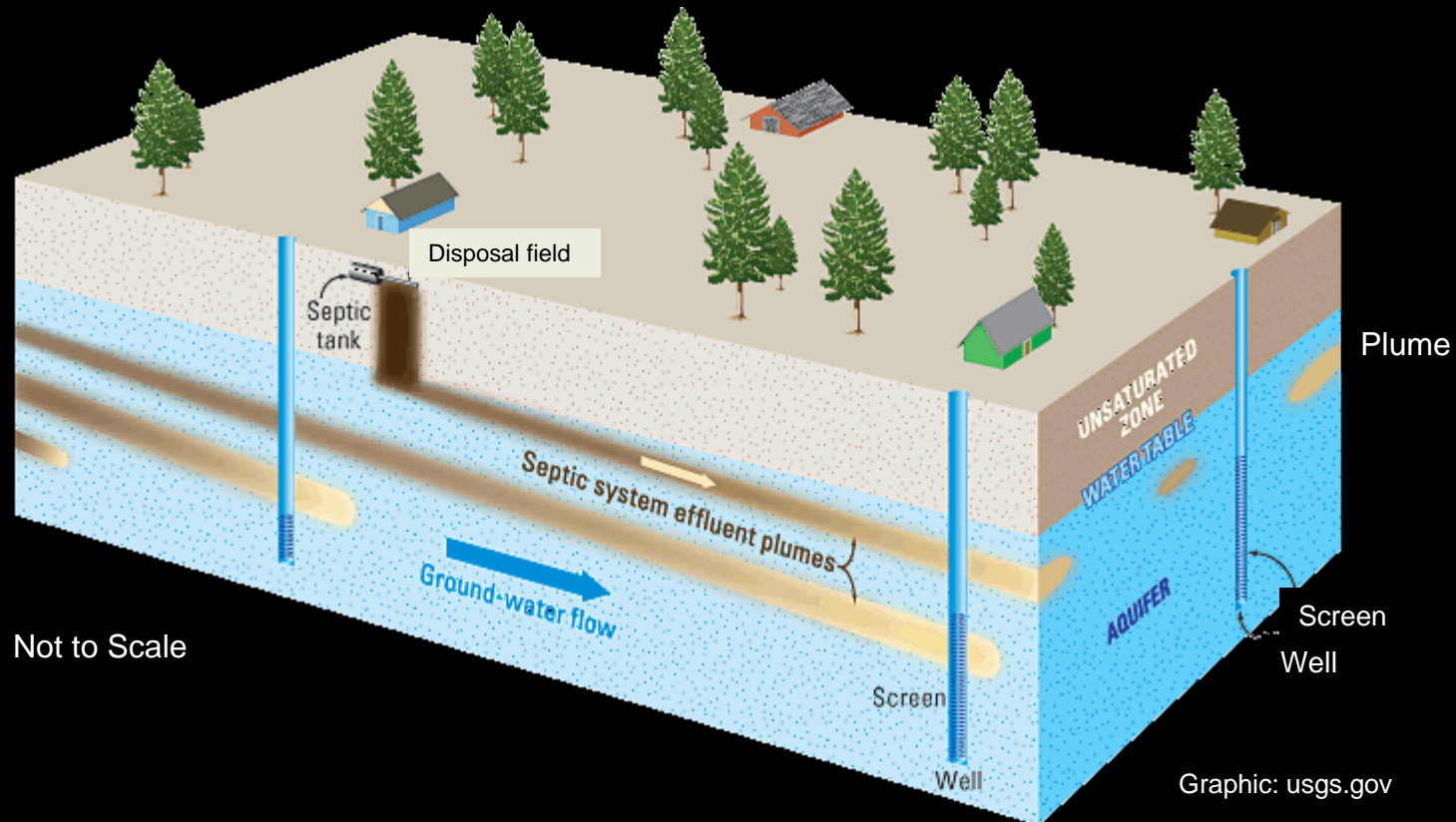


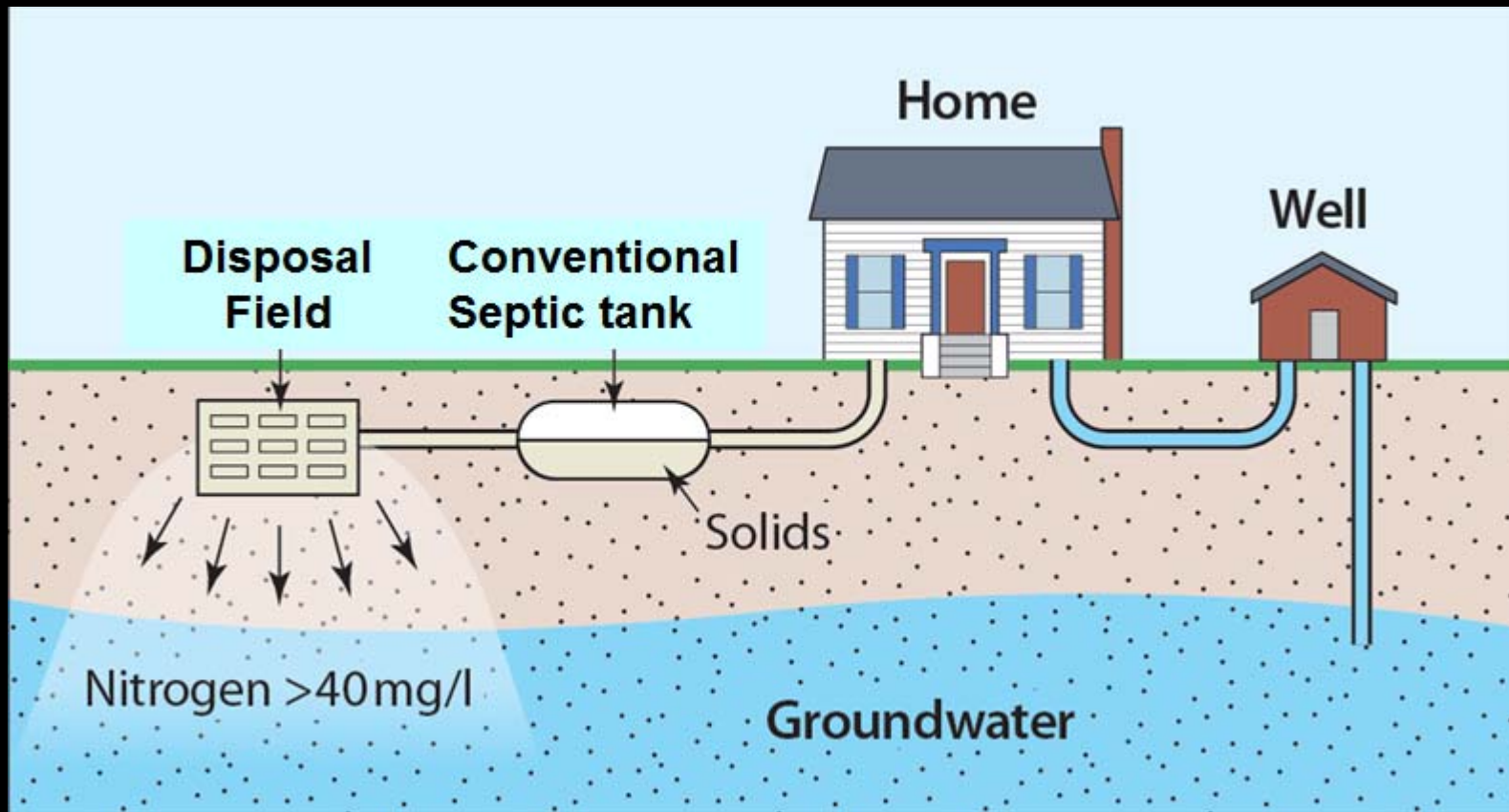
NJ PINELANDS COMMISSION ONSITE WASTEWATER TREATMENT SYSTEMS PILOT PROGRAM



NJ PINELANDS COMMISSION ALTERNATE DESIGN WASTEWATER TREATMENT SYSTEMS PILOT PROGRAM IMPLEMENTATION REPORT AND PROGRAM SUMMARY

APRIL 27, 2018

Septic Systems Contribute Nitrogen to Groundwater



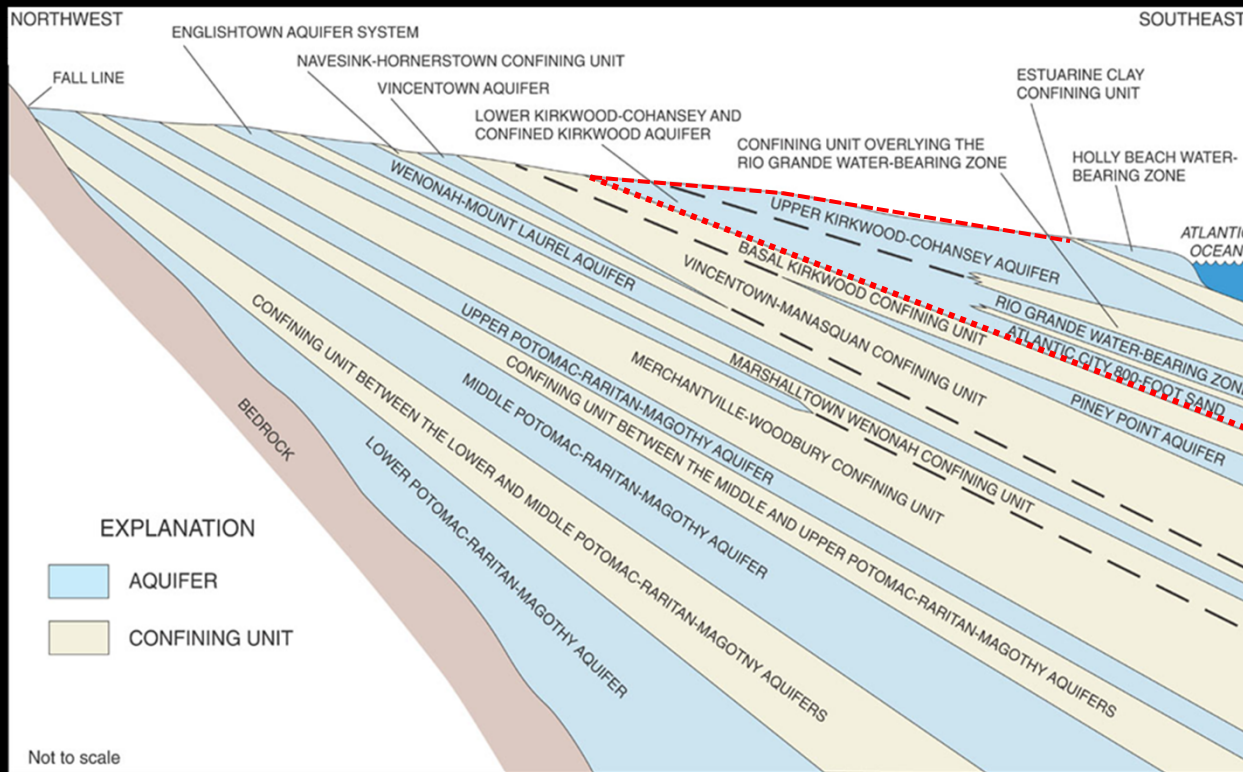
Modified from:
http://www.stonybrook.edu/newsroom/general/2016_21_06_CleanWaterTechnology.php

The New Jersey Pinelands

An Ecologically Nitrogen-Sensitive Environment



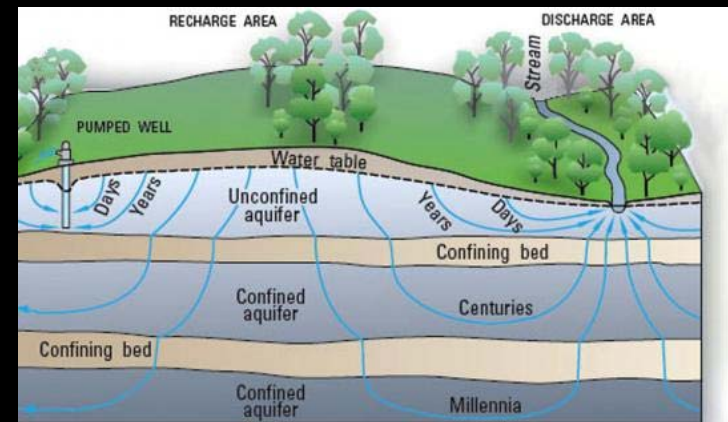
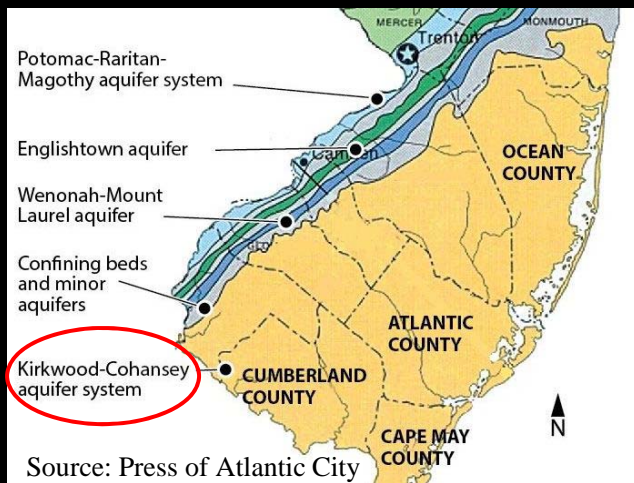
COASTAL PLAIN & PINELANDS AREA AQUIFER SYSTEMS



Aquifers & Confining Units

- Holly Beach
-
- Kirkwood – Cohansey
-
- Piney Point
-
- Wenonah-Mount Laurel
-
- Vincentown
-
- Englishtown
-
- Upper Potomac-Raritan-Magothy
-
- Middle Potomac-Raritan-Magothy
-
- Lower Potomac-Raritan-Magothy

Generalized Cross Section of New Jersey's Coastal Plain Aquifer System. (from Charles et al., 2011)



Source: Pinelands Preservation Alliance

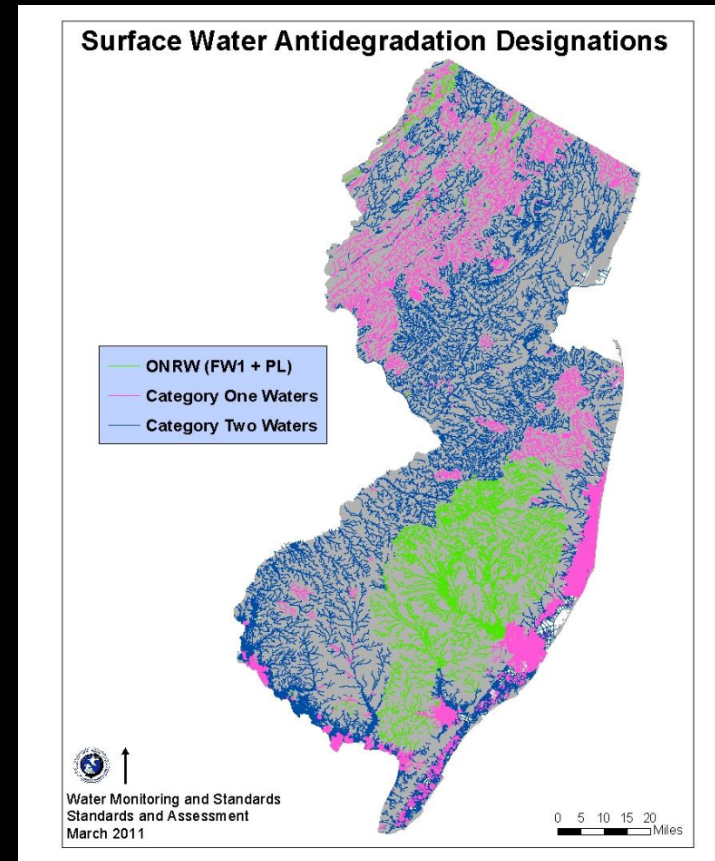
Public Health Implications & Ecological Concerns in the Nitrogen-Sensitive Environments of the Pinelands and Throughout NJ



High density residential development on septic systems & wells (potable water well contamination threat)



Lake communities with shallow SHWT and legacy septic systems (eutrophication threat)



Outstanding National Resource Waters (ONRW)

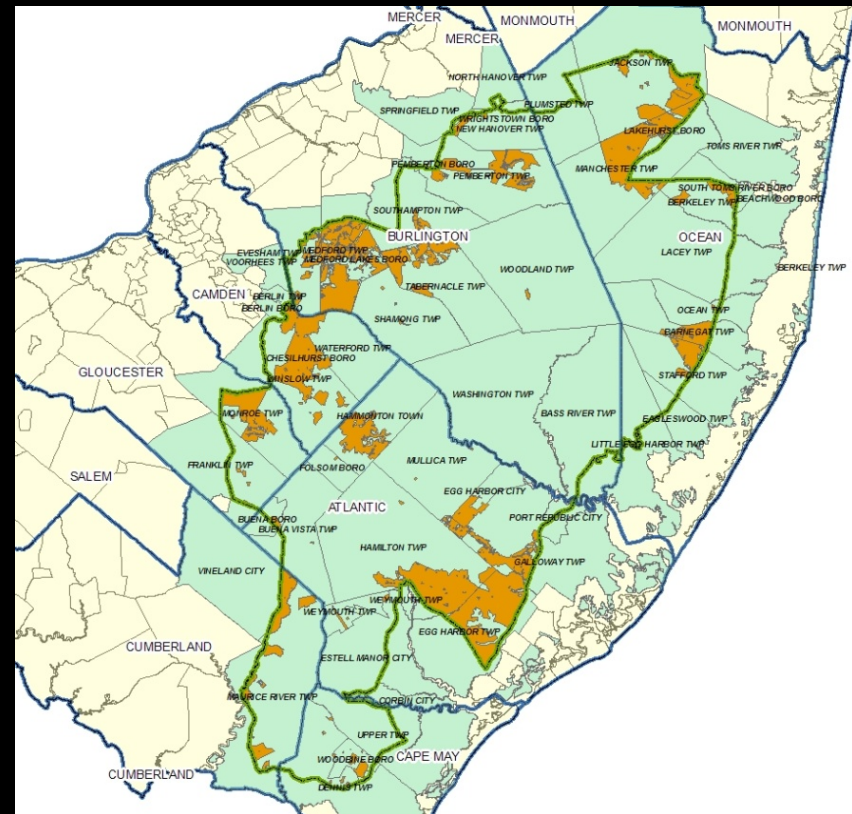
- Afforded the highest level of protection-set aside for posterity
 - FW1 Nondegradation waters
 - PL waters

Category One (C1) Waters

- Protected from measurable change in quality due to exceptional ecological, recreational water supply or fisheries significance.

Pinelands Centralized Sewer and Onsite Septic System Service Areas

- Centralized sewers are permitted only in designated growth areas. (RGA, Towns and Villages)
- Onsite (septic and advanced) systems are relied upon in the Pinelands protection areas and are a **permanent component of the region's distributed or decentralized wastewater infrastructure.**
- Standard septic systems meet the Commission's nitrogen standard through dilution on larger lots.
- Advanced systems meet the nitrogen standard by a combination of active treatment and dilution on smaller lots.



Pinelands Alternate Design Wastewater Treatment Systems Pilot Program



Goal is to protect surface and groundwater from excessive nitrogen loading.

- Federal and State Pinelands Statutes call for preservation, protection and enhancement of Pinelands water resources.
- Pinelands standard is 2 mg/L Nitrate-N (anti-degradation – not ambient).
- All septic systems must result in ≤ 2 mg/L Total Nitrogen at the parcel line (based on septic dilution modeling).

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;
 - Excessive [NO₃] can cause ecological disruptions;
 - Inexpensive laboratory test.

Ecological Implications of Excessive Nitrogen Loading

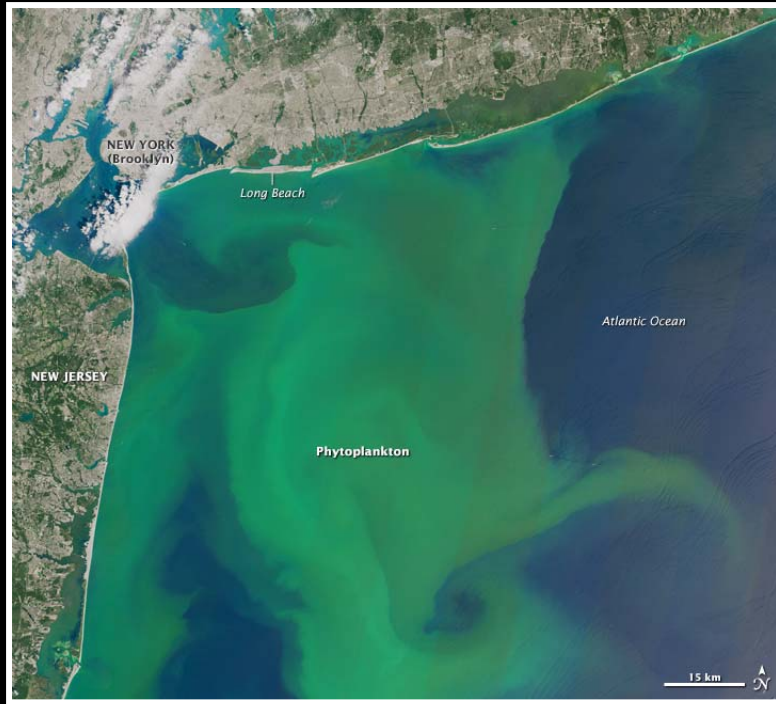
- **Eutrophication of surface waters - nitrogen from septic systems (and other sources) “fertilize” the waters increasing algae and phytoplankton growth**
- **Phytoplankton and algae blooms increase turbidity, decrease sunlight penetration: stress and kill benthic vegetation that serves as fish nurseries and habitat.**
- **Blooms die off, decomposition leads to low dissolved oxygen levels stressing aquatic organisms.**
- **Deposition of biomass speeds the process of hydrarch succession in which lakes and ponds fill-in via deposition of phytoplankton and algae.**



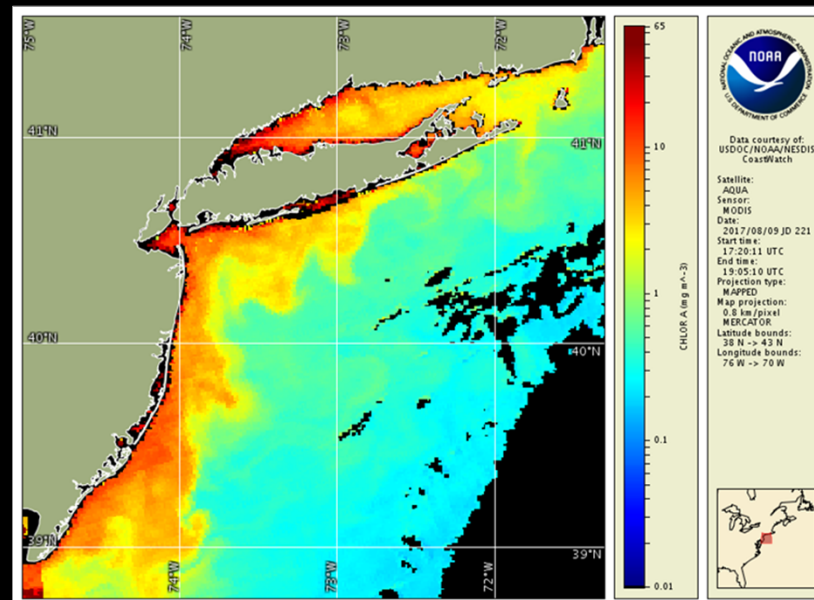
(lake → marsh → dry land)

Algae Bloom in Sept. 2014 Pancoast Mill Pond, Buena Vista Township, Atlantic County, (Downstream of wastewater treatment plant outfall (prior to plant upgrades) and managed turf on golf course fairways).

Nutrient-fueled Phytoplankton Blooms off the New Jersey Coast



August 3, 2015 NASA
Operational Land Imager Landsat 8
<https://earthobservatory.nasa.gov/IO/TD/view.php?id=86377>



July 6, 2016 NASA Aqua
Satellite Image
<http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=88340>

Nutrients +
Sunlight =
Phytoplankton
& Algae
Blooms

August 9, 2017 NOAA AQUA
satellite Image
<http://www.ospo.noaa.gov/data/ocean/oceanos/html>

The Pinelands Septic Dilution – Mass Balance Model

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)

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

<u>Parameter</u>	<u>Assumption</u>
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

Requires 3.2 acres to meet Pinelands 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

Pinelands Pilot Program

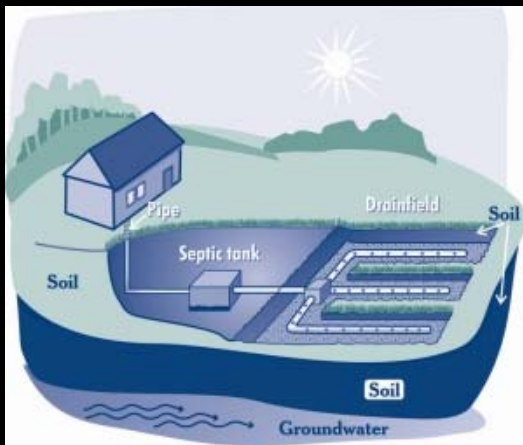
Septic System Effluent Monitoring

- Testing for multiple nitrogen species:
 - Total Kjeldahl Nitrogen (TKN) (Ammonia + Organic N)
 - Nitrate
 - Nitrite
 - Ammonia

$$\text{Total Nitrogen} = \text{TKN} + \text{Nitrate} + \text{Nitrite}$$

Rules Governing Onsite Wastewater Systems in the Pinelands

STANDARDS FOR INDIVIDUAL SUBSURFACE SEWAGE DISPOSAL SYSTEMS

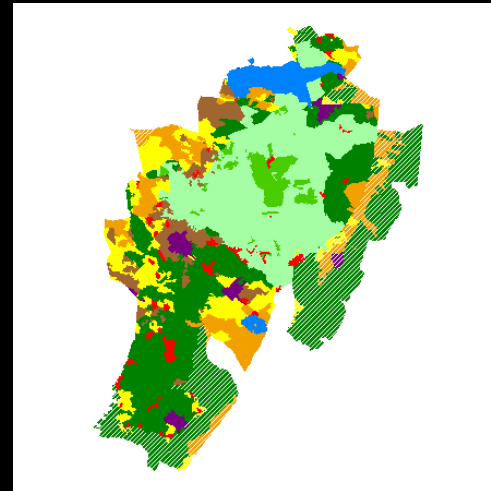


New Jersey Department
Of Environmental
Protection
N.J.A.C 7:9A



Treatment and isolation of pathogens to
prevent disease transmission

PINELANDS COMPREHENSIVE MANAGEMENT PLAN

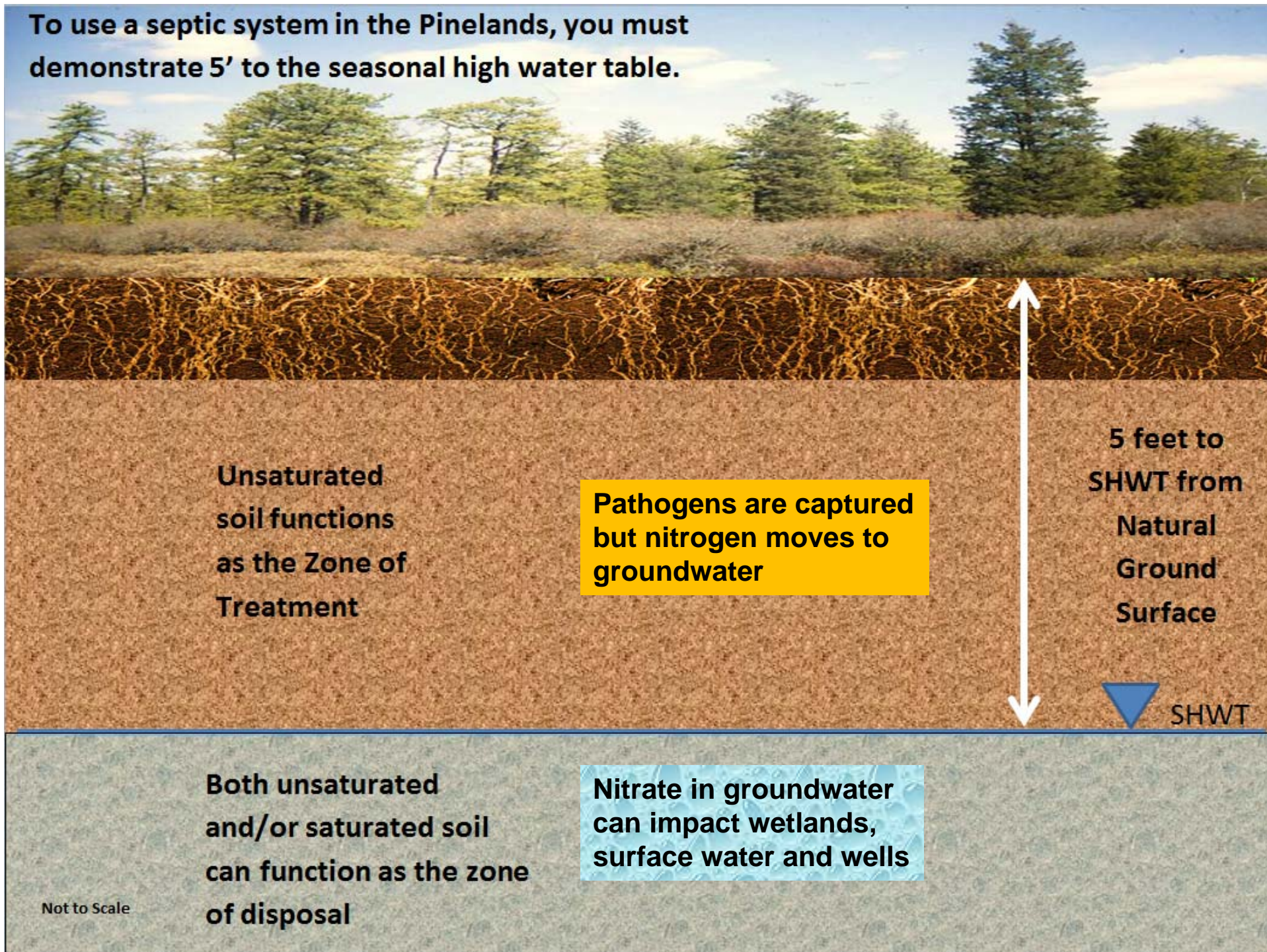


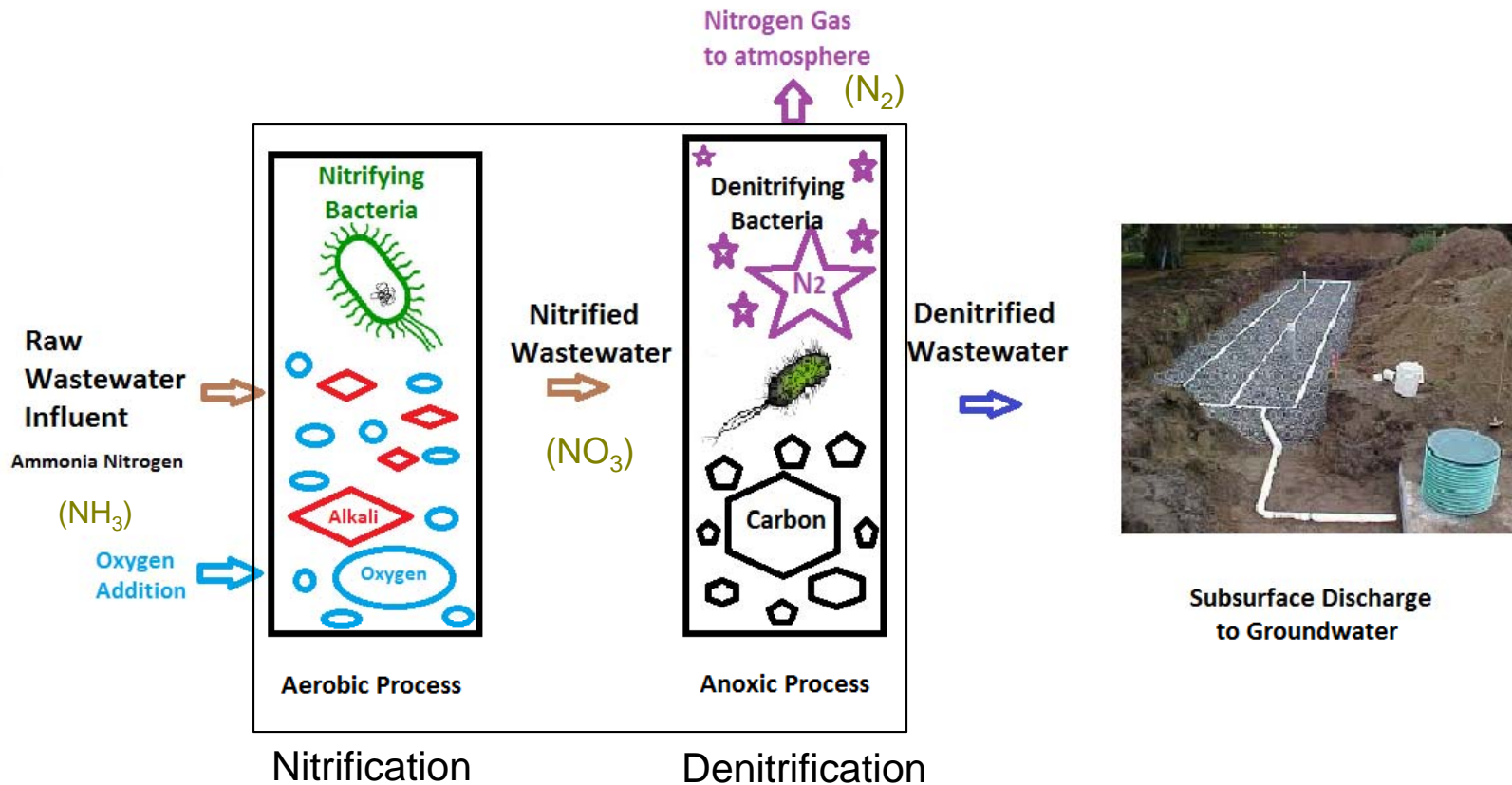
New Jersey
Pinelands Commission
N.J.A.C 7:50



Treatment and dilution of Nitrogen for
ecological protection

To use a septic system in the Pinelands, you must demonstrate 5' to the seasonal high water table.





Onsite Treatment Process for Biological Nitrogen Removal

(Required in Pinelands if < 3.2 acres)

Original Five Pilot Program Authorized Systems

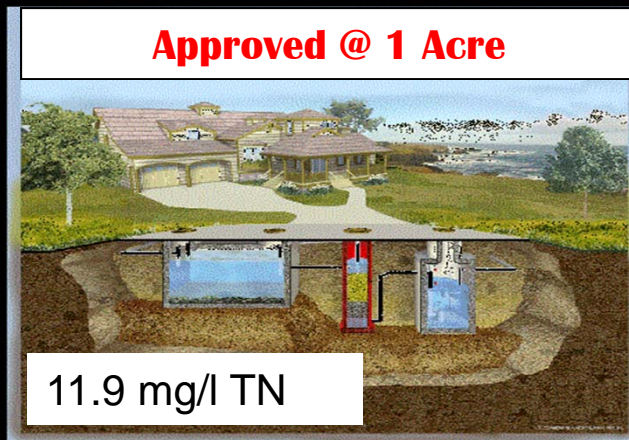
<u>System Name</u>	<u>System Vendor</u>	<u>Treatment Process</u>
Amphidrome	F.R. Mahony & Assoc.	Fixed Film SBR
Bioclere	Aqua point Inc.	Modified Trickling Filter
Cromaglass	Cromaglass Corp.	Sequencing Batch Reactor
Fast	Bio-Microbics, Inc.	Fixed Film Activated Sludge
Ashco RFS ^{III} (Removed Dec. 2007)	Ashco-A-Corp.	Recirculating Sand Filter

Original Five Pilot Program Wastewater Systems

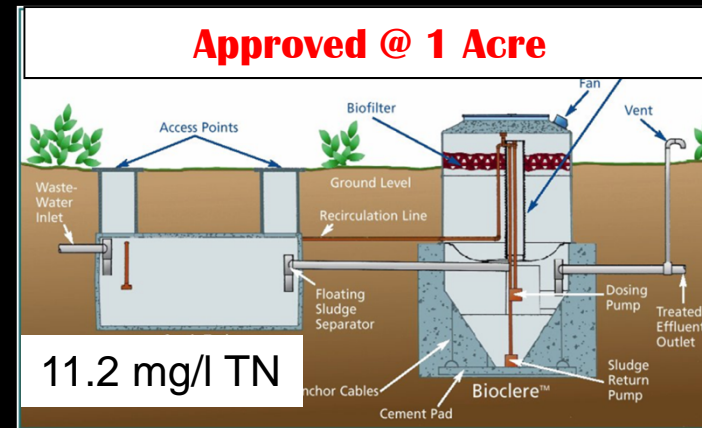
<u>System Name</u>	<u>Pilot Program Status</u>
Amphidrome	Permanently approved for use on min. 1.0 acre lots
Bioclere	Permanently approved for use on min. 1.0 acre lots
Fast	Permanently approved for use on minimum 1.4 acre lots
Cromaglass	Removed from the pilot program (Sept. 2014)
Ashco RFS ^{III}	Removed from pilot program Dec. 2007

Original Pilot Program Technologies

Amphidrome



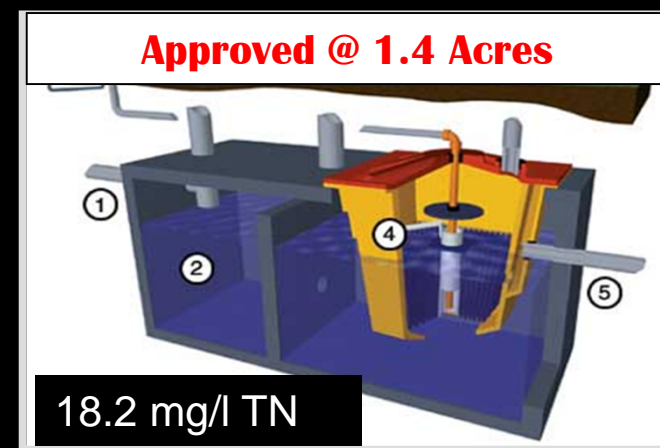
Bioclere



Cromaglass



FAST



Four New NSF 245 Pilot Program Systems

<u>System Name</u>	<u>System Vendor</u>	<u>Treatment Process</u>
BioBarrier	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

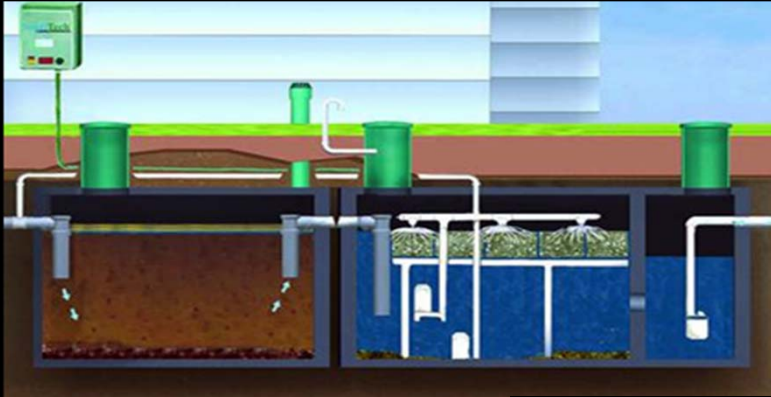
Four New NSF 245 Pilot Program Systems

<u>System Name</u>	<u>Pilot Program Status</u>
BioBarrier	Currently authorized for use on minimum 1.7 acre lots based on interim performance
Busse GT	Currently authorized for use on minimum 1.0 acre lots – but none yet installed
Hoot ANR	Currently authorized for use on minimum 1.0 acre lots – but none yet installed
SeptiTech	Currently authorized for use on minimum 1.7 acre lots based on interim performance

New Pilot Program Technologies

Septi Tech

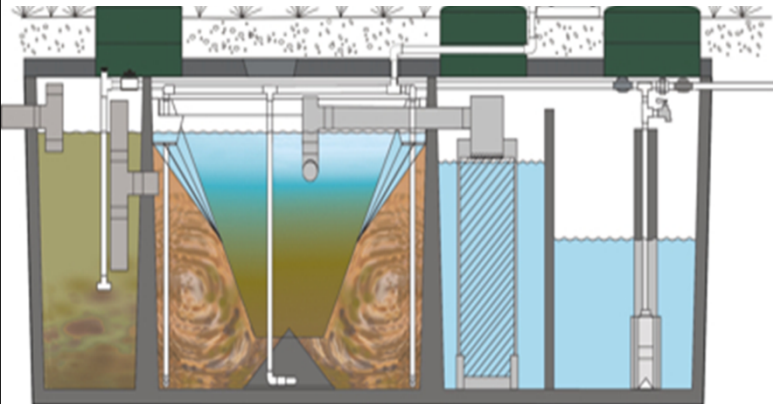
Recommend continued piloting on 1.7 acre parcels



15.7 mg/l TN

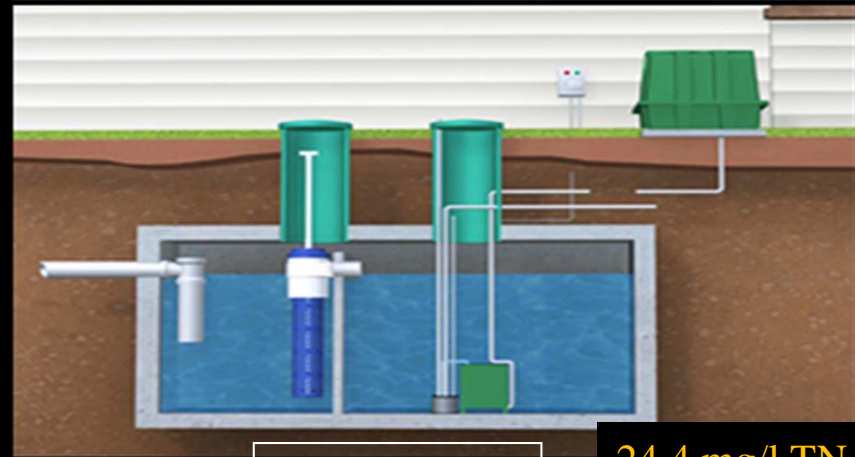
Hoot ANR

Recommend continued participation on 1.0 acre parcels subject to effluent monitoring



Bio Barrier

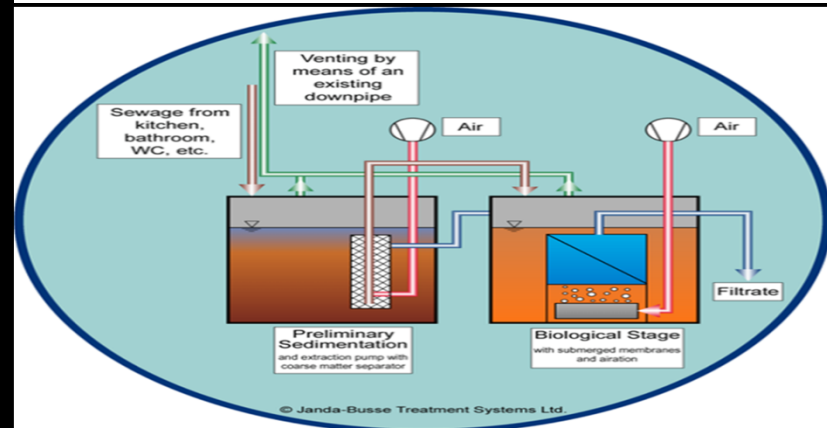
Recommend continued piloting on 1.7 acre parcels



24.4 mg/l TN

Busse GT

Recommend placing technology on notice if not installed by Nov. 2019



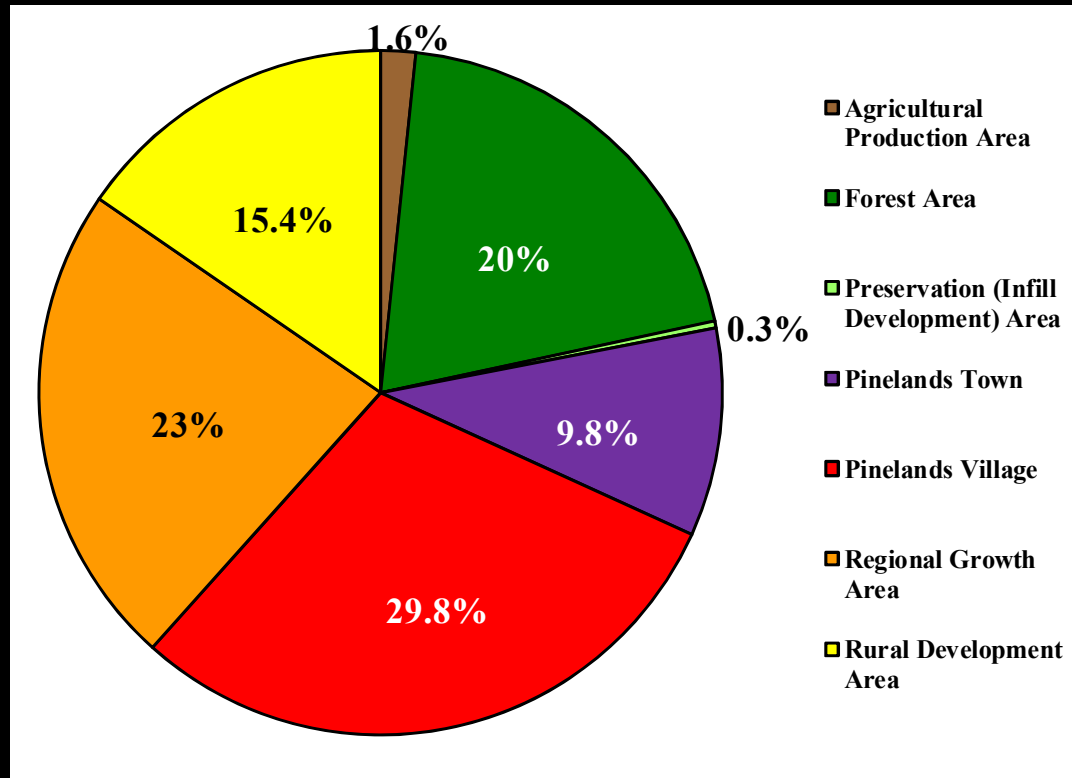
Installed Pilot Program Technologies

Technology	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Amphidrome	7	10	10	27	12	7	5	8	4	5	1	1	4	2	103
Bioclere	0	2	11	9	7	9	6	5	5	5	8	4	4	1	76
Cromaglass	0	19	24	3	6	4	3	0	0	0	0	0	0	0	59
FAST	0	0	0	0	2	5	3	3	3	5	2	2	0	0	25
SeptiTech	Admitted into the pilot program in 2013										3	9	11	7	30
BioBarrier	Admitted into the pilot program in 2013										5	7	0	0	12
Busse GT	Admitted into the pilot program in 2013										0	0	0	0	0
Hoot ANR	Admitted into the pilot program in 2013										0	0	0	0	0
Total	7	31	45	39	27	25	17	16	12	15	19	23	19	10	305

Pilot Program Technologies Past and Present

Technology Name	Microbiological Treatment Type	Equipment Cost	Median [TN] mg/L to date (≤ 14.0 mg/L TN is required for use on a 1 acre parcel)	Status
Amphidrome	Sequencing Batch Aerated <i>Stone Aggregate Filter</i> (Attached Growth)	\$19,563	< 14.0	Authorized for permanent use on 1.0 acre lots. “Graduated” from the pilot program.
Ashco RFS III	Recirculating <i>Sand Filter</i> (Attached Growth)	N/A	N/A	Eliminated due to lack of sales in the Pinelands Area. No units installed in the Pinelands.
Bioclere	Trickling <i>Plastic Media</i> Filter (Attached Growth)	\$17,612	< 14.0	Authorized for permanent use on 1.0 acre lots. “Graduated” from the pilot program.
BioBarrier	Membrane Bioreactor (Suspended Growth)	\$18,708	24.4	Min. lot size increased to 1.7 acres. Moratorium on new installations by vendor.
Busse GT	Membrane Bioreactor (Suspended Growth)	N/A	N/A	No units installed in the Pinelands.
Cromaglass	Sequencing Batch Reactor (Suspended Growth)	\$22,553	31.5	Eliminated from the pilot program due to unsatisfactory TN attenuation.
FAST	Fixed Film (Attached <i>Plastic Media</i> and Suspended Growth)	\$17,892	18.2	Authorized for permanent use on 1.4 acre lots. “Graduated” from pilot program.
Hoot ANR	Suspended Growth Activated Sludge	N/A	N/A	No units installed in the Pinelands.
SeptiTech	Fixed Film <i>Plastic and Polystyrene</i> Trickling Filter	\$19,132	15.7	Minimum lot size increased to 1.7 acres. Performance has improved with system re-programming

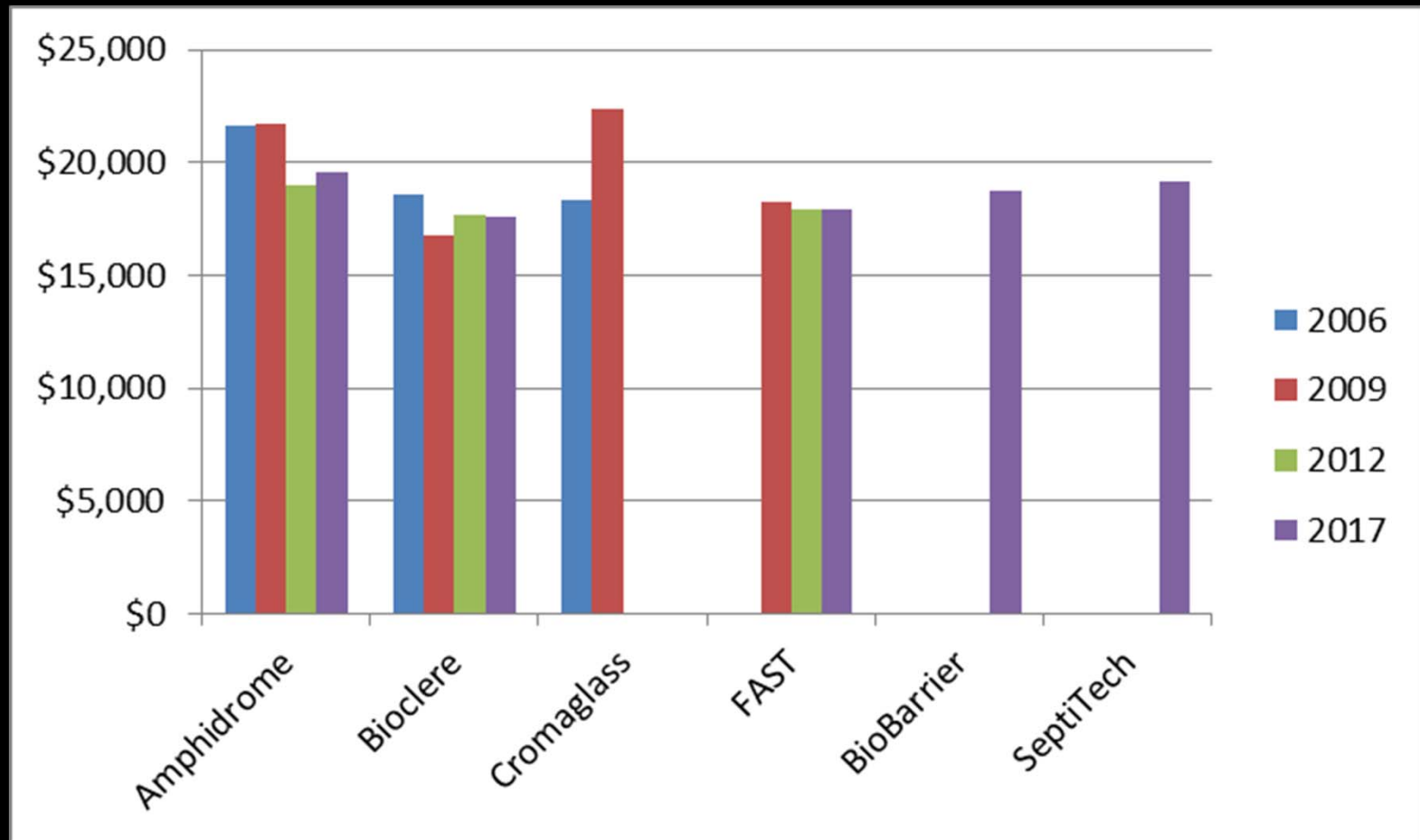
Pilot Program Technologies - Installations by Management Area



* Approximately 65 % installed in designated Pinelands Growth Areas

Pinelands Management Area	No. of Systems	Percentage of Systems
Agricultural Production Area	5	1.6
Forest Area	61	20
Preservation (Infill Development) Area	1	0.3
* Pinelands Town	30	9.8
* Pinelands Village	91	29.8
* Regional Growth Area	70	23
Rural Development Area	47	15.4

Average Equipment Cost for the Pilot Program Technologies



Average Total Cost for the Pilot Program Technologies

Name of Treatment System Technology	No. of Systems included in this cost analysis	Average Reported Cost per Treatment Unit and 5 year service package	Average Reported Cost for Engineering, Soil Absorption Field Installation, Electrical Connections, etc. ⁽¹⁾	Average Reported <u>Total Cost</u> of the <u>Alternate Design Treatment Systems</u>
BioBarrier	12	\$18,708	\$10,033	\$ 28,741
Busse GT	N/A	N/A	N/A	N/A
Hoot ANR	N/A	N/A	N/A	N/A
SeptiTech	27	\$19,132	\$9,360	\$28,492
Amphidrome	69	\$19,563	\$12,202	\$31,765
Ashco RSF III	0	N/A	N/A	N/A
Bioclere	59	\$17,612	\$10,023	\$27,635
Cromaglass	41	\$22,553	\$12,712	\$ 35,265
FAST	25	\$17,892	\$11,616	\$ 29,508

Pilot Program Implementation Report Recommendations

- Amend the CMP to extend the pilot program beyond its current sunset date of Aug. 5, 2018 without establishing a new deadline for system installations.
 - The Executive Director can suspend new installations and/or adjust minimum lot size requirements by publishing notice in the NJR.
- Retain SeptiTech and BioBarrier technologies in the pilot program to allow for continued evaluation.
- Provide a follow-up Implementation Report to the Commission by Nov. 5, 2019.

Pilot Program Implementation Report

Recommendations

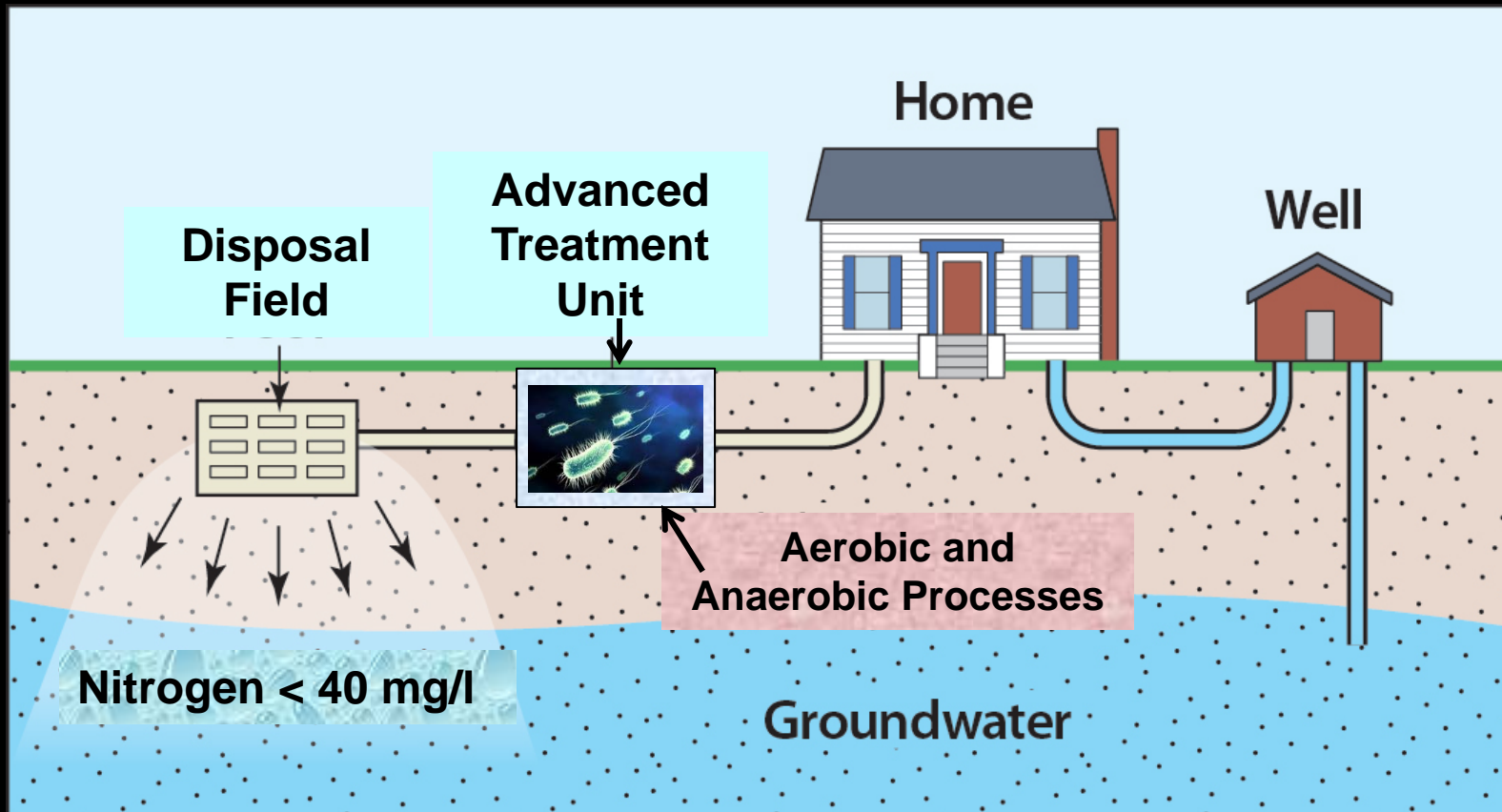
- Introduce two new NSF Standard 245 / US EPA ETV certified technologies to the pilot program. (CMP permits up to six piloted technologies at one time).
- Notify the manufacturer of the Busse GT technology that the system will be suspended from participating in the pilot program unless the system is installed by Nov. 5, 2019. (7 years since first being admitted)
 - If permanently removed via a CMP amendment, introduce a third new NSF Standard 245 / US EPA ETV certified technology.

Pilot Program Implementation Report

Recommendations

- Continue to work with NJDEP and the County Health Departments to ensure adherence to NJDEP's advanced treatment system Operation and Maintenance (O&M) requirements.
 - This includes meeting regularly with program managers at the County Health Departments to provide:
 - Refresher training on NJDEP's septic system regulations;
 - Advanced treatment system location and management status updates;
 - Contact information for qualified O&M service providers;
 - Enhanced O&M tracking software; and
 - Notice of O&M contract expiration dates and non-renewals.

Pinelands Alternate Design Wastewater Treatment System Pilot Program



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www.nj.gov/pinelands

Modified from:
http://www.stonybrook.edu/newsroom/general/2016_21_06_CleanWaterTechnology.php