Sawdust and Septic Systems the Final Chapter

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Or…

- *How certain lignolytic enzymes free the carbon in cellulosic materials to subsequently provide carbon for the denitrification of percolating wastewater from onsite septic system soil treatment units.*

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SNEP
Southeast New England Program

Or……

Saws 4 – the final Chapter

Just when you thought it was safe to go back into the woods

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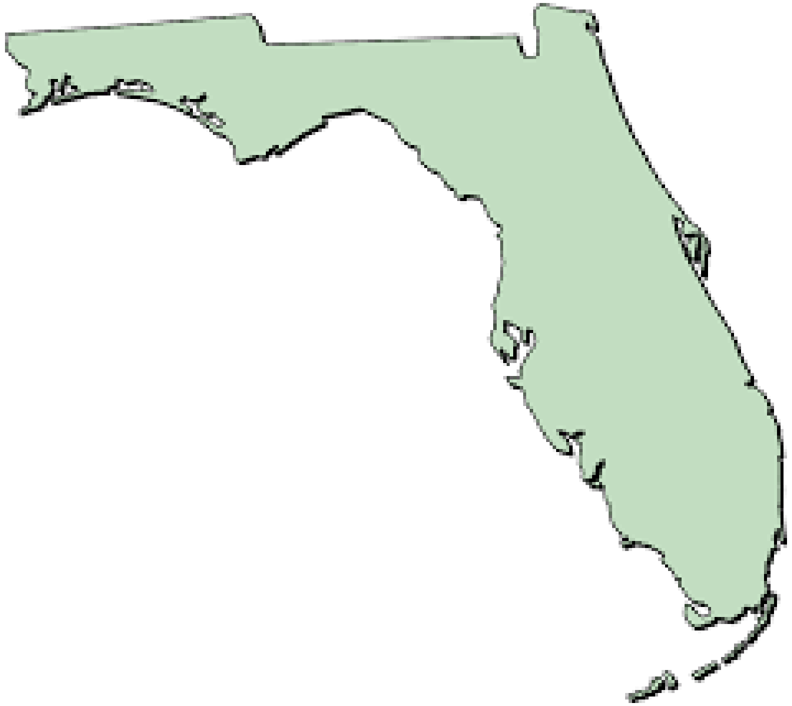
Background



Due to the impact of nitrogen from onsite septic systems, the State of Florida funded research on non-proprietary "passive" means to remove nitrogen from onsite wastewater systems using lignocellulose (sawdust and woodchips) integrated into the soil treatment areas (a.k.a. Leachfields)

We set as our goal

To examine all elements of successful non-proprietary onsite denitrification projects and determine how to adjust the design features to work in our particular climatological and geological setting.

To determine whether the principles used in these projects will allow a design that is economical and feasible to install in coastal settings.

Collaborative Effort

- Barnstable County Department of Health and Environment and MASSTC
- Damann L. Anderson, P.E., a researcher of passive nitrogen removal systems for the State of Florida Onsite Sewage Nitrogen Reduction Study (FOSNRS);
- George Loomis, an onsite septic system specialist and published author from the University of Rhode Island;
- Following work by Dr. Will Robertson of the University of Waterloo;
- Jose Amador and Sara Wiggington at the University of Rhode Island;
- More recently, researchers at Stony Brook University, NY

MASSTC The Massachusetts Alternative Septic System Test Center
A Division of the Barnstable County Department of Health and Environment

COUNTY OF BARNSTABLE MASSACHUSETTS

GREAT SEAL OF THE STATE OF FLORIDA IN GOD WE TRUST

UNIVERSITY OF RHODE ISLAND HOPE 1892

buzzards BAY COALITION

Three promising designs

Simple "layer cake"

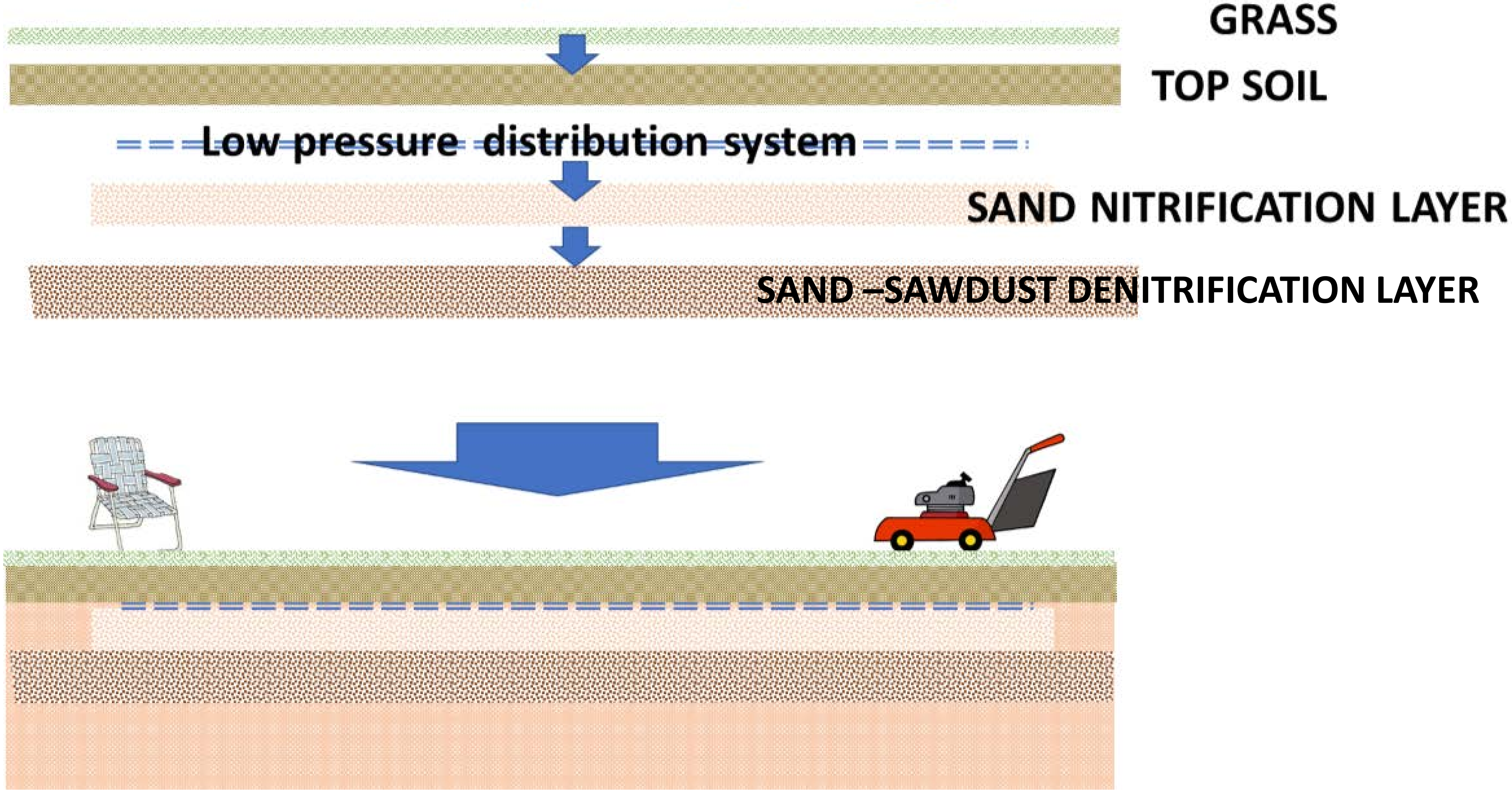
Lined "layer cake"

"Box" system

Simple layering

An intuitively easier and less expensive option

Simple layering




Lysimeter port
Lysimeter port
Sand (nitrification layer)placement
Sand:Sawdust (denitrification) Layer


DHI


GeoMat™ 3900

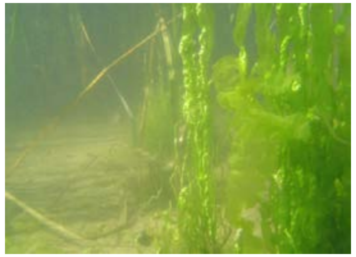
Principle of Operation

STANDARD SEPTIC SYSTEM

Septic tank effluent goes to leachfield

Nitrogen coverts to nitrate(nitrification)

Nitrate goes to embayment



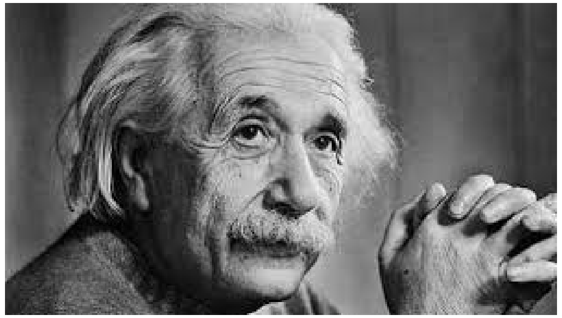
LAYERED SEPTIC SYSTEM

Septic tank effluent goes to leachfield

Nitrogen coverts to nitrate(nitrification)

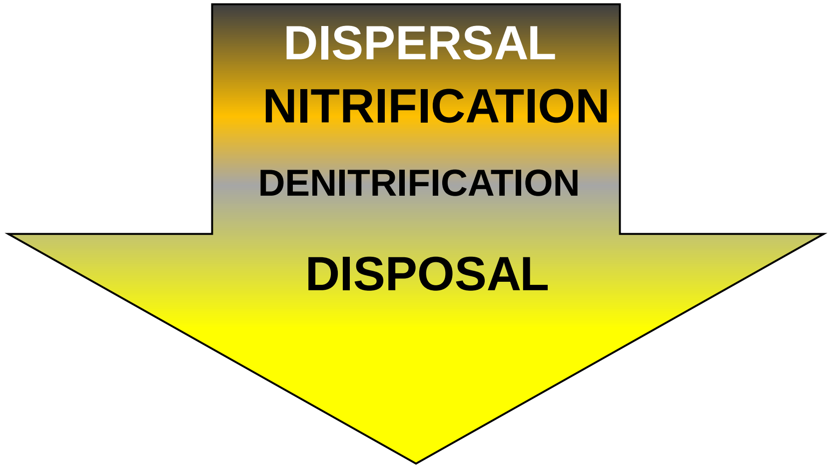
Nitrate is reduced to nitrogen gas (denitrification)

But will it work?



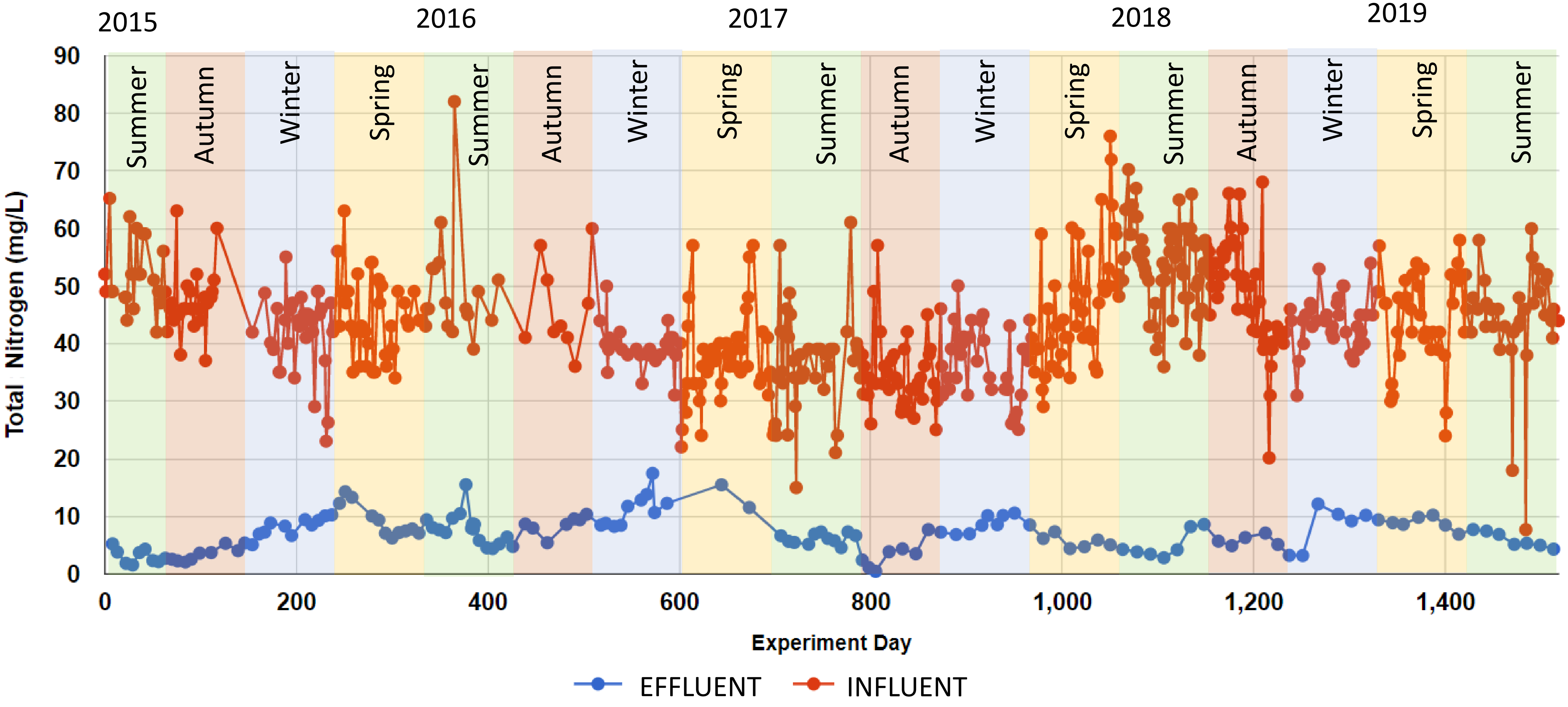
"Everything should be made as simple as possible, but not simpler"

keeping it Simple

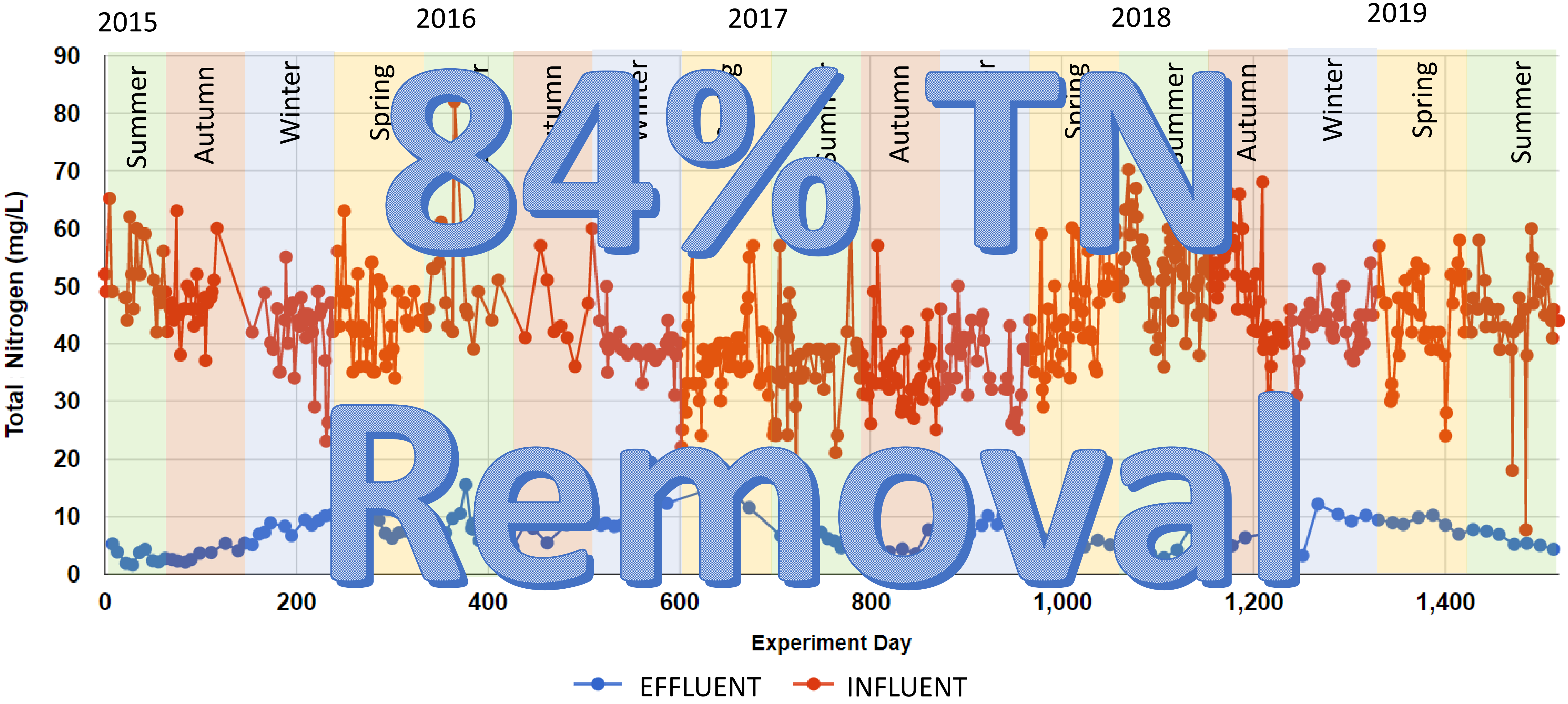


MASSTC
The Massachusetts Alternative
Septic System Test Center

MASSTC (test center)venue



MASSTC (test center)venue



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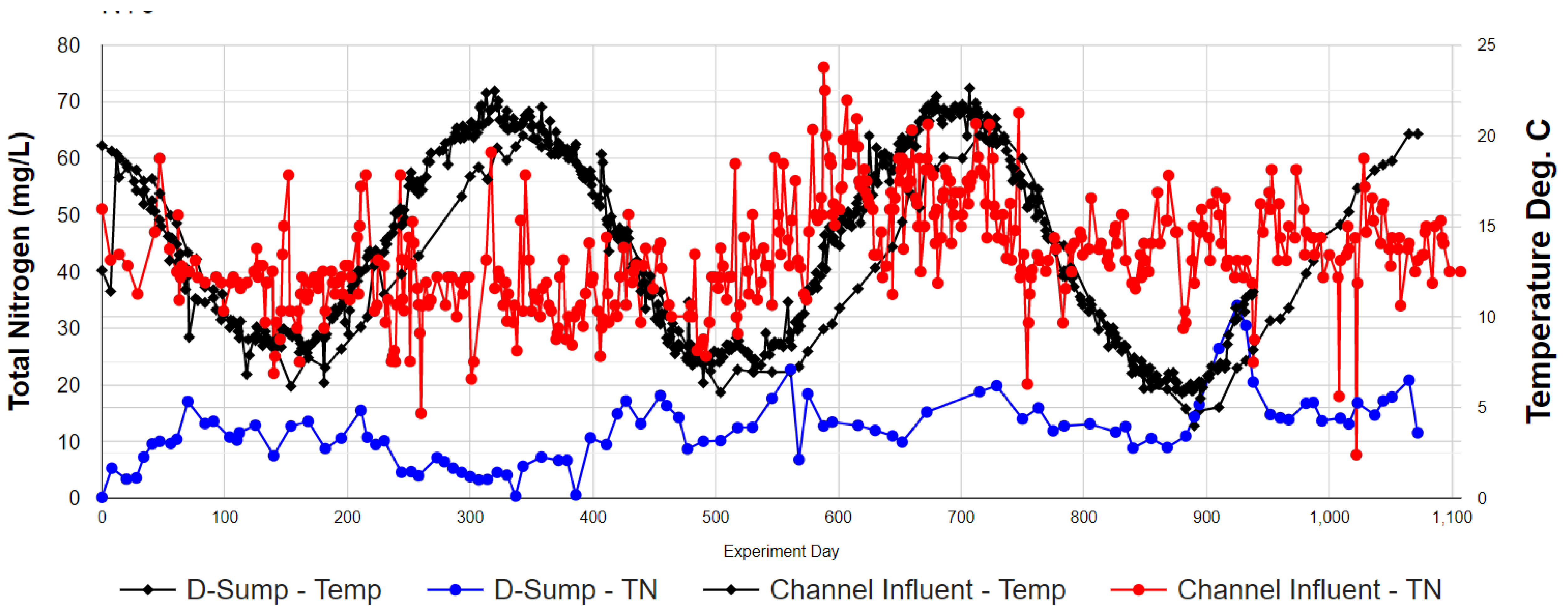
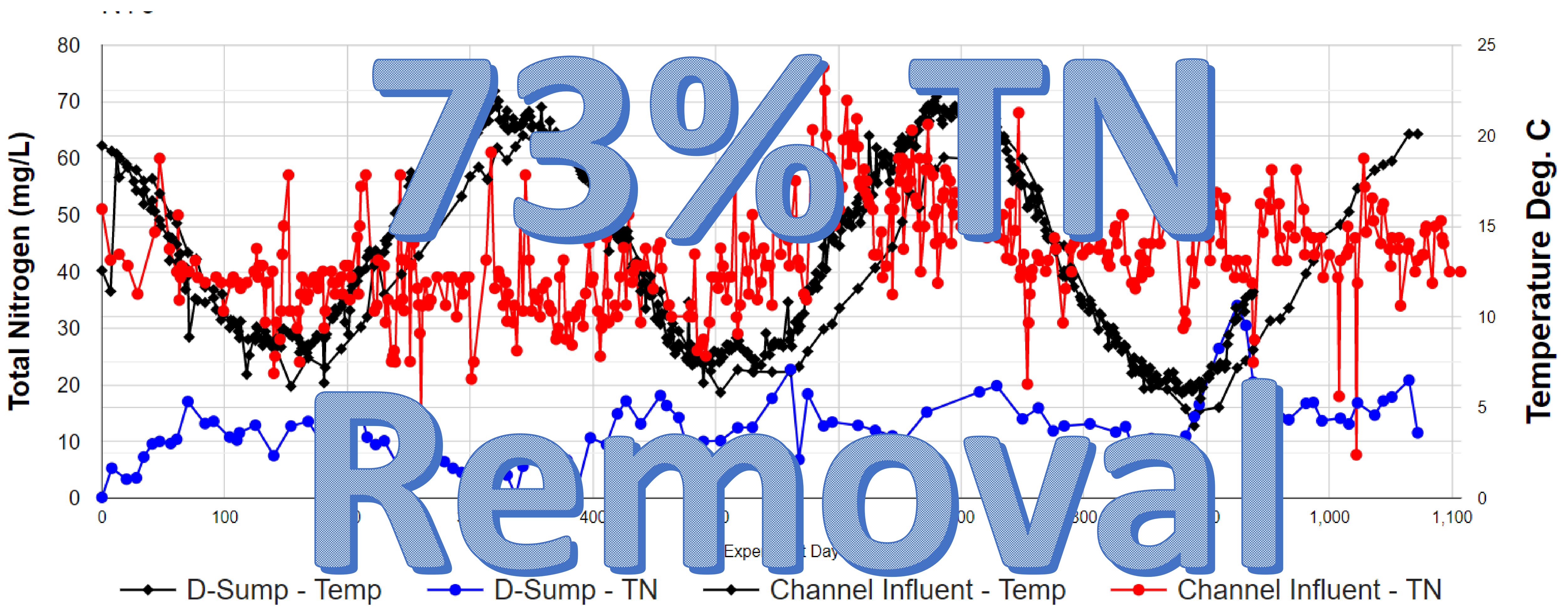
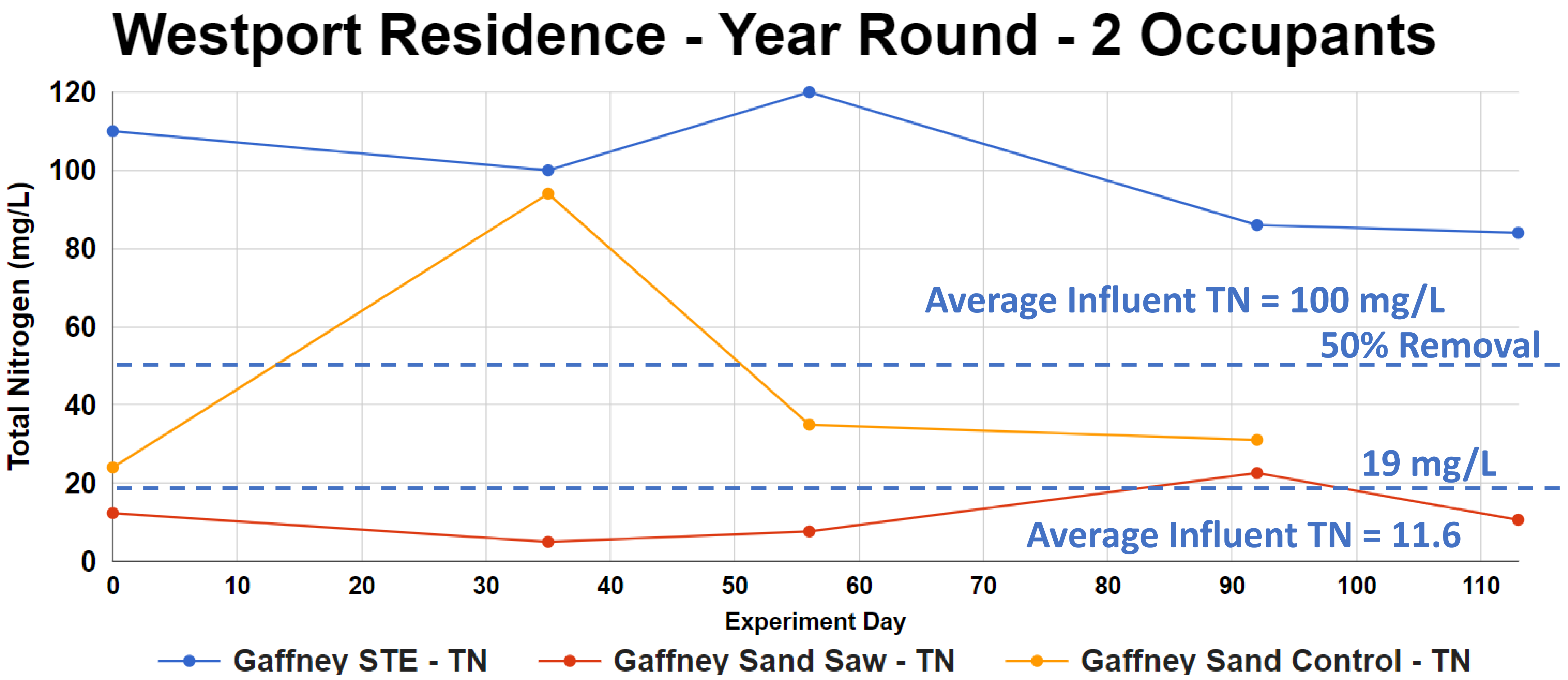


MASSTC (test center)venue



What about the Real World ?

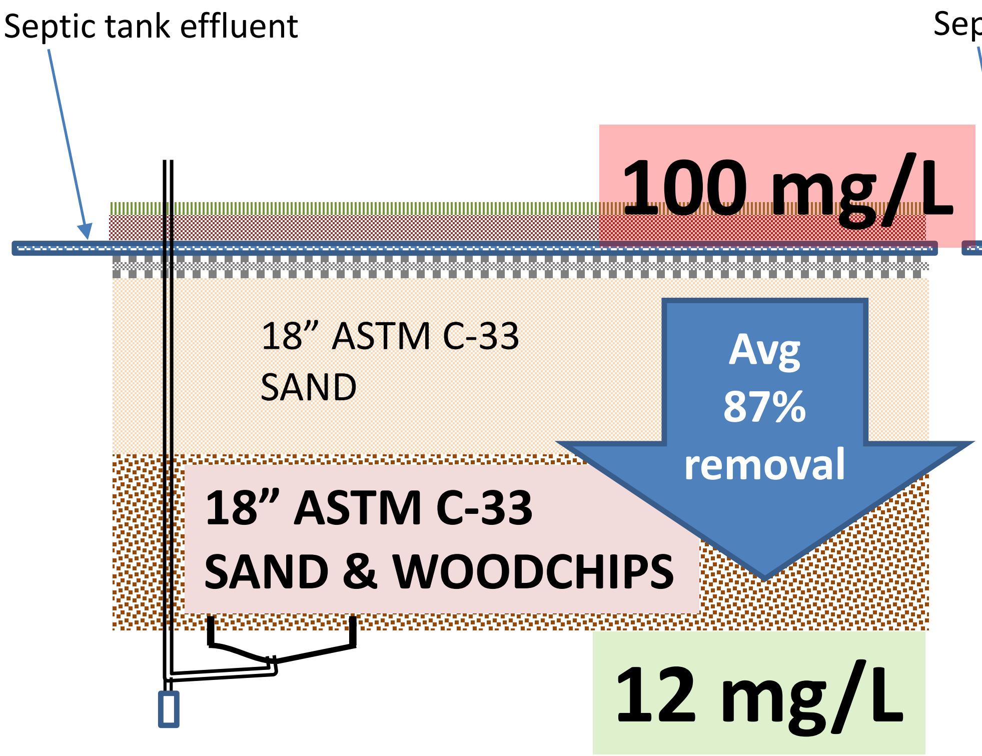
vs. Test Center Studies



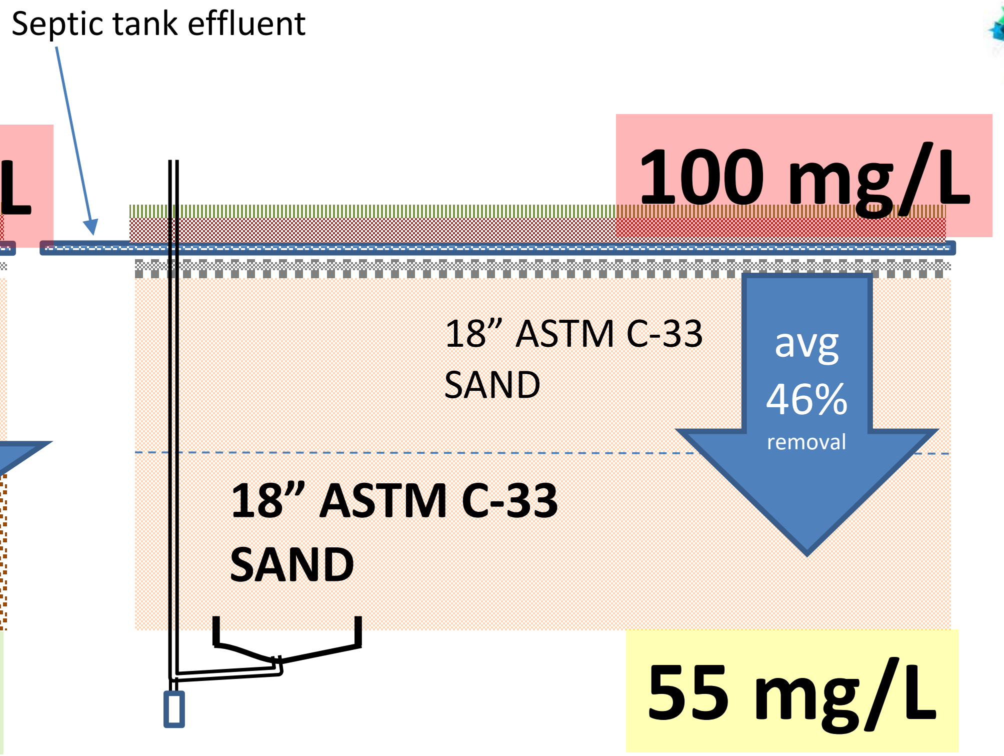
Westport Residence - Year Round - 2 Occupants
Total Nitrogen (mg/L)
120
100
80
60
40
20
0
0
10
20
30
40
50
60
70
80
90
100
110
Experiment Day
Average Influent TN = 100 mg/L
50% Removal
19 mg/L
Average Influent TN = 11.6
Gaffney STE - TN
Gaffney Sand Saw - TN
Gaffney Sand Control - TN

Westport Year-Round Residence – Two adult occupants

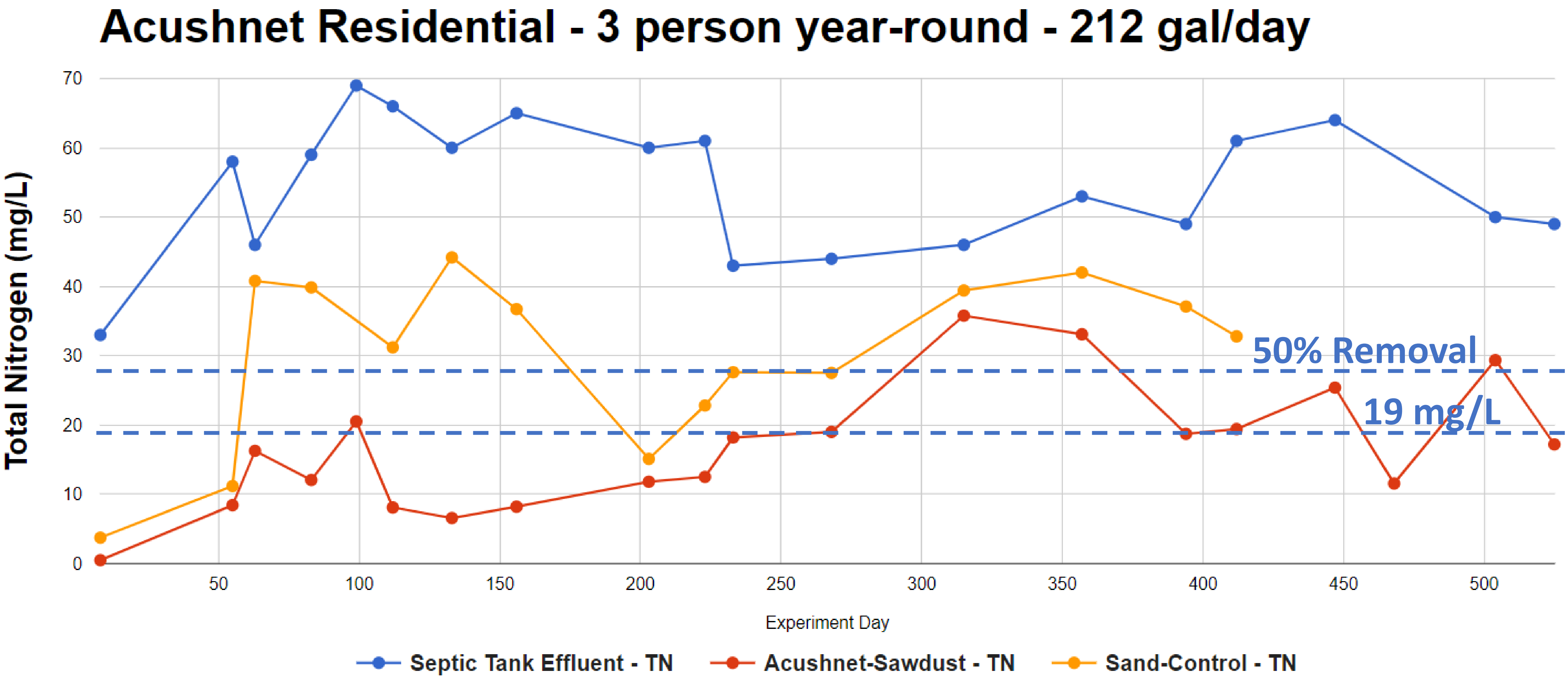
Treated Portion of Soil Absorption System



Un-Treated (Control) Portion of Soil Absorption System



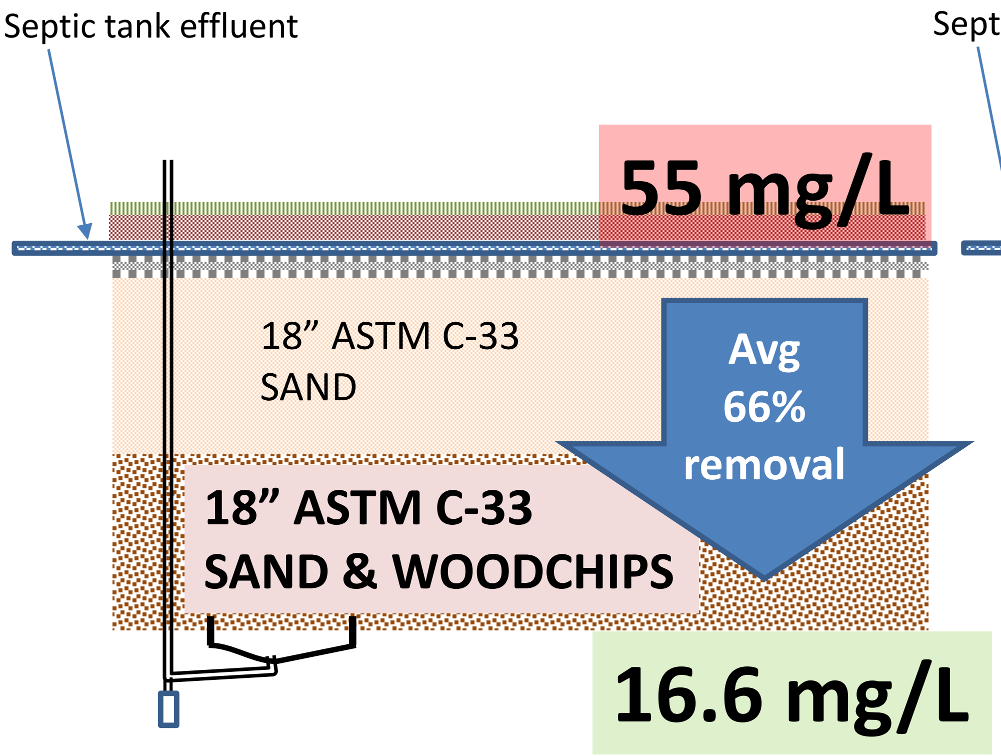
Only 4 months of data



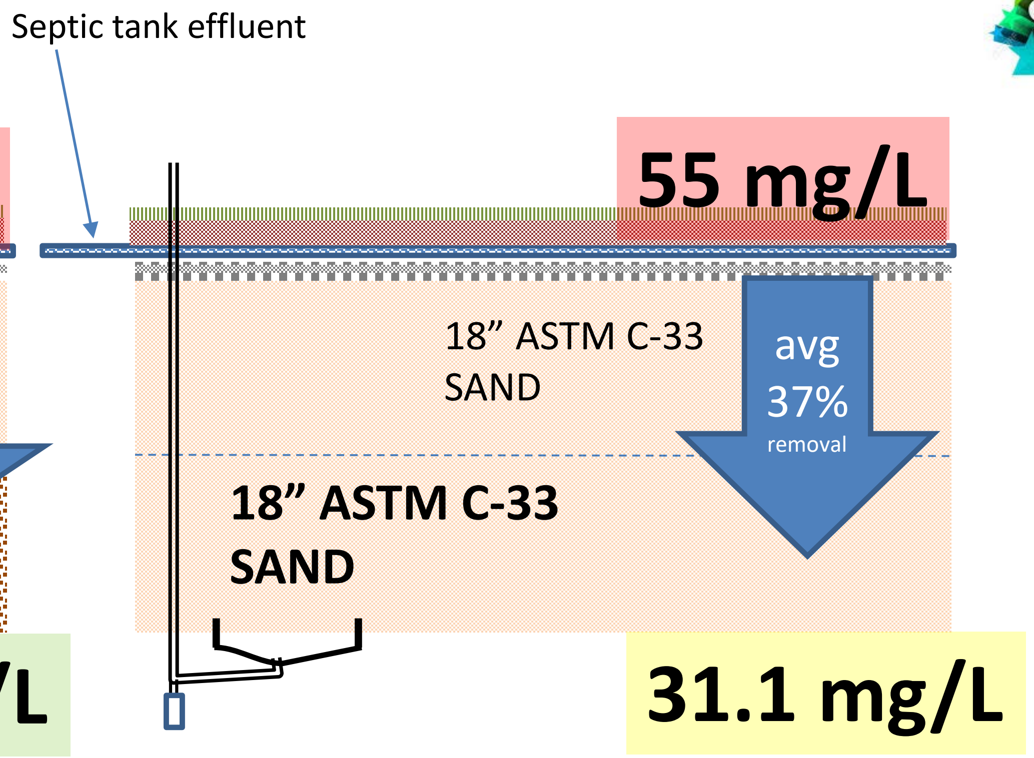
Acushnet Residential - 3 person year-round - 212 gal/day
Total Nitrogen (mg/L)
70
60
50
40
30
20
10
0
50
100
150
200
250
300
350
400
450
500
Experiment Day
50% Removal
19 mg/L
Septic Tank Effluent - TN
Acushnet-Sawdust - TN
Sand-Control - TN

Westport Year-Round Residence – Two adult occupants

Treated Portion of Soil Absorption System



Un-Treated (Control) Portion of Soil Absorption System

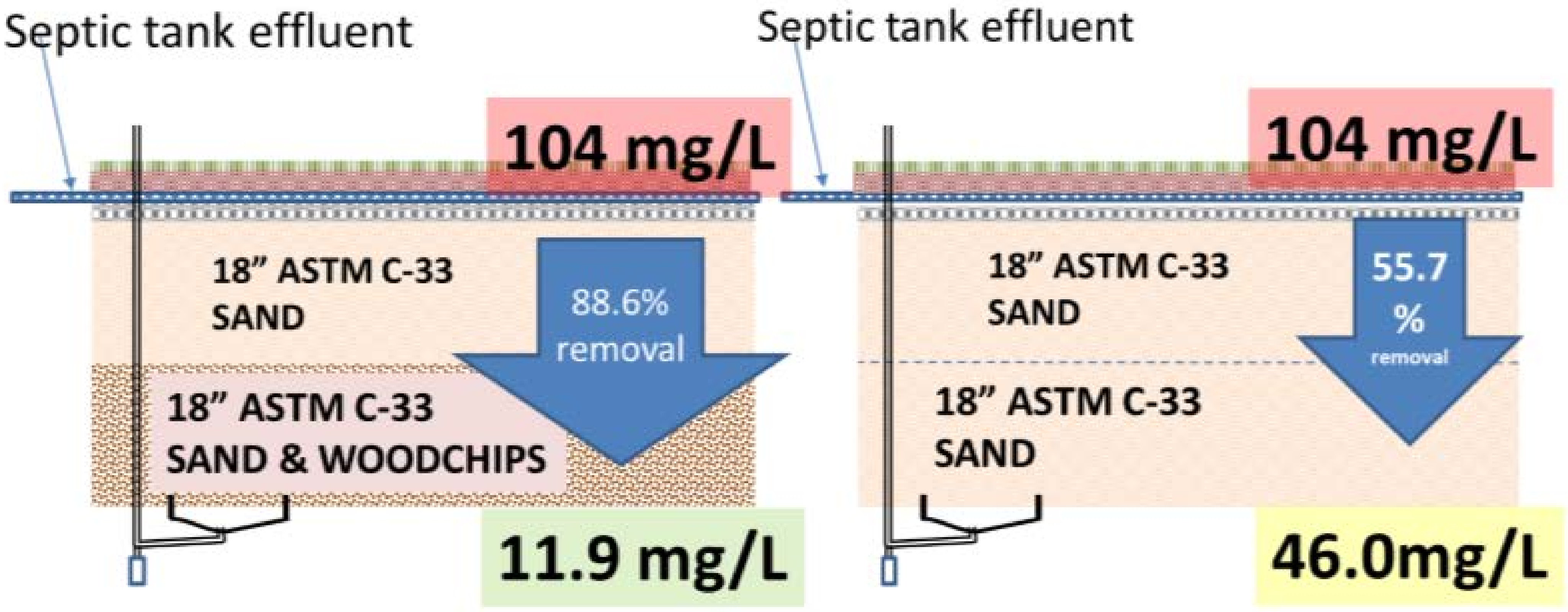


18 months of data

Seasonal Use

Treated Portion of Soil Absorption System

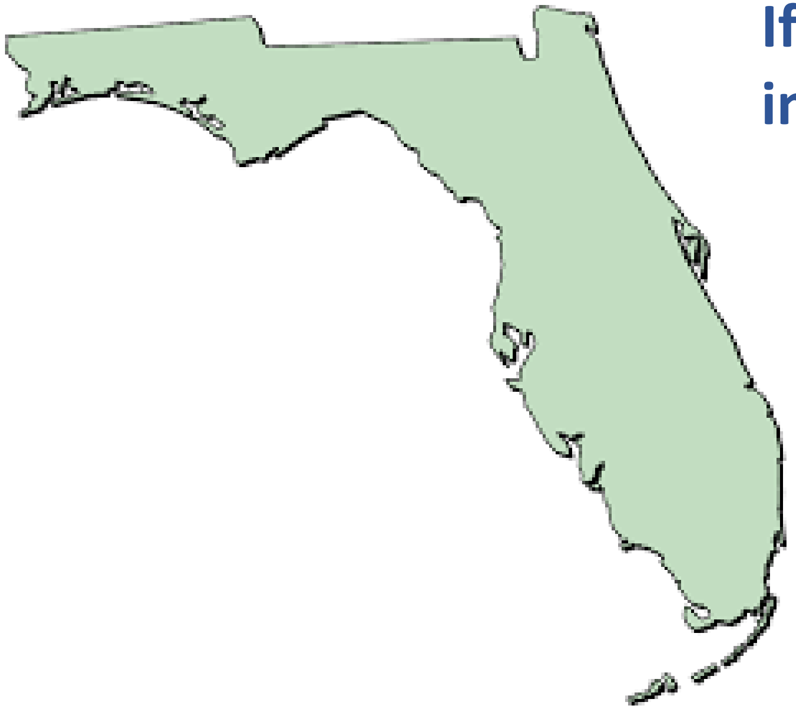
Un-Treated (Control) Portion of Soil Absorption System



Major Findings - simple layering approach

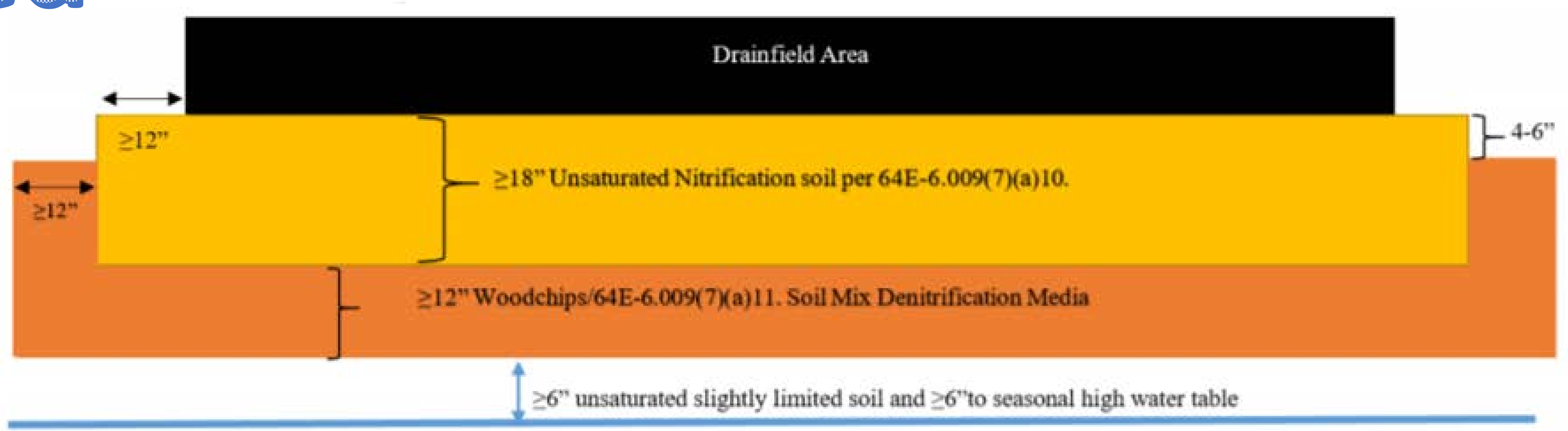
- **Cold weather impacts performance – Below 10^{o} C (50^{o}F) denitrification slows. Removal rates are reduced to 40 – 50%.**
- **We have still not determined the mechanism that slows performance to enhance cold-weather denitrification.**
- **Nitrification (the precursor of denitrification) does not seem to be appreciably reduced in soils-based systems** (but does slow a bit below 5^{o} C)
- **Residence time matters** (higher hydraulic loading – lower performance especially in cold weather)

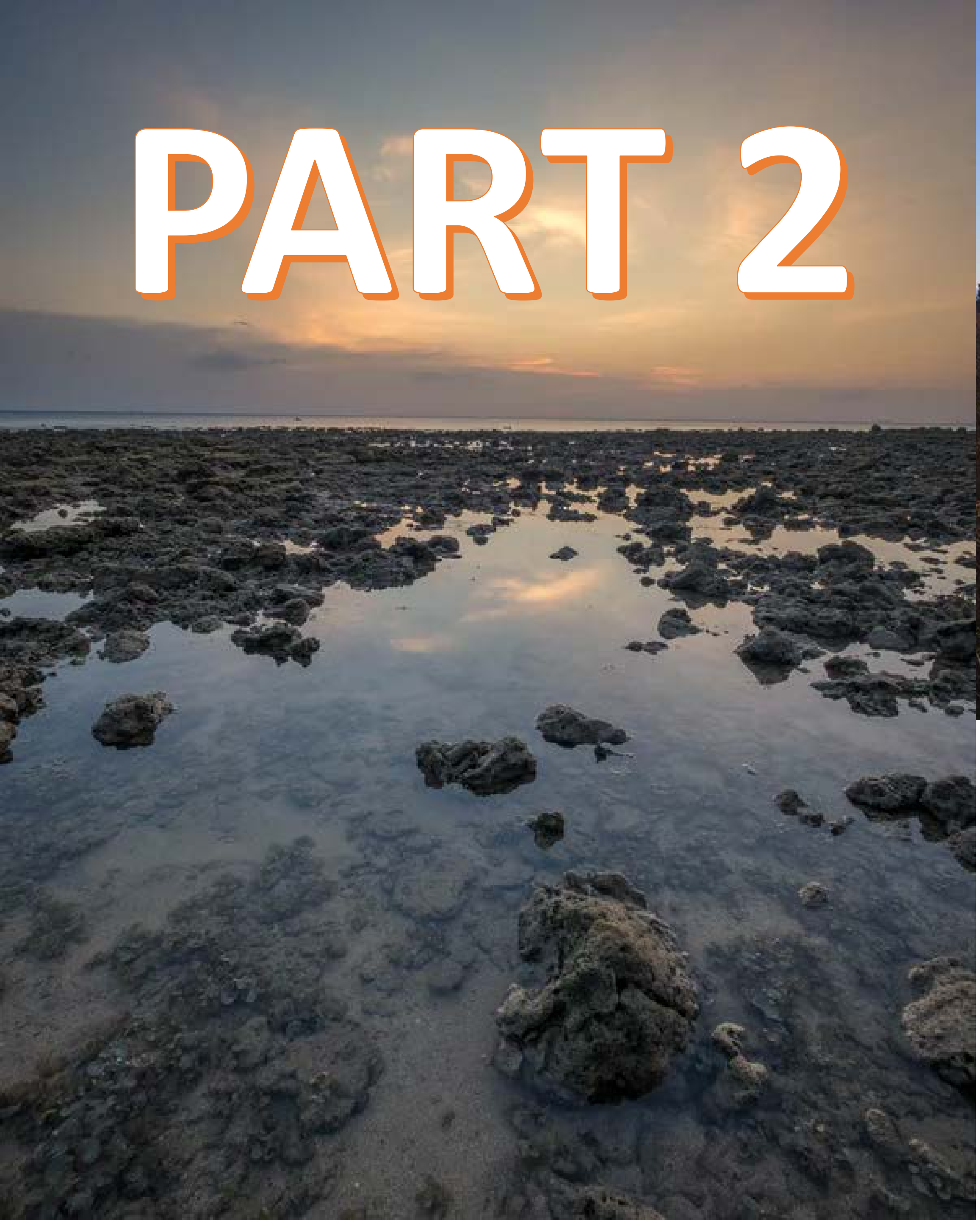
If you’re in Florida, there is probably little impact by temperature ☺



Source: STATE OF FLORIDA DEPARTMENT OF HEALTH CHAPTER 64E-6, FLORIDA ADMINISTRATIVE CODE - STANDARDS FOR ONSITE SEWAGE TREATMENT AND DISPOSAL SYSTEMS.

Allowed

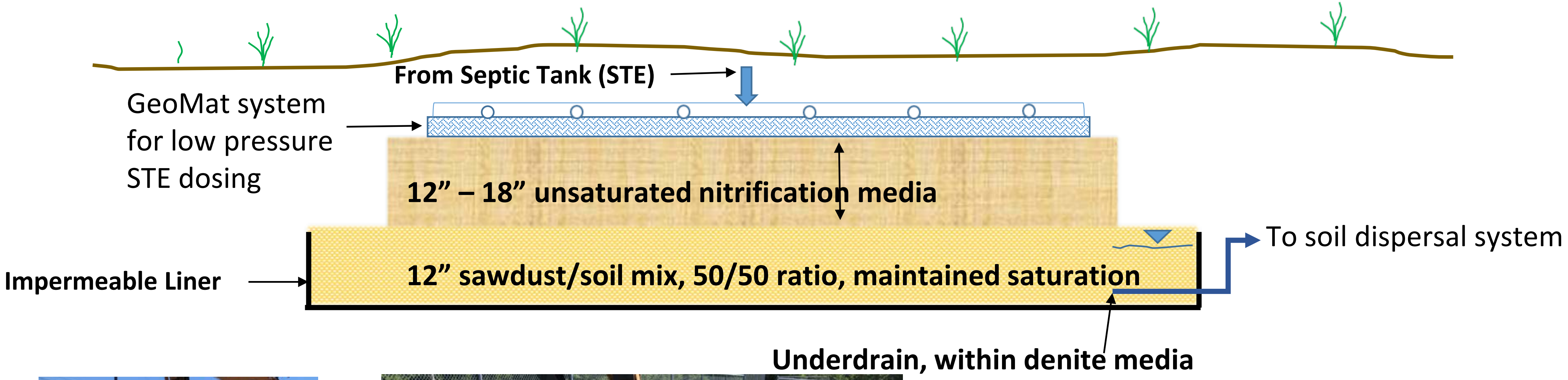




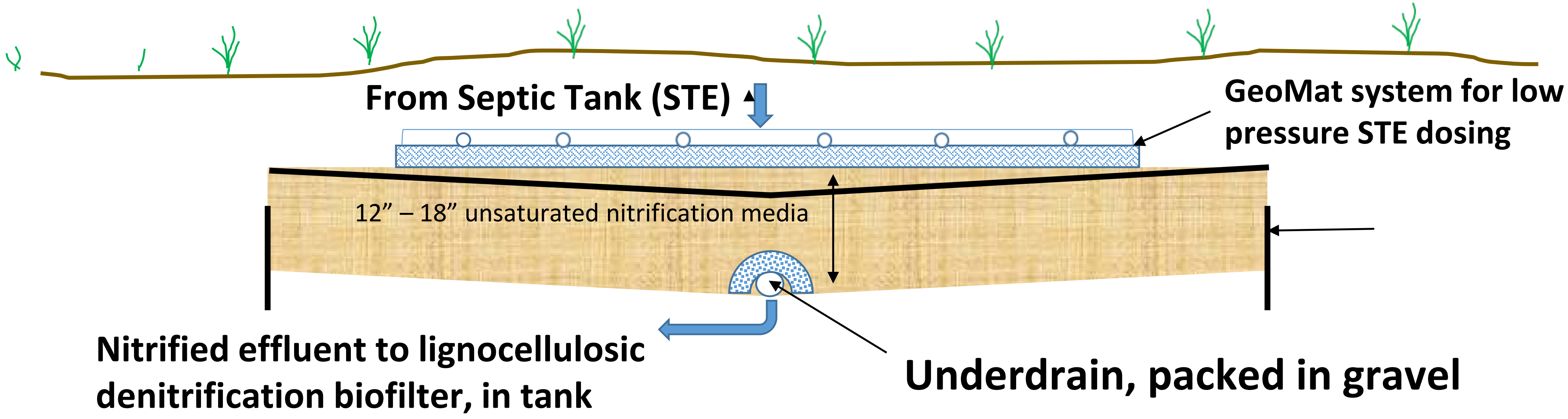
Saturation may be the key to stable denitrification

Two saturated designs show promise and are being installed under various demonstration projects

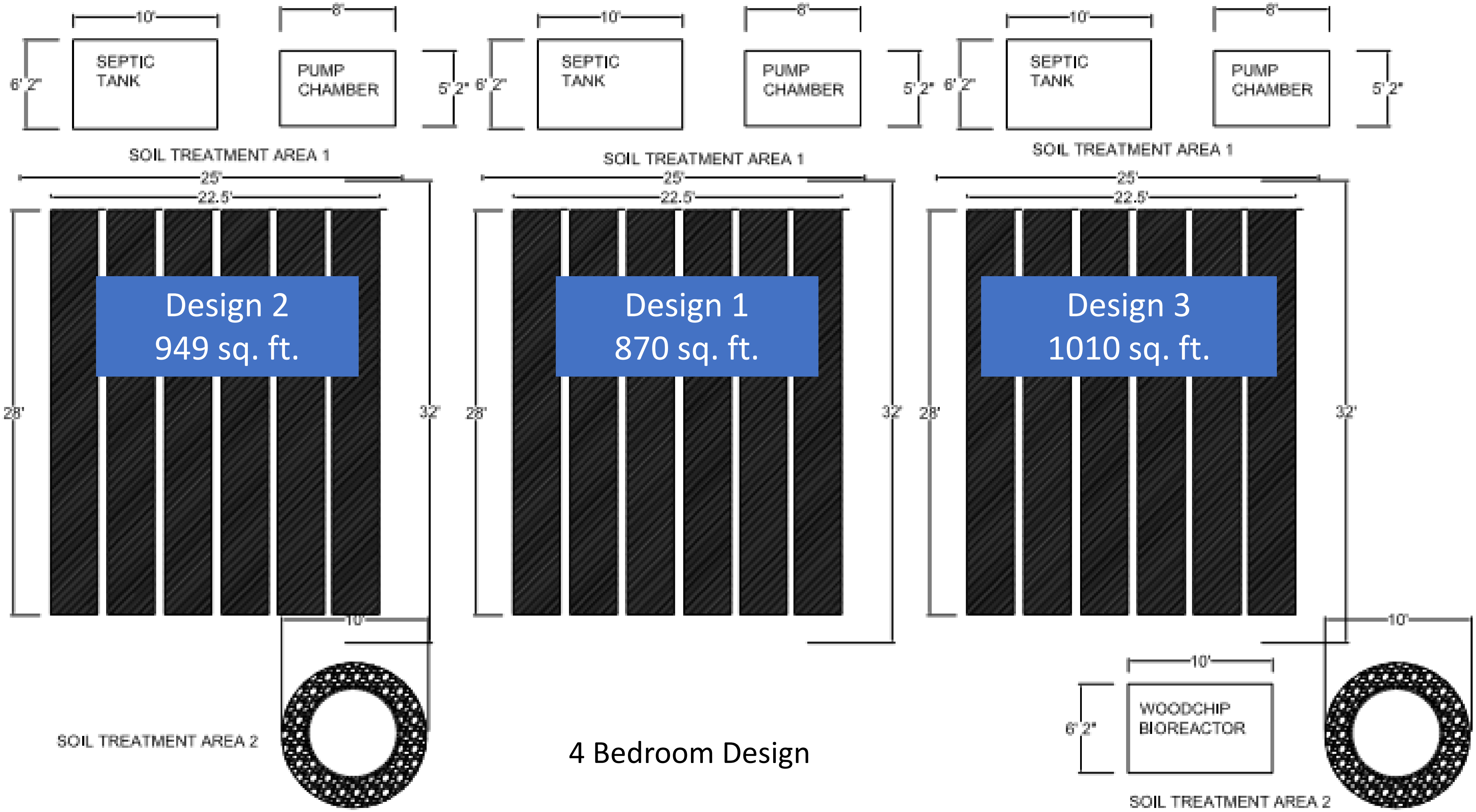
Layered, lined soil treatment system cross section



Unsaturated, Lined Nitrification System Cross Section (not to scale)



Both saturated designs require an additional soil treatment area for final disposal



4 Bedroom Design

	Design 1 Layered system with saturated denitrification layer	**Design 2** Layered system with no containment liner	**Design 3** Contained nitrification bed followed by a contained woodchip bioreactor	Standard Gravity System	Standard system requiring a pump
Septic Tank, pump chamber and Installation	$8,500	$8,500	$8,500	$3,500	$8,500
Pressure distribution means/piping	$1,500	$1,500	$1,500	$500	$500
Excavation leachfield	$2,600	$3,600	$1,500	$1,750	$1,750
Sand	$1,500	$1,500	$950	$1,700	$1,700
Gravel	$250	$200	$250	$1,000	$1,000
Miscellaneous	$1,000	$1,000	$1,000	$1,000	$1,000
Pump and wiring	$600	$600	$600		$600
Control Panel and wiring	$900	$900	$900		$900
Containment Liner and piping	$600		$600		
Containment tank and piping			$2,500		
Sawdust	$400	$400			
Woodchips			$300		
Soil Treatment Area 2**	$3,500		$3,500		
Total Costs	$21,350	$18,200	$22,100	$9,450	$15,950

Where to now?

- **Further experiments with unsaturated design**
- **Installation and testing of “box“ saturated design**
- **Enhancement experiments to find ways to overcome diminished winter performance**
- **Research the findings in Florida, Long Island, Connecticut and anywhere else these systems are allowed**
- **Continue to research ways to bring down costs**
- **Anything else that comes to mind**


Questions?