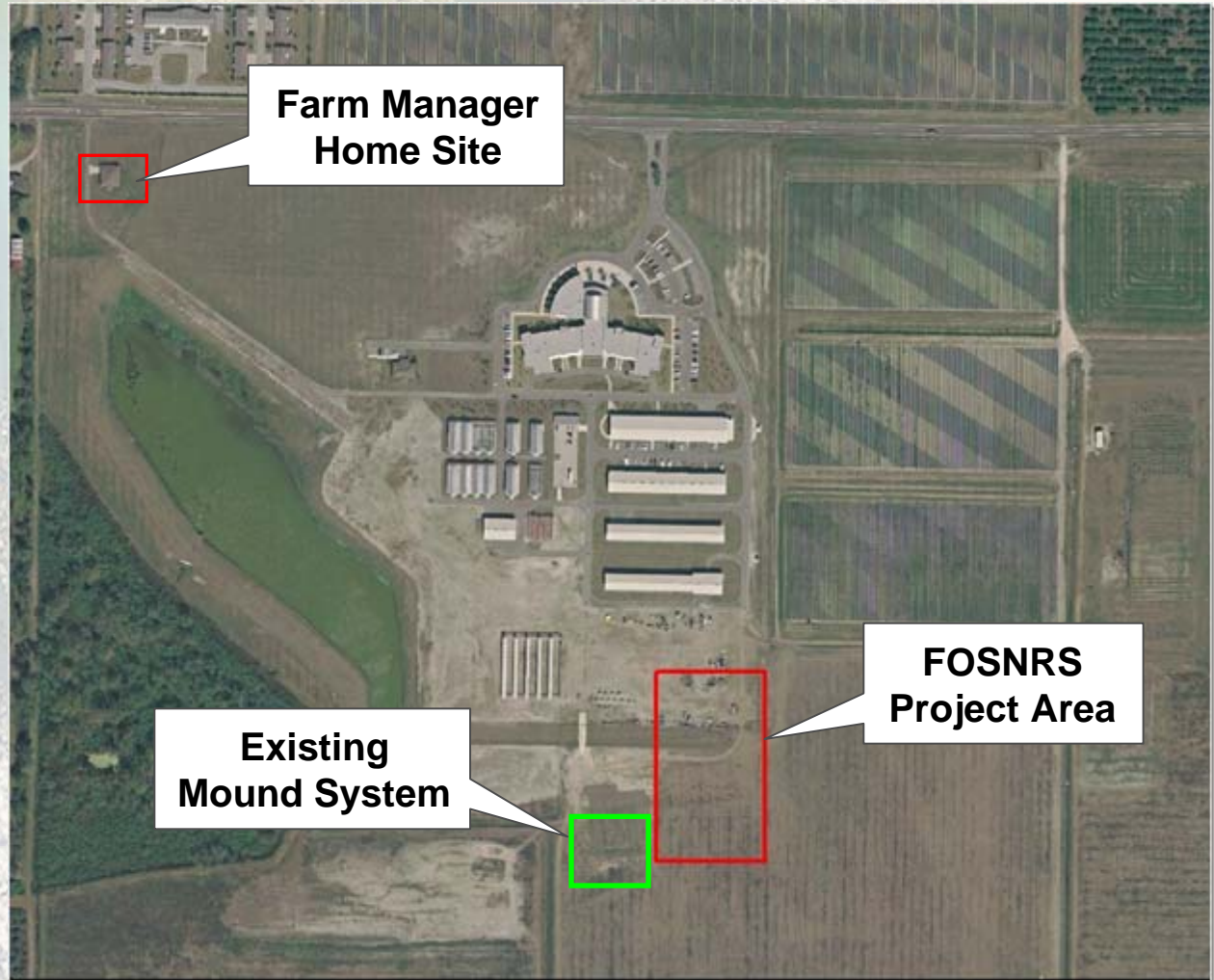
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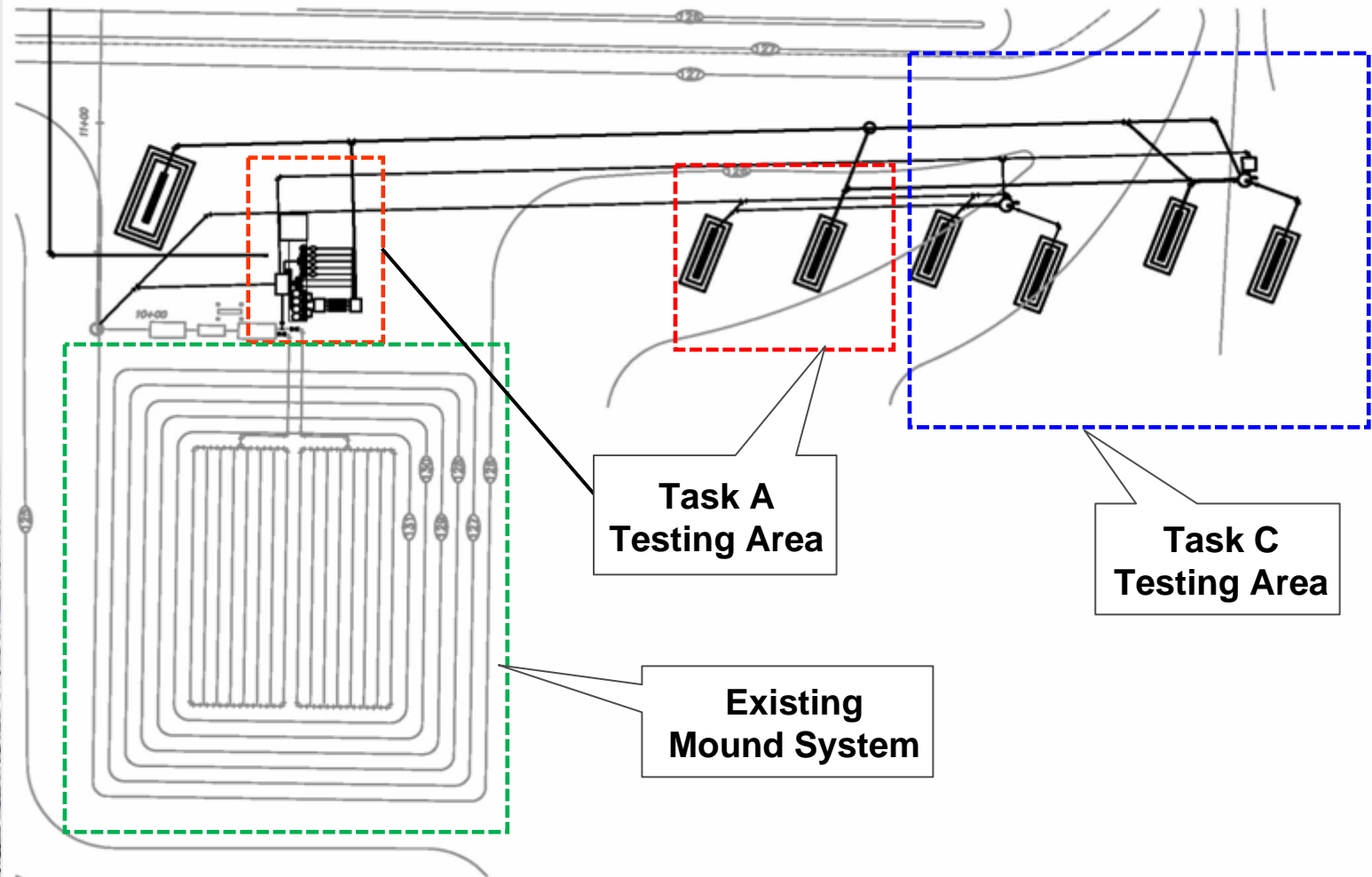
- University of Florida, Institute for Food & Agricultural Sciences (IFAS)
- 475 acres of land in SE Hillsborough County
- Facility conducts agricultural research & trials for vegetables, fruit and ornamental plants
- 16 laboratories housed onsite (1 water quality lab)

**HAZEN AND SAWYER**  
Environmental Engineers & Scientists

# GCREC Facility and FOSNRS Project Area



# GCREC FOSNRS Project Area

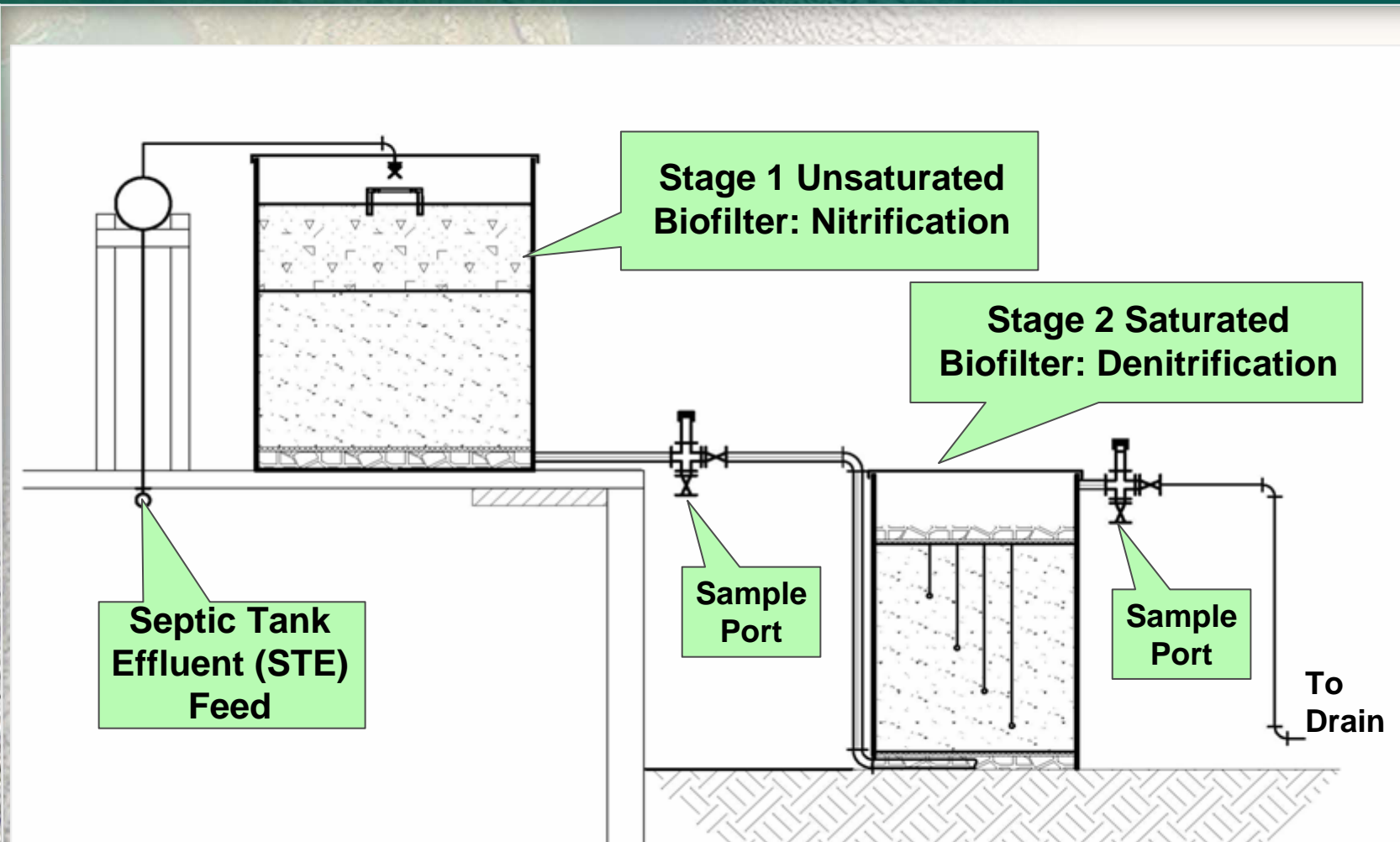


# Passive Nitrogen Removal Study II

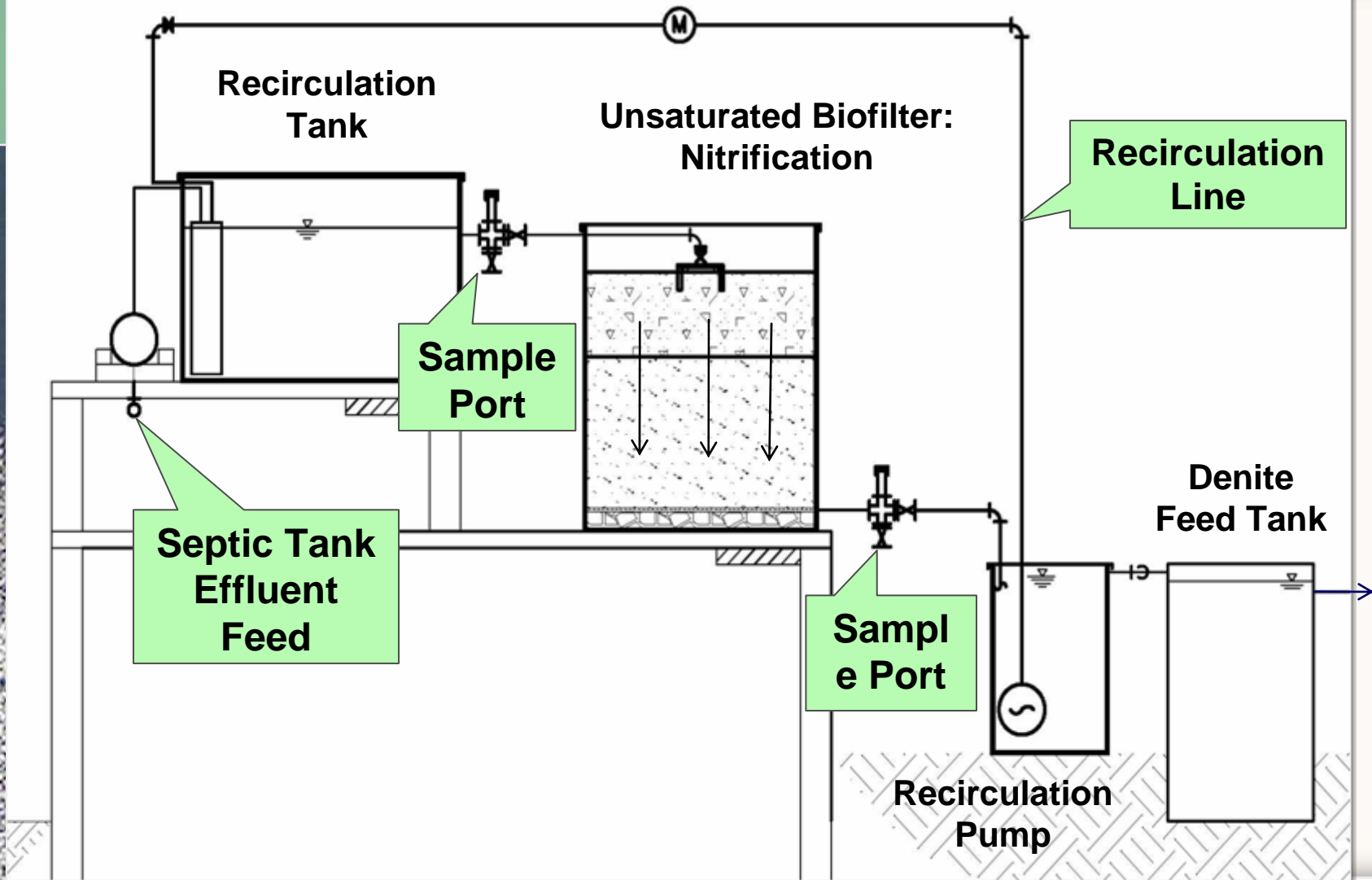
## Significant Features

- Couple first stage recycle (mixed biomass) to denitrification (separate stage biomass)
- Stage 1 unsaturated filter: 2 layer stratification design with 2 media depths
- Evaluate lignocellulosic and sulfur based Stage 2 denitrification biofilters
- Test reactive media in in-ground systems

# Two Stage Single Pass Biofilters



# Stage 1 Recirculating Biofilters



# Stage 1 Media (nitrification)



**Expanded clay**



**Zeo-Pure  
clinoptilolite**



**Expanded  
polystyrene**

# Stage 2 Media (denitrification)



**Expanded clay**



**Lignocellulosics**



**Elemental sulfur**

# PNRS II Test Facility Construction



**Setting up tanks**



**Mixing media batches**



**Gravel underdrain**

# Placing media in tanks



# 2-Stage Single Pass Biofilters



**Stage 1 Unsaturated Biofilters - Nitrification**

**Stage 2 Saturated Upflow Biofilters - Denitrification**

# Stage 1 Recirculating Biofilters & Stage 2 Horizontal Saturated Biofilters



**Stage 1 Recirculating Biofilters**



**Stage 2 Saturated Biofilters**

# Monitoring & Controls



**Flow Monitoring**



**Control Panel**

# PNRS II Test Facility Nearing Completion

**(4)  
Recirculation  
Tanks**

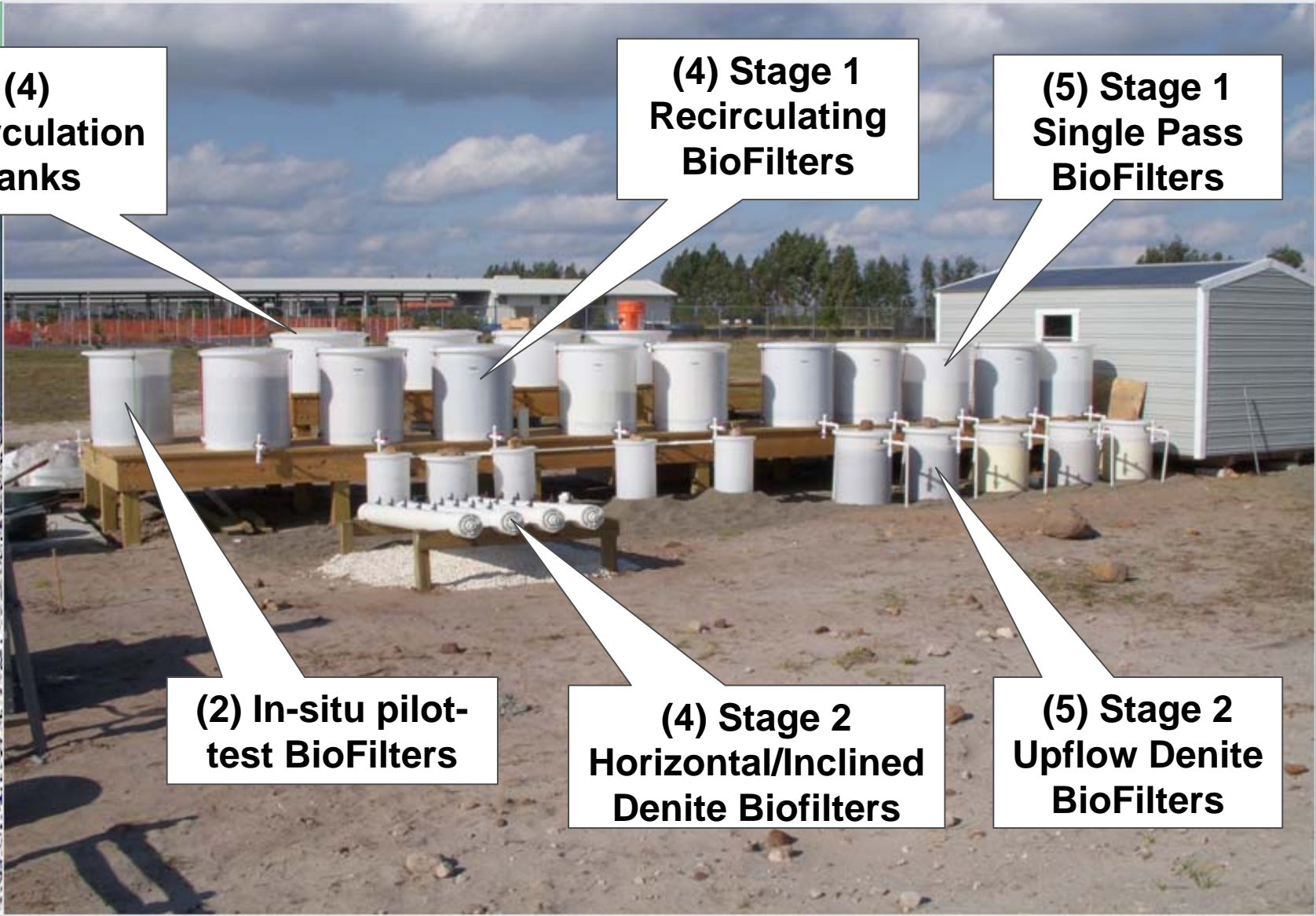
**(4) Stage 1  
Recirculating  
BioFilters**

**(5) Stage 1  
Single Pass  
BioFilters**

**(2) In-situ pilot-  
test BioFilters**

**(4) Stage 2  
Horizontal/Inclined  
Denite Biofilters**

**(5) Stage 2  
Upflow Denite  
BioFilters**

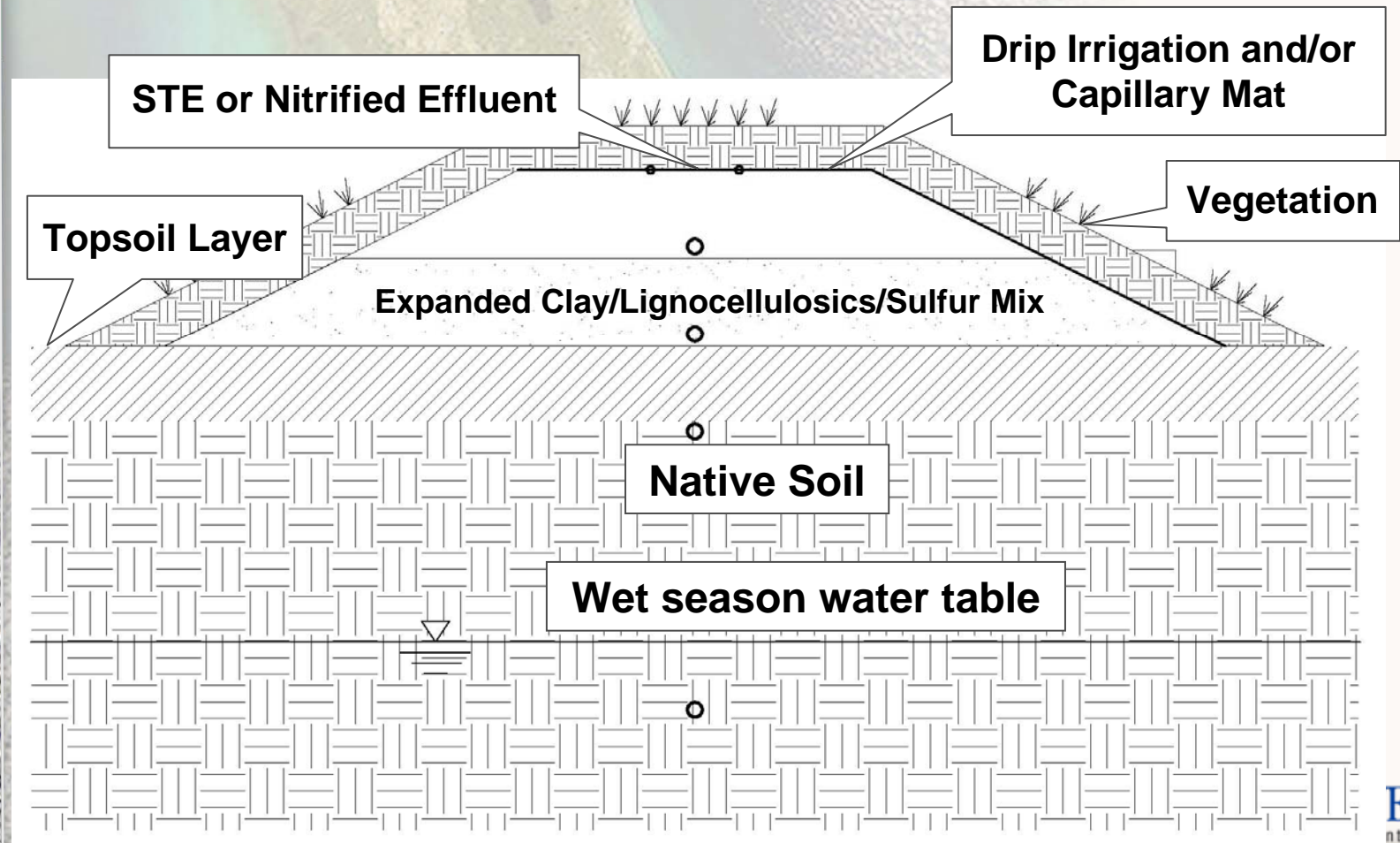


# Completed PNRS II Test Facility



# Passive Nitrogen Removal Study II

## In-Ground Engineered Media Concept



# Passive Nitrogen Removal Study II

## Application of Technologies

	Passive Two Stage Biofiltration	In-Situ Biofiltration	Passive Denitrification
New or replacement systems	X	X	
Retrofit to existing conventional system	X	X	
Addition to existing aerobic treatment system		X	X

# FOSNRS Summary

- Multi-prong project underway to reduce nitrogen from Florida's Onsite Sewage Treatment and Disposal Systems
- Integrated tasks of:
  - Treatment technology evaluation including new passive systems
  - Full-scale field testing of treatment technologies
  - Monitoring of nitrogen fate and transport in subsurface
  - Modeling and planning tools to support regulatory decision making
- Successful results would allow OSTDS to achieve nutrient removal similar to wastewater treatment plants and play a role in nitrogen reduction in sensitive watersheds

# Proposed Project Scope Phase II and Phase III



# Scope – Task A

Task	Phase I	Phase II	Phase III
A.1 Draft Lit Review	1		
A.2 Final Lit Review	1		
A.3 Draft Classification of Tech	1		
A.4 Draft Tech Ranking Criteria	1		
A.5 Draft Priority List for Testing	1		
A.6 Tech Classification, Ranking & Prioritization Workshop	1		
A.7 Final Classification of Tech	1		
A.8 Final Tech Ranking Criteria	1		
A.9 Final Priority List for Testing	1		
A.10 Draft Innovative Systems Application		5	
A.11 Final Innovative Systems Application		5	
A.12 Identification of Test Facility Sites	2		
A.13 Draft QAPP PNRS II	1		
A.14 Recommendation for Process Forward	1		
A.15 Final QAPP PNRS II	1		
A.16 Materials Testing for FDOH Additives Rule	2	2	
A.17 PNRS II Specification Reports	1	1	

# Scope – Task A (continued)

Task	Phase I	Phase II	Phase III
A.18 PNRS II Test Facility Design 50%	1		
A.19 PNRS II Test Facility Design 100%	1		
A.20 PNRS II Test Facility Construction Support & Admin	2		
A.21 PNRS II Test Facility Construction 50%	2		
A.22 PNRS II Test Facility Construction 100%	1		
A.23 PNRS II Test Facility Construction Sub. Completion	1		
A.24 PNRS II Test Facility Accept Construction	1		
A.25 Monitoring and Sample Event Reports	1	5	
A.26 Data Summary Report		6	
A.27 Draft PNRS II Report			1
A.28 Final PNRS II Report			1
A.29 Draft Task A Final Report			1
A.30 Task A Final Report			1

# Scope – Task B

Task	Phase I	Phase II	Phase III
B.1 Identification of Home Sites		10	
B.2 Vendor Agreement Report		8	
B.3 Draft QAPP for Field Testing	1		
B.4 Recommendation for Process Forward		1	
B.5 Final QAPP for Field Testing		1	
B.6 Field System Installation Report		8	
B.7 Field System Monitoring Report		4	4
B.8 Field System Op., Maintenance & Repairs Report			8
B.9 Technical Description of Nitrogen Reduction Tech. Report			1
B.10 Acceptance of System by Owner Report		4	4
B.11 Draft LCAA Template Report		1	
B.12 Final LCCA Template Report			1
B.13 LCCA Report (per system)			8
B.14 Draft Task B Final Report			1
B.15 Task B Final Report			1

# Scope – Task C

Task	Phase I	Phase II	Phase III
C.1 Draft Literature Review on N Reduction in Soil	1		
C.2 Final Literature Review on N Reduction in Soil	1		
C.3 Draft QAPP Eval. of N Red. by Soils & Shallow GW	1		
C.4 Recommendation for Process Forward	1		
C.5 Final QAPP Eval. of N Red. by Soils & Shallow GW	1		
C.6 S&GW Test Facility Design 50%	1		
C.7 S&GW Test Facility Design 100%	1		
C.8 S&GW Test Facility Design Final	1		
C.9 S&GW Construction Support & Admin.		2	
C.10 S&GW Test Facility Construction 50%		2	
C.11 S&GW Test Facility Construction 100%		1	
C.12 S&GW Test Facility Con. Substantial Completion		1	
C.13 S&GW Test Facility Accept Construction		1	
C.14 Soils & Hydrogeologic & Monitoring Plan for S&GW		1	
C.15 Tracer Testing at GCREC		3	
C.16 S&GW Sample Event Reports		6	6
C.17 S&GW Data Summary Report		6	6
C.18 Test Facility Closeout Report			1
C.19 Field Site Selection		8	

# Scope – Task C (continued)

Task	Phase I	Phase II	Phase III
<b>C.20 Instrumentation of GCREC Mound System</b>	<b>0.5</b>	<b>0.5</b>	
C.21 GCREC Mound Sample Event Report		3	1
C.22 GCREC Mound Data Summary Report		3	1
C.23 Instrumentation of Remaining Field Sites Report		2	3
C.24 Field Sites Sample Event Reports		4	16
C.25 Field Sites Data Summary Report		4	16
C.26 Draft Site Summary and Close-Out Report			5
C.27 Final Site Close-Out Report			5
C.28 Draft Task C Final Report			1
C.29 Task C Final Report			1

# Scope – Task D

Task	Phase I	Phase II	Phase III
D.1 Draft Lit Review on N Fate & Transport Model	1		
D.2 Final Lit Review on N Fate & Transport Model	1		
D.3 Selection of Existing Data Set for Calibration	1		
D.4 Draft QAPP N Fate & Transport Models	1		
D.5 Recommendation for Process Forward	1		
D.6 Final QAPP N Fate & Transport Models		1	
D.7 Simple Soil Model Development		1	
D.8 Non-Steady State Aquifer Model, Simple Soil Model		1	
D.9 Aquifer Model with Averaged Output, Simple Soil Model		1	
D.10 Multi-Source Aquifer Model		1	
D.11 Calibrate Non-Steady State Aquifer Model		1	
D.12 Calibrate Aquifer Model			1
D.13 Calibrate Multi-Source Aquifer Model			1
D.14 Complex Soil Model Development			1
D.15 Non-Steady State Aquifer Model, Complex Soil Model			1
D.16 Aquifer Model with Averaged Output, Complex			1

# Scope – Task D (continued)

Task	Phase I	Phase II	Phase III
D.17 Multi-Source Aquifer Model, Complex			1
D.18 Calibrate Non-Steady State Aquifer Model, Complex			1
D.19 Calibrate Multi-Source Aquifer Model, Complex			1
D.20 Uncertainty Analysis for Non-Calibrated Models		1	
D.21 Validate/Refine Non-Steady State Aquifer Model with Task C Data			1
D.22 Validate/Refine Complex Soil with Task C Data			1
D.23 Uncertainty Analysis for Calibrated Models			1
D.24 Validate/Refine Non-Steady State Aquifer, Complex with Task C Data			1
D.25 Decision-Making Framework Considering Uncertainty			1
D.26 Validate/Refine Multi-Source Aquifer Model, Complex with Task C Data			1
D.27 Draft Task D Final Report			1
D.28 Task D Final Report			1

# Scope – Task E

Task	Phase I	Phase II	Phase III
E.1 Project Kick-Off Meeting	1		
E.2 PM – Project Progress Reports	6	4	12
E.3 RRAC or TRAP Presentation	2	1	4
E.4 RRAC or TRAP Meeting Attendance	1	1	4
E.4 PAC Meetings		1	3

Questions?