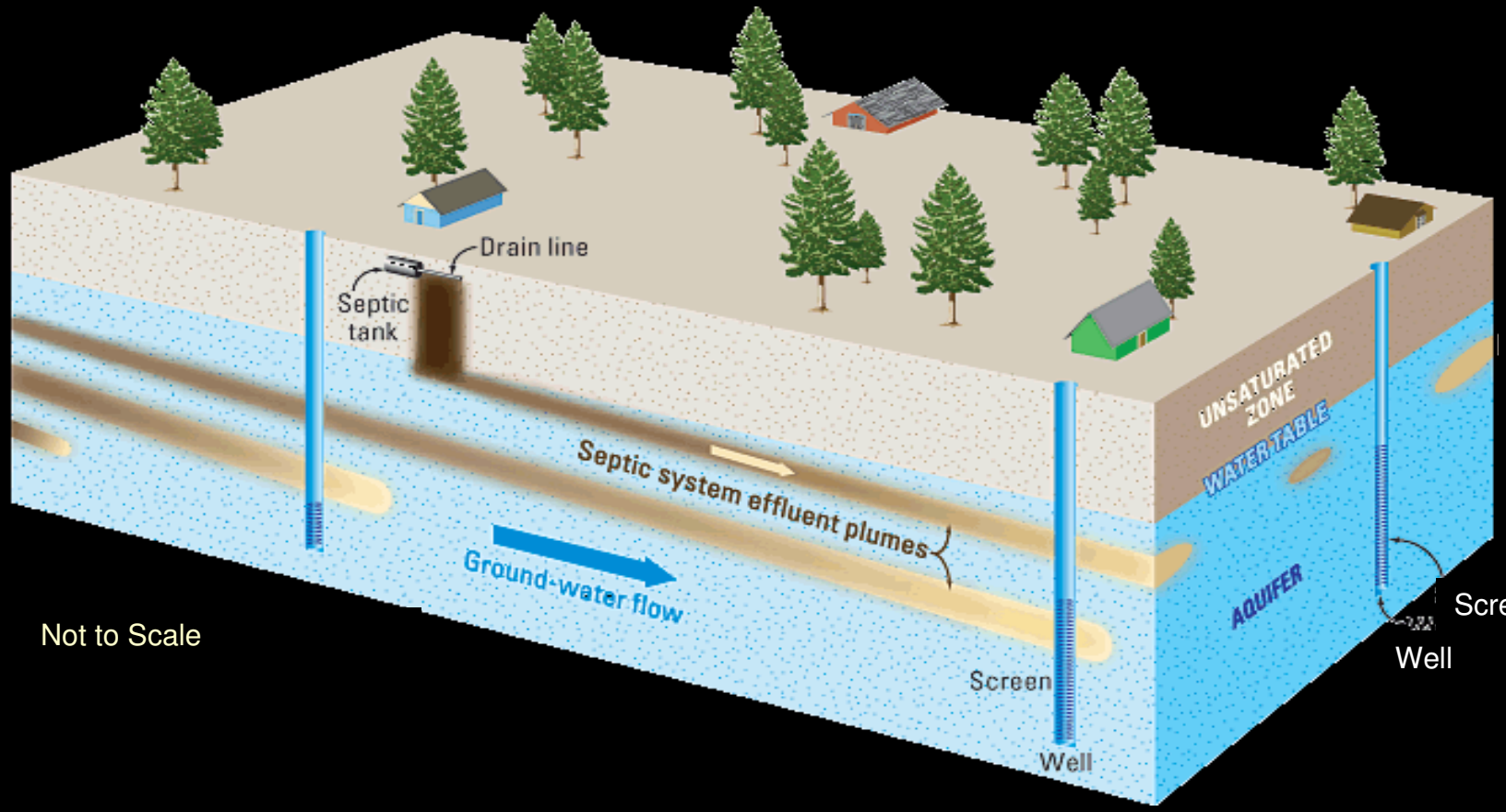
Alternate Design Treatment Systems Pilot Program



Not to Scale

http://pubs.usgs.gov/fs/2007/3103/

August 26, 2016

New Jersey Pinelands Commission

Alternate Design Treatment Systems Pilot Program

Pinelands Ad Hoc Committee on Alternative Septic Systems

Members:

- S. Joseph Kowalski, Pinelands Commissioner
- Candace McKee Ashmun, Pinelands Commissioner
- Sally Dudley, Pinelands Commissioner
- Linda M. Eckenhoff, Pinelands Commissioner
- Theodore Gordon, Pinelands Commissioner
- Jay Edward Mounier, Pinelands Commissioner
- Norman F. Tomasello, Pinelands Commissioner
- Edward McGlinchey, Pinelands Municipal Council
- Lee Rosenson, Pinelands Preservation Alliance
- John Sheridan, New Jersey Builders Association

Committee was formed in 2000
Final Report issued on August 24, 2001

NJ Pinelands

- Unique nitrogen-sensitive ecosystem characterized by acidic, nutrient-poor streams fed by shallow water table aquifer
- Overlies the 17.7 trillion gallon unconfined Kirkwood-Cohansey Aquifer
- Habitat for 41 T&E animal species and 54 T&E plant species
- Headwaters to both Atlantic and Delaware Basin Watersheds

Alternate Design Treatment Systems Pilot Program -Basis for the Program

Water Quality Protection

•Federal and State Pinelands Statutes call for preservation, protection and enhancement of Pinelands water resources.

• Pinelands standard is 2 mg/l (2 ppm) Nitrate-N (anti-degradation)

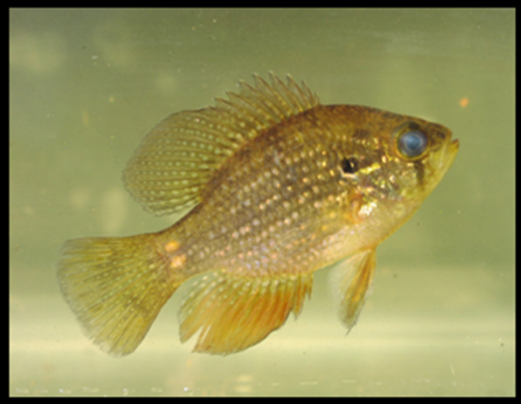
Why monitor Nitrogen?

• Useful indicator of both surface and groundwater quality in the Pinelands.

- Limiting nutrient, naturally present < [0.17mg/l];
- Conservative (persistent) pollutant (as nitrate);
- Mobility marker due to solubility in water;
- Inexpensive laboratory tests are readily available.

Ecological Implications

- Rising nutrient levels can tip the balance and provide competitive advantage to non-native plants and animals
- Ammonia toxicity to fish life & oxygen depletion via nitrification of ammonia in receiving streams (NOD)
- Nitrate from septic systems generally affects shallow groundwater which discharges as “base flow” to lakes, ponds and streams during times of low flow.



Ecological Implications

- Eutrophication of surface waters - nitrate from septic systems “fertilize” the waters greatly increasing algae growth
- Phytoplankton and algae blooms increase turbidity, decrease sunlight penetration: stress and kill eelgrass beds - fish and shellfish habitat in coastal estuaries
- Blooms die off, decomposition leads to low dissolved oxygen levels stressing aquatic animals
- Speeds the natural process of hydrarch succession in which lakes and ponds fill via deposition of organic matter and siltation.

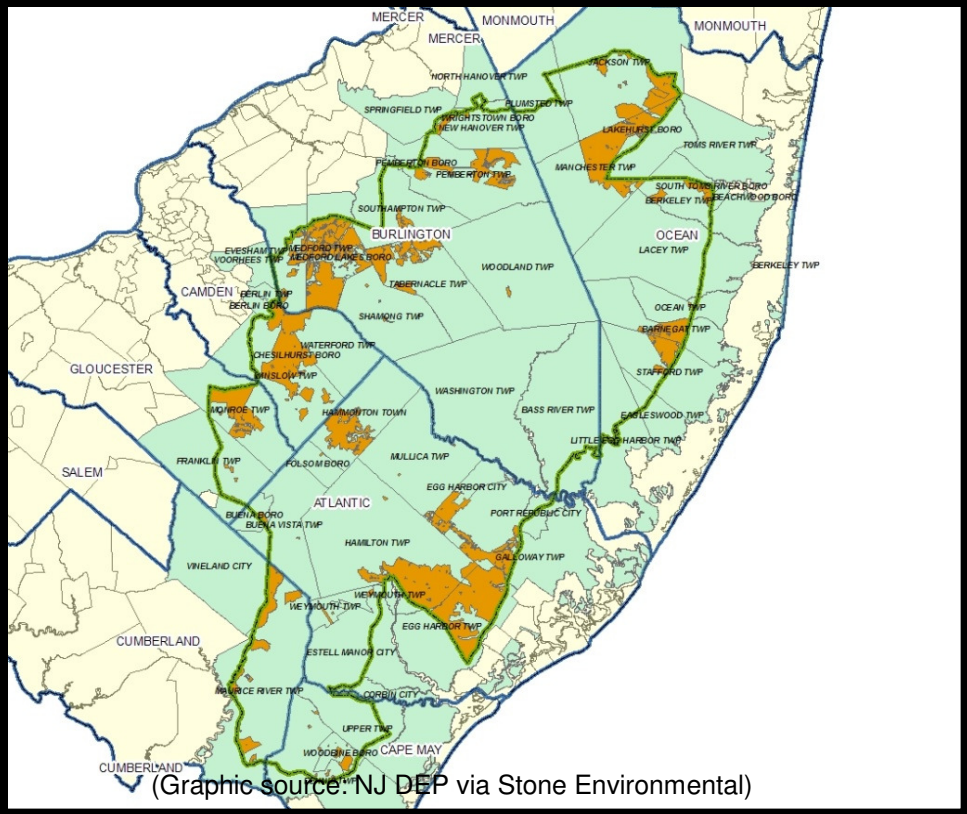
(lake ⟶ marsh ⟶ dry land)

Pinelands Centralized Sewer and Onsite Wastewater System Service Areas

- Onsite (septic and advanced) systems are relied upon throughout the Pinelands area and are a permanent component of the region's wastewater infrastructure.

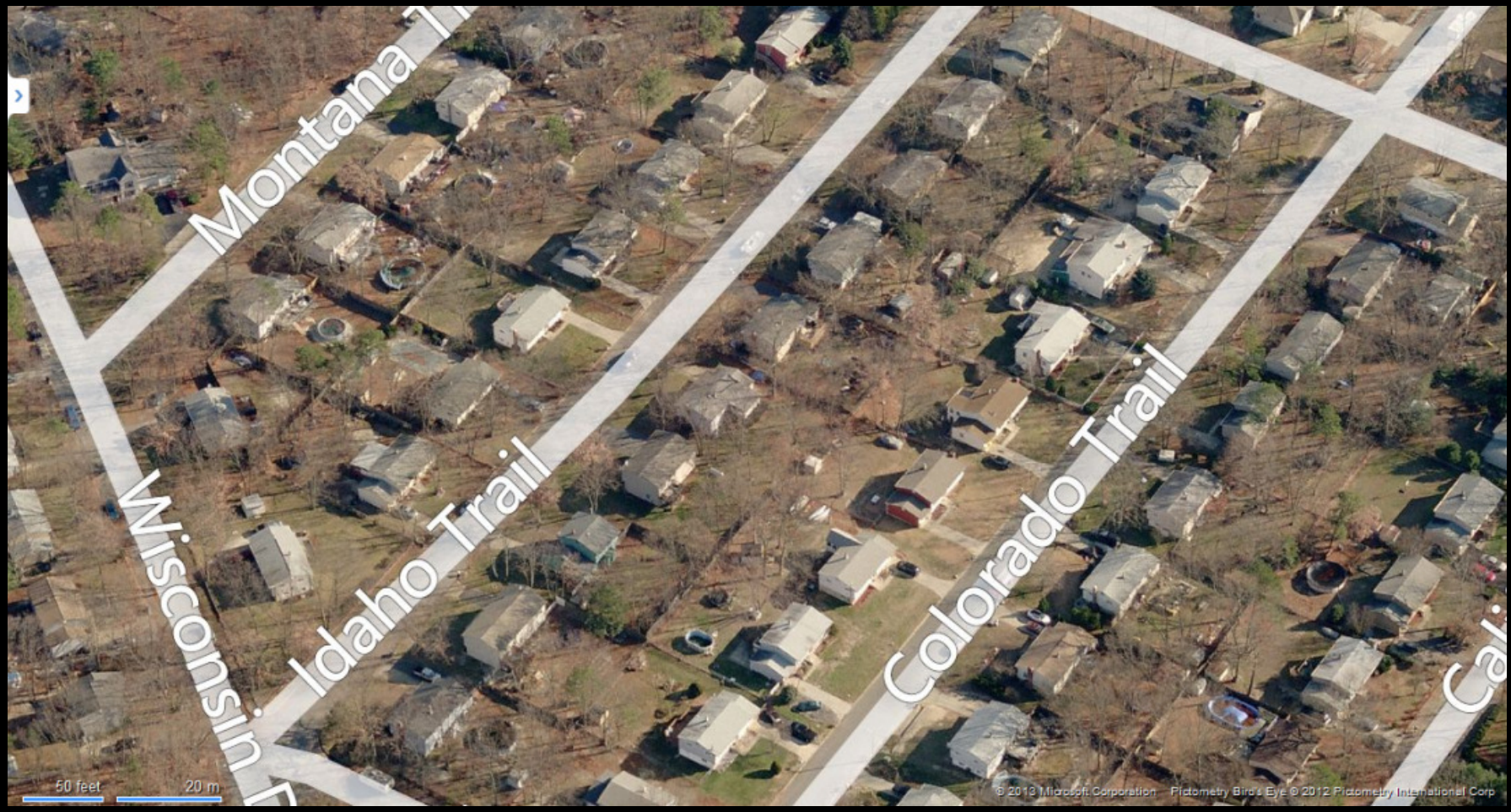
- Standard septic systems achieve nitrogen standard through dilution on larger lots.

- Advanced systems meet the nitrogen standard through active treatment and dilution on smaller lots.



(Graphic source: NJ DEP via Stone Environmental)

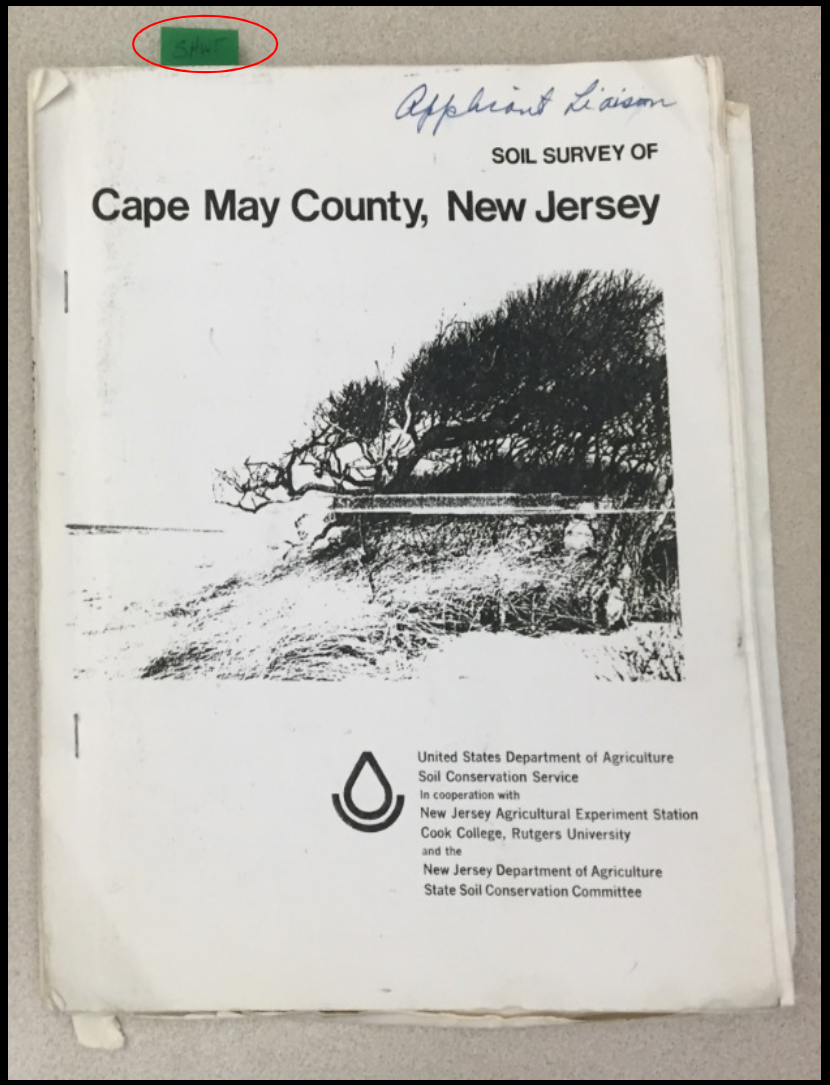
Onsite Wastewater Systems in the Pinelands



Approximately 22,000 existing septic systems in the Pinelands Area

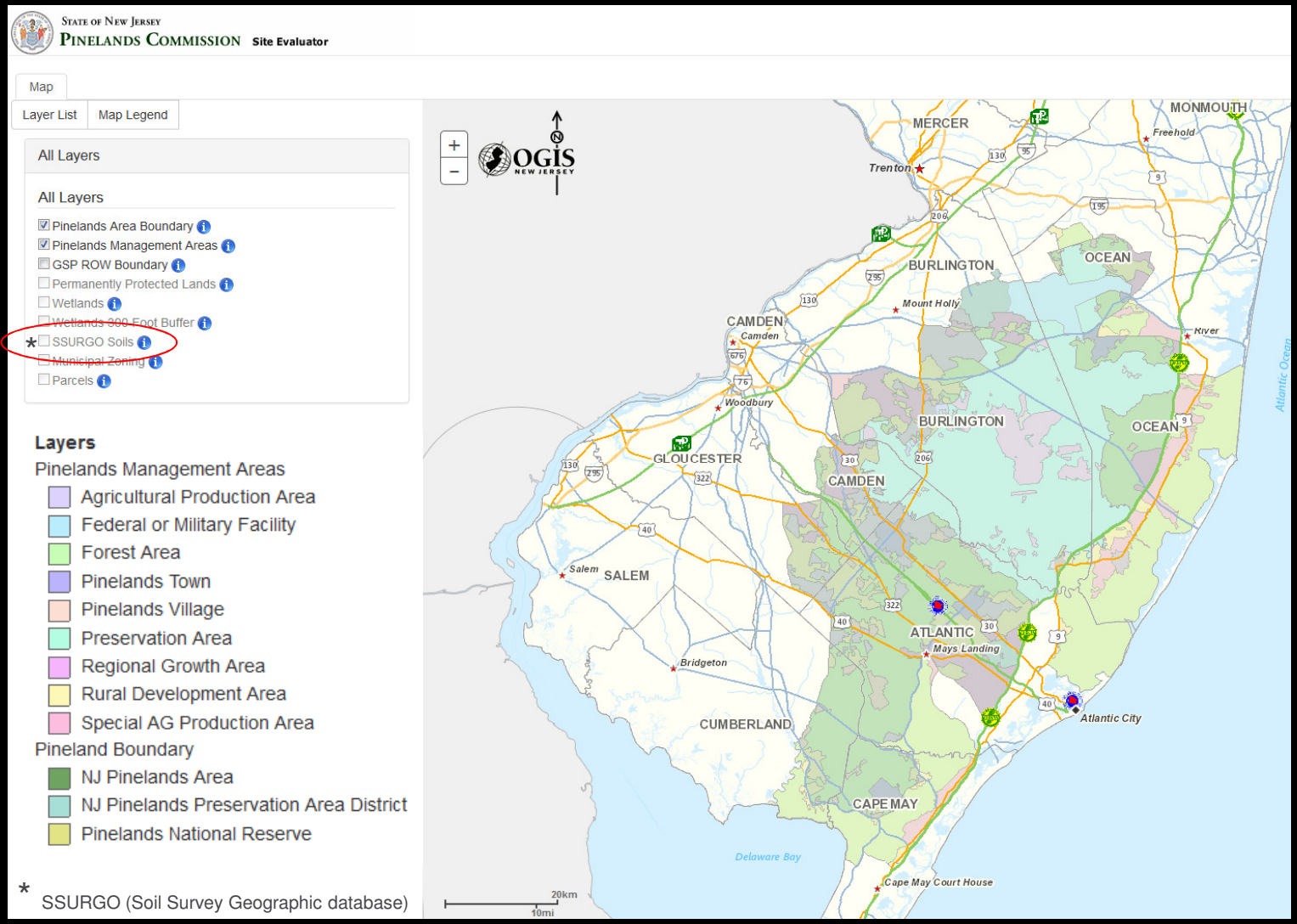
Siting and Designing an Onsite Wastewater System in the NJ Pinelands

Desktop Soil Evaluation Tools



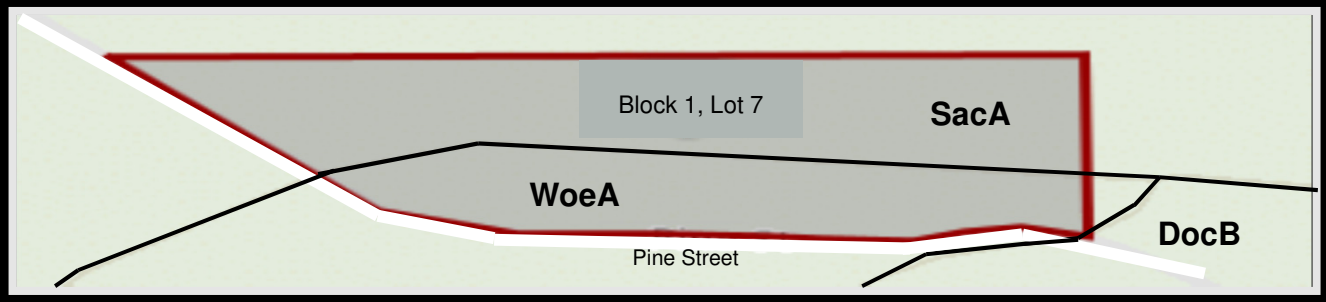
Siting and Designing an Onsite Wastewater System in the NJ Pinelands

The Pinelands Site Evaluator : A state of the art Desk Top Soil Evaluation Tool:



Siting and Designing an Onsite Wastewater System in the NJ Pinelands

Pinelands Site Evaluator



- Locate area of interest and draw polygon around the parcel
- Zoom in to see soil map unit symbols for soil types likely present in the area of concern
- Create reports containing relevant (engineering, agricultural, etc.) soil properties

Map Unit Symbol	Map Unit Name	Map Unit Acreage	% of Total Acreage	
DocB	Downer loamy sand, 0 to 5 percent slopes	0.12	2%	
	Component Name	**Component Acreage**	**Component % of Map Unit Acreage**	**Component Disposal Field Rating**
	Atsion	0.01	5%	Very limited
	Evesboro	0.01	5%	Not limited
	Downer	0.10	80%	Not limited
	Hammonton	0.01	5%	Somewhat limited
	Mullica	0.01	5%	Very limited
Map Unit Symbol	**Map Unit Name**	**Map Unit Acreage**	**% of Total Acreage**	
SacA	Sassafras sandy loam, 0 to 2 percent slopes	2.32	38%	
	Component Name	**Component Acreage**	**Component % of Map Unit Acreage**	**Component Disposal Field Rating**
	Woodstown	0.12	5%	Somewhat limited
	Downer	0.12	5%	Not limited
	Sassafras	1.86	80%	Not limited
	Fallsington	0.12	5%	Very limited
	Aura	0.12	5%	Very limited
Map Unit Symbol	**Map Unit Name**	**Map Unit Acreage**	**% of Total Acreage**	
WoeA	Woodstown sandy loam, 0 to 2 percent slopes	3.69	60%	
	Component Name	**Component Acreage**	**Component % of Map Unit Acreage**	**Component Disposal Field Rating**
	Fallsington	0.37	10%	Very limited
	Downer	0.18	5%	Not limited

Component Name	Component Acreage	Component % of Map Unit Acreage	Month	Component Depth to Water Table (in)
Sassafras	1.76	80%	January	> 79 in
SacA			February	> 79 in
			March	> 79 in
			April	> 79 in
			May	> 79 in
			June	> 79 in
			July	> 79 in
			August	> 79 in
			September	> 79 in
			October	> 79 in
			November	> 79 in
			December	> 79 in
Component Name	**Component Acreage**	**Component % of Map Unit Acreage**	**Month**	**Component Depth to Water Table (in)**
Woodstown	0.11	5%	January	20 - 39 in
WoeA			February	20 - 39 in
			March	20 - 39 in
			April	20 - 39 in
			May	40 - 59 in
			June	40 - 59 in
			July	> 79 in
			August	> 79 in
			September	> 79 in

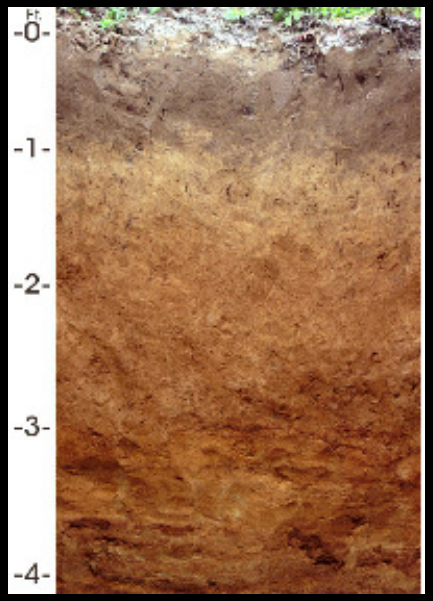
Siting and Designing an Onsite Wastewater System in NJ

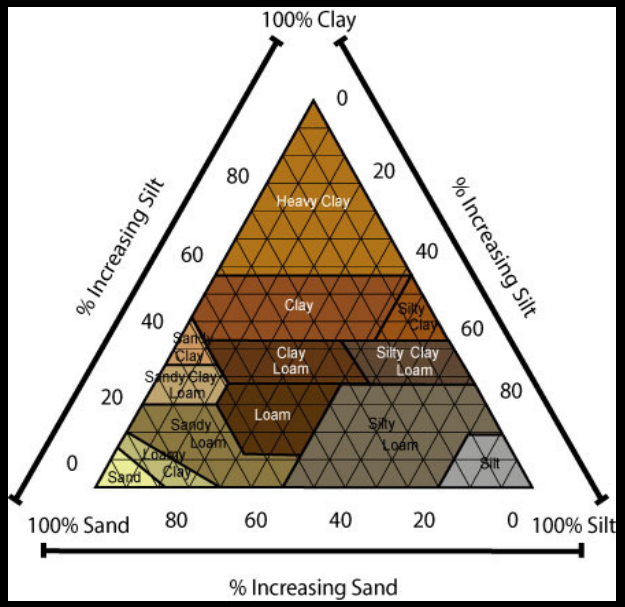
NJDEP's Septic Reg's – Desk top tool

Soil Series Name (Map Unit Symbol)	**Typical Classification(s)** (Severity of limitations)	**Type of Leach Field Permitted**
Sassafras (SacA)	I	Conventional
Woodstown (WoeA)	IIIWr (IIWr)	Unsuitable in the Pinelands Area if SHWT < 5' (IIIWr) Unsuitable outside Pinelands Area if SHWT < 2' (If SHWT > 2' and < 7' mounded system would be required)

Siting and Designing an Onsite Wastewater System in the NJ Pinelands

Site Specific Field Work – Soil Test Pit Log





Block 1, Lot 7 Pinelands Twp.
SL-16
Existing grade elevation = 32.1'

0"- 3" very dark grayish brown (10YR 3/1) **sandy loam**, weak fine granular; very friable, many fine to medium roots; abrupt smooth boundary.

3"- 6" yellowish brown (10YR 5/4) **sandy loam**, weak fine granular, friable, 5% fine gravel, common medium roots, clear smooth boundary.

6" - 12" brown (10YR 5/6) **sandy loam**, weak fine subangular blocky; friable, 5% fine gravel, common medium roots, clear smooth boundary.

12" - 17" brown (10YR5/6) **loam,** moderate medium subangular blocky; friable, 5% fine gravel, common medium roots, clay bridging between sand grains, clear smooth boundary.

17" - 41" yellowish brown (10YR 5/6) **sandy clay loam,** moderate medium subangular blocky; firm; 5% fine gravel; clay bridging between sand grains; abrupt wavy boundary.

41" - 54" reddish yellow (7.5YR 5/8) **loamy coarse sand;** massive; very friable, 10 % fine gravel; abrupt wavy boundary.

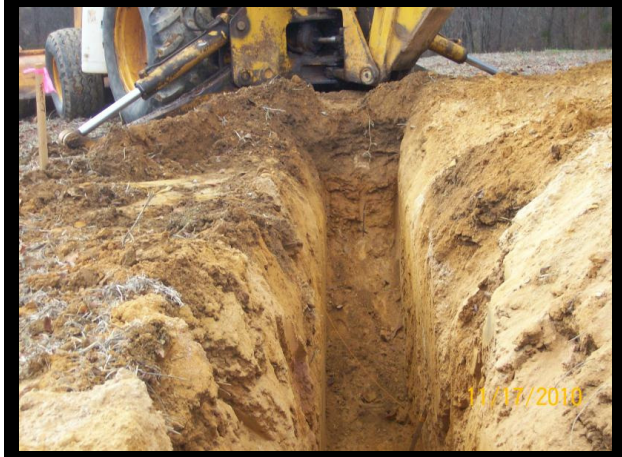
54'- 96" brownish yellow (10YR 6/8) **sand**, single grain, loose, gradual wavy boundary

96" – 144" brownish yellow (10YR 6/8) **sand**, single grain, loose, common medium prominent white (10YR 8/1) mottles beginning at 96" and extending to 144". Moderate groundwater seepage at 101", water stabilized at 101" after 3 hours.

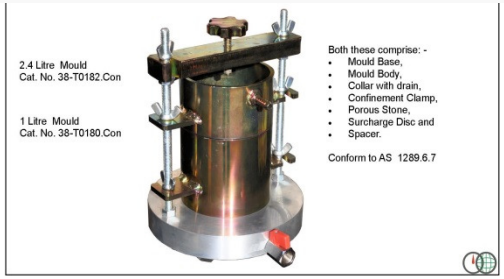
Test pit completed at 144"
Mottles encountered at 96"
Groundwater seepage encountered at 101"
Estimated SHWT at 96" (Mottles)
Date Completed May 15, 2016

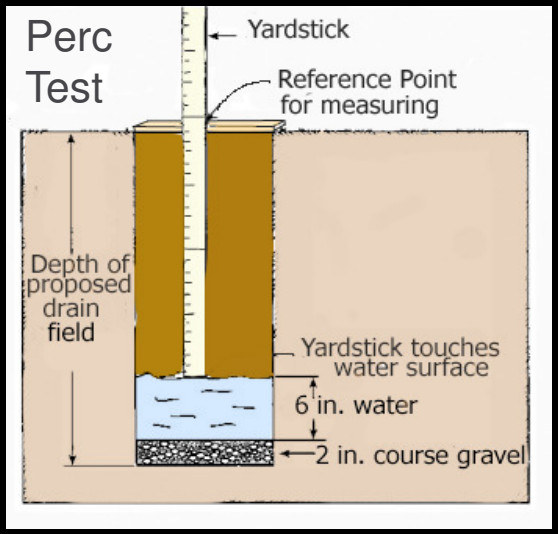
Siting and Designing an Onsite Wastewater System in the NJ Pinelands

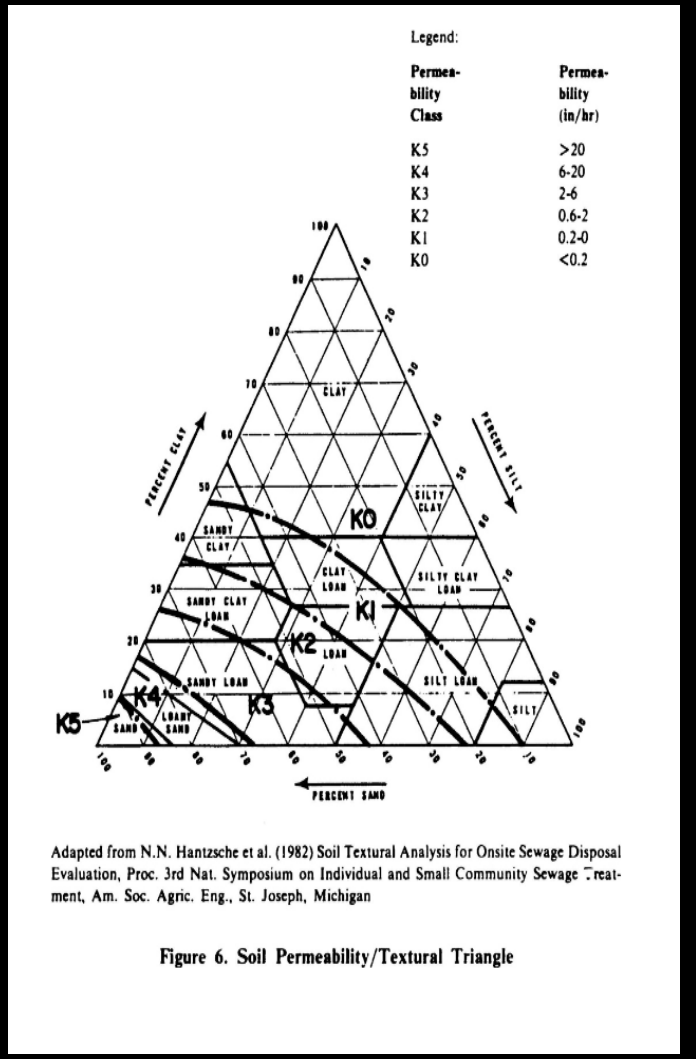
Hydraulic Conductivity – Permeability Testing



Laboratory Tube Permeameter





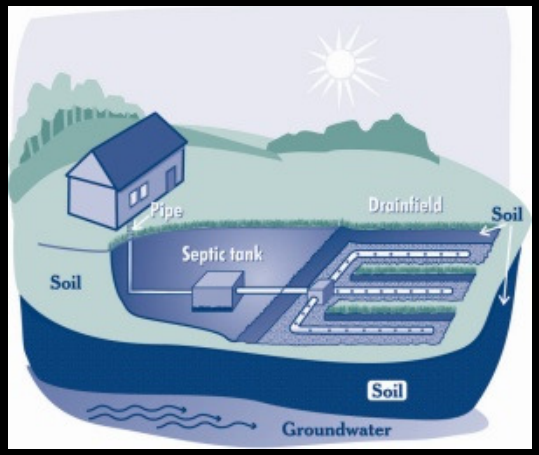


Adapted from N.N. Hantzsche et al. (1982) Soil Textural Analysis for Onsite Sewage Disposal Evaluation, Proc. 3rd Nat. Symposium on Individual and Small Community Sewage Treatment, Am. Soc. Agric. Eng., St. Joseph, Michigan

Figure 6. Soil Permeability/Textural Triangle

Rules Governing Onsite Wastewater Systems in the Pinelands

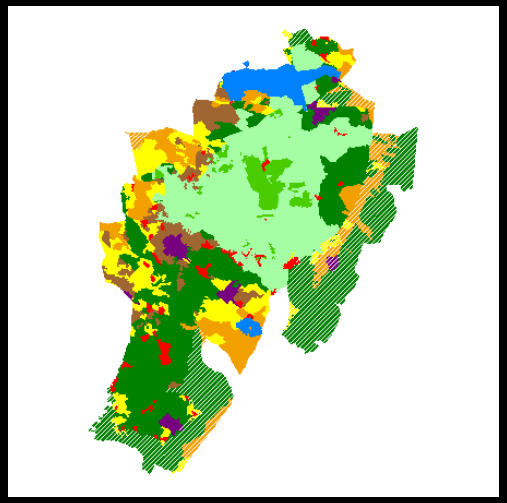
STANDARDS FOR INDIVIDUAL SUBSURFACE SEWAGE DISPOSAL SYSTEMS



New Jersey Department
Of Environmental
Protection
N.J.A.C 7:9A

System design, use and management standards

PINELANDS COMPREHENSIVE MANAGEMENT PLAN



New Jersey
Pinelands Commission
N.J.A.C 7:50

5' to SHWT
2 ppm NO_3^-
System management standards

Siting and Designing an Onsite Wastewater System in the NJ Pinelands

Septic tank size is determined by design flow – number of bedrooms for residential systems

Minimum size septic tank = 1000 gal (Required for 4 bedroom and smaller homes)

Add 250 gal for each additional bedroom over four

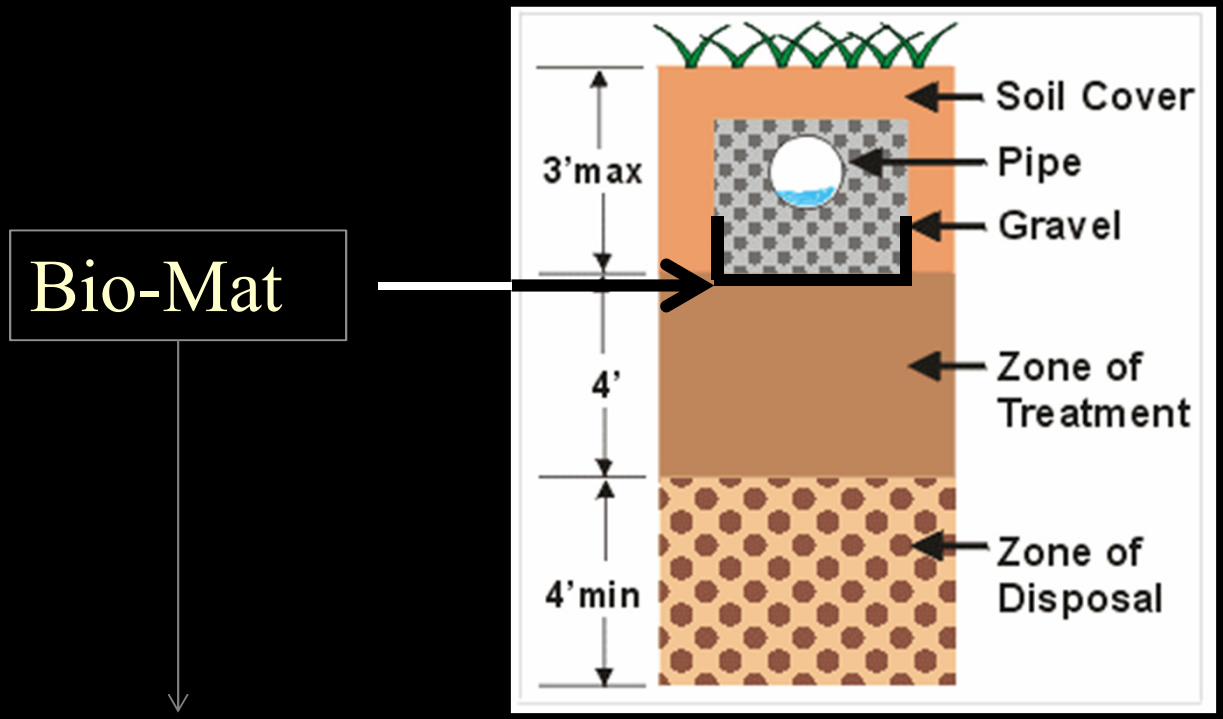
Multiple compartment tanks retain solids better that single compartment tanks

Siting and Designing an Onsite Wastewater System in the NJ Pinelands

Leach field size is determined by wastewater volume to be infiltrated and the permeability of the receiving soil. Low permeability soils require larger area to absorb a given volume of wastewater.

A typical residential leach field, designed by current standards is on the order of 1050 SF (21' x 50')

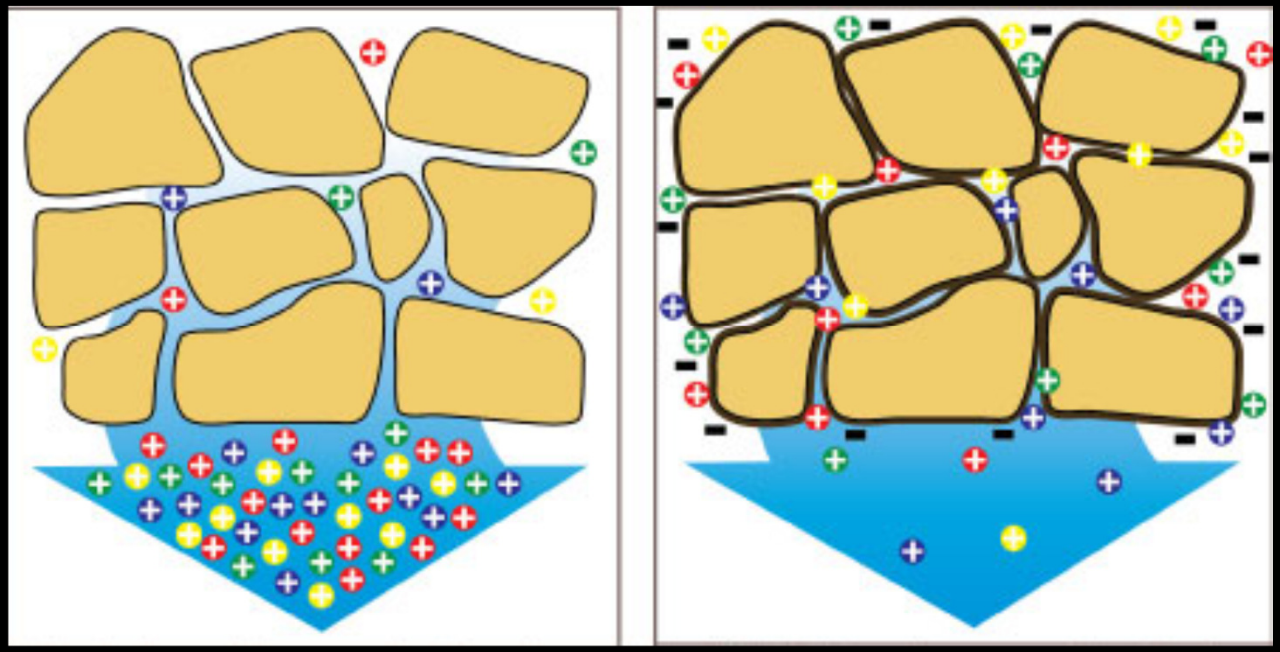
Wastewater renovation via soil-treatment systems



- Wastewater solids, dead and living microorganisms, microbial secretions, insoluble compounds and non-degradable synthetic fibers.
- 3/16 to 1-3/8 thick with permeability on the order of 0.25 inches per hour (K1)
- Removes organic material and pathogens but no sustained nitrogen removal

Soil as a treatment medium –removal of viral pathogens and positively charged pollutants

Cation Exchange – attraction and retention due to electric charge



Sandy soils often lack the negative charge on clay & organics & don't retain positively charged (cation) pollutants.

Loamy soils containing clay and organics attract and retain positively charged cations (Virus particles, heavy metals, sodium, etc.)

Neither sandy soils nor loamy (silty/clayey) soils are effective at removing NO_3^-

Effects of Local Nutrient Pollution

Sept. 11, 2014 Pancoast Mill Pond, Buena Vista Township

Nutrient-fueled Phytoplankton Bloom off the New Jersey Coast

July 6, 2016 NASA Aqua Satellite Image

http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=88340

The Pinelands Septic Dilution Model

$$At = Af + \frac{\left(\frac{FLf}{C} - Df\right)}{Do} Af$$

Land use planning tool where:
At = total parcel area
Af = area of disposal field
F = unit conversion factor of 10
Lf = flux of nitrate-nitrogen below disposal field (kg/ha/yr)
C = concentration of nitrate-nitrogen (ppm)
Df = equivalent depth of percolate below disposal field (cm/yr)
Do = equivalent depth of percolate below open acres (cm/yr)

Parameter	Assumption
Number of persons/dwelling	3.5
Number of persons/age restricted dwelling	2.0
Residential wastewater flow (gal/capita/day)	75
Plant uptake of nitrogen	4.5% A soils / 9.0% B soils
Infiltration rainfall	20.0 inches/year
Nitrogen production (grams/capita/day)	11.2
Distribution of nitrogen in wastewater	83% blackwater / 17% greywater
Nitrogen concentration in residential wastewater	39.45 ppm

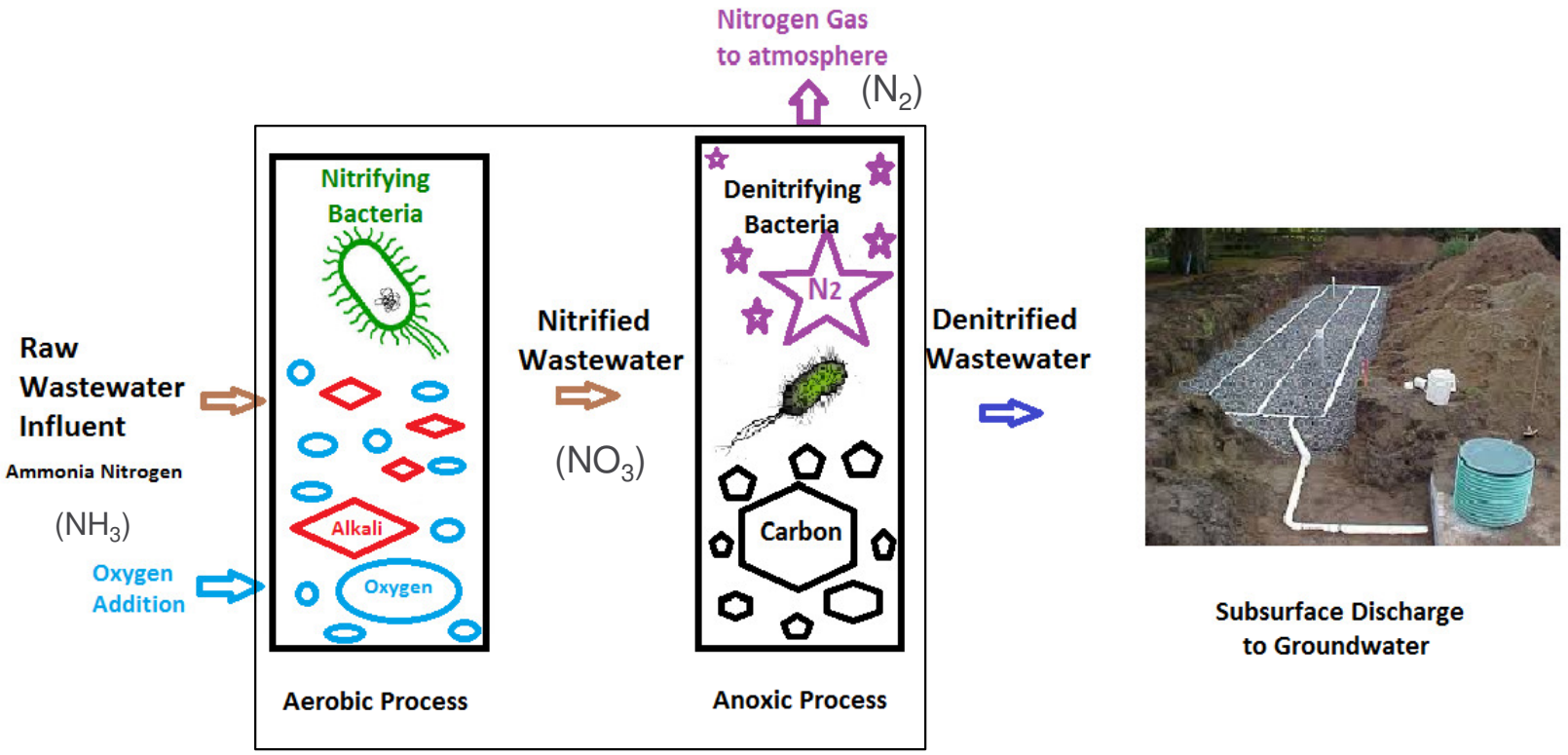
- The model assumes an average residential flow of 262.5 gpd based (3.5 persons x 75 gal/person).
- Requires 3.2 acres to meet water quality standard if using a conventional septic system.

Nitrogen Dilution Modeling

* Minimum lot size requirements

Effluent Total [N] mg/l	% Reduction N removal rate	Lot Area (acres) to meet 2 mg/l
39.45	0	3.2
32	20	2.5
26	35	2.0
19	50	1.5
14	65	1.0

* Nitrogen attenuation achieved by the pilot program technologies does not allow for the creation of more 1 acre parcels than are otherwise already permitted. Instead, these technologies permit development to occur where preexisting zoning already allows for 1 unit/acre, enabling that development to meet Pinelands water quality standards.



Onsite Treatment Process for Biological Nitrogen Removal

(Required in Pinelands if < 3.2 acres)

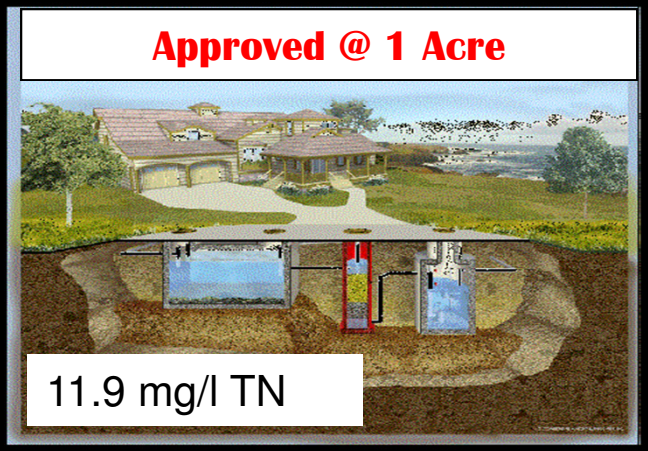
Original Five Pilot Program Wastewater Systems Selected for their Ability to Reduce Nitrogen

System	Pilot Program Status
Amphidrome	Permanently approved for use on min. one acre lots
Bioclere	Permanently approved for use on min. one acre lots
Cromaglass	Eliminated from the pilot program (Sept. 2014)
Fast	To be authorized for use on minimum 1.4 acre lots
Ashco RFS^{III}	Removed from pilot program Dec. 2007

Original Pilot Program Technologies

Amphidrome

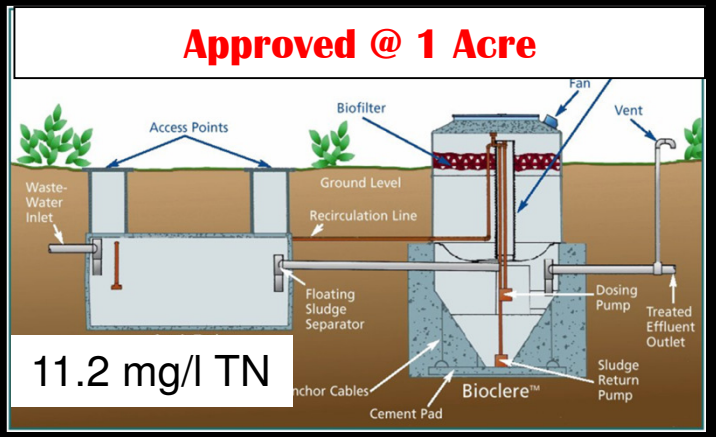
Approved @ 1 Acre



11.9 mg/l TN

Bioclere

Approved @ 1 Acre



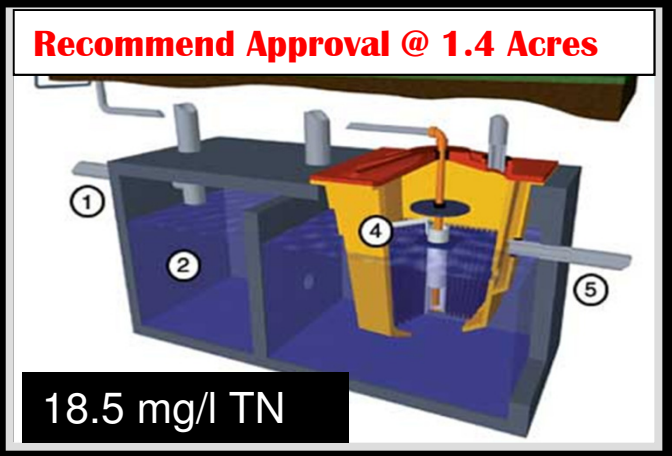
11.2 mg/l TN

Cromaglass

31.5 mg/l TN

FAST

Recommend Approval @ 1.4 Acres



18.5 mg/l TN

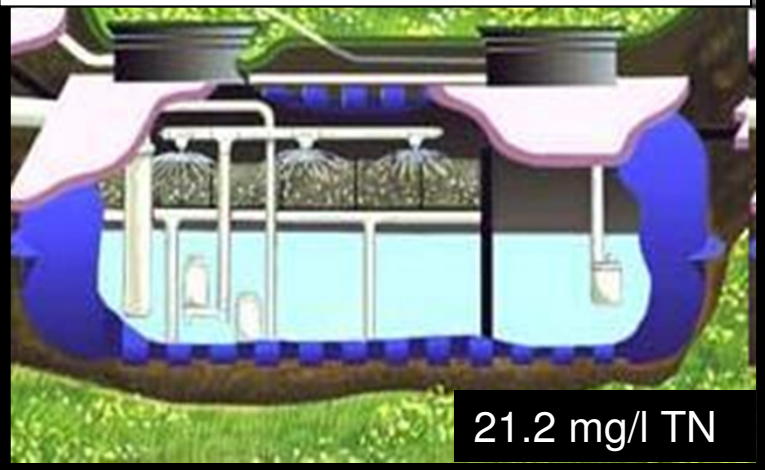
Four New Pilot Program Wastewater Systems

System Name	System Vendor	Treatment Process
Bio Barrier	Bio-Microbics, Inc.	Membrane Bioreactor
Busse GT	Busse Green Technologies, Inc.	Membrane Bioreactor
Hoot ANR	Hoot Systems, LLC.	Extended Aeration/Activated Sludge
SeptiTech	SeptiTech, LLC	Fixed Film Trickling Filter

Second Round Pilot Program Technologies

Septi Tech

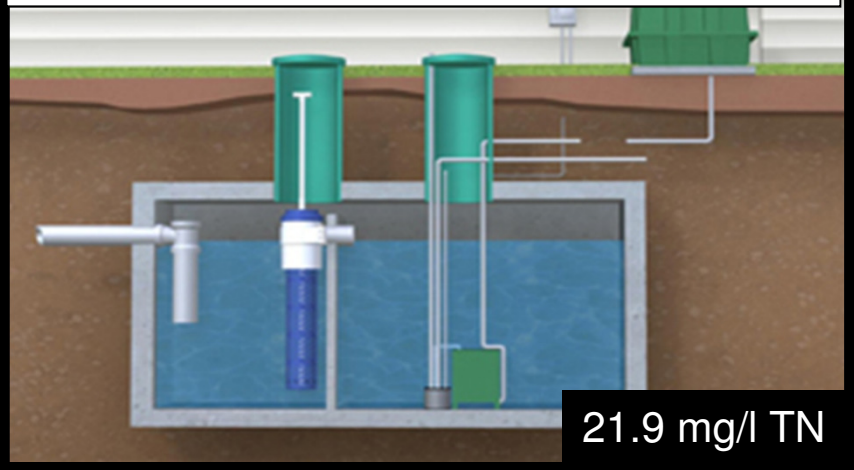
Recommend continued piloting on 1.7 acre parcels



21.2 mg/l TN

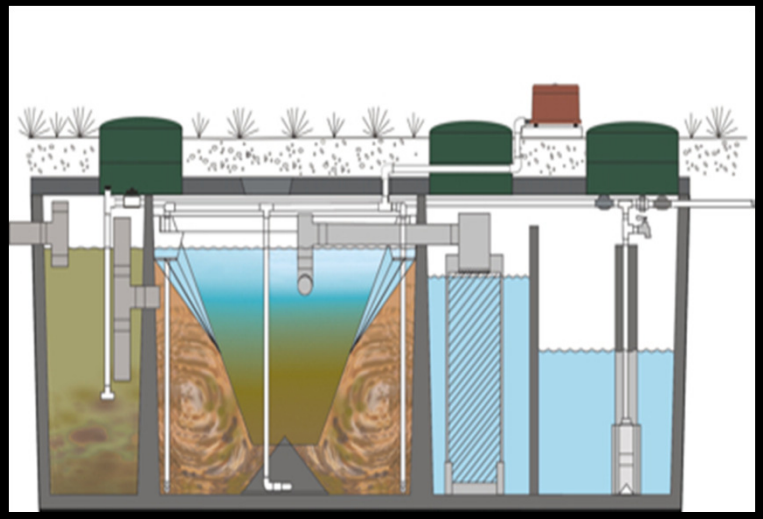
Bio Barrier

Recommend continued piloting on 1.7 acre parcels

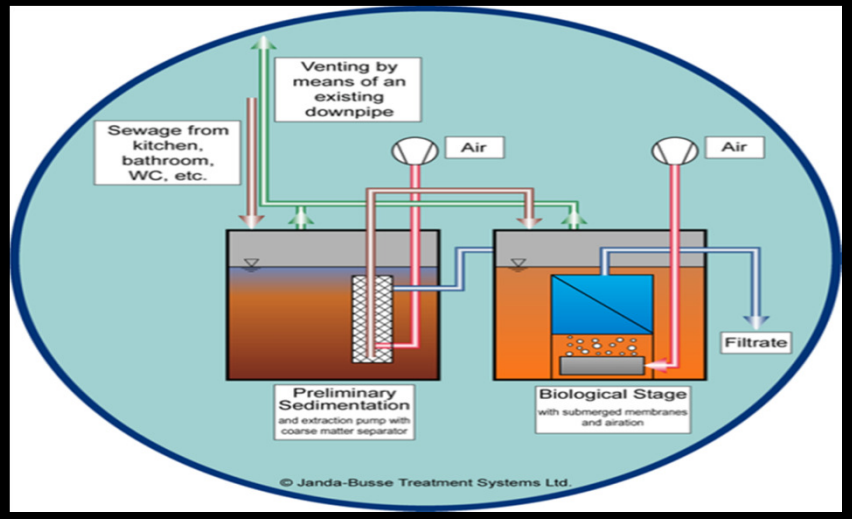


21.9 mg/l TN

Hoot ANR



Busse GT



Installed Pilot Program Technologies

Technology	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total Installed
Amphidrome	7	10	11	29	13	7	5	8	4	6	1	1	4	106
Bioclere	0	2	11	9	7	9	6	5	3	5	6	4	2	69
Cromaglass	0	5	39	7	4	1	0	0	0	0	0	0	0	56
FAST	0	0	0	0	2	5	3	3	3	5	2	2	0	25
SeptiTech	Admitted into pilot program in 2013										3	9	12	24
BioBarrier	Admitted into pilot program in 2013										5	7	0	12
Total	7	17	61	45	26	22	14	16	10	16	17	23	18	292

Pilot Program Technologies: Cost Information

Technology	Average Treatment System & Five Year Service Cost	Ave. Total Reported Cost
Amphidrome	$ 19,434	$32,114
Bioclere	$ 17,466	$ 27,635
Cromaglass	$ 22,553	$ 35,265
FAST	$ 17, 892	$29,508
Bio Barrier	$ 18,708	$28,783
SeptiTech	$ 19,218	$28,702
Hoot ANR	$ 14,500	N/A
Busse GT	$ 24,000	N/A

These technologies are permanent components of the region's wastewater infrastructure and help protect public health and the Pinelands ecosystem.

2016 Pilot Program Report Recommendations

- Grant permanent approval status to the FAST treatment technology for use on minimum 1.4 acre parcels.

- Increase the minimum parcel size from 1.0 acre to 1.7 acres while still piloting the SeptiTech and BioBarrier technologies based upon the latest effluent nitrogen monitoring data.

- Consider a CMP amendment to provide an opportunity for pre-existing nonresidential development to expand or change to another conforming use by using an advanced wastewater treatment system in non-growth-oriented Pinelands Management Areas.

Pinelands Alternate Design
Wastewater Treatment System Pilot Program

Ed Wengrowski

Environmental Technologies Coordinator

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www.nj.gov/pinelands