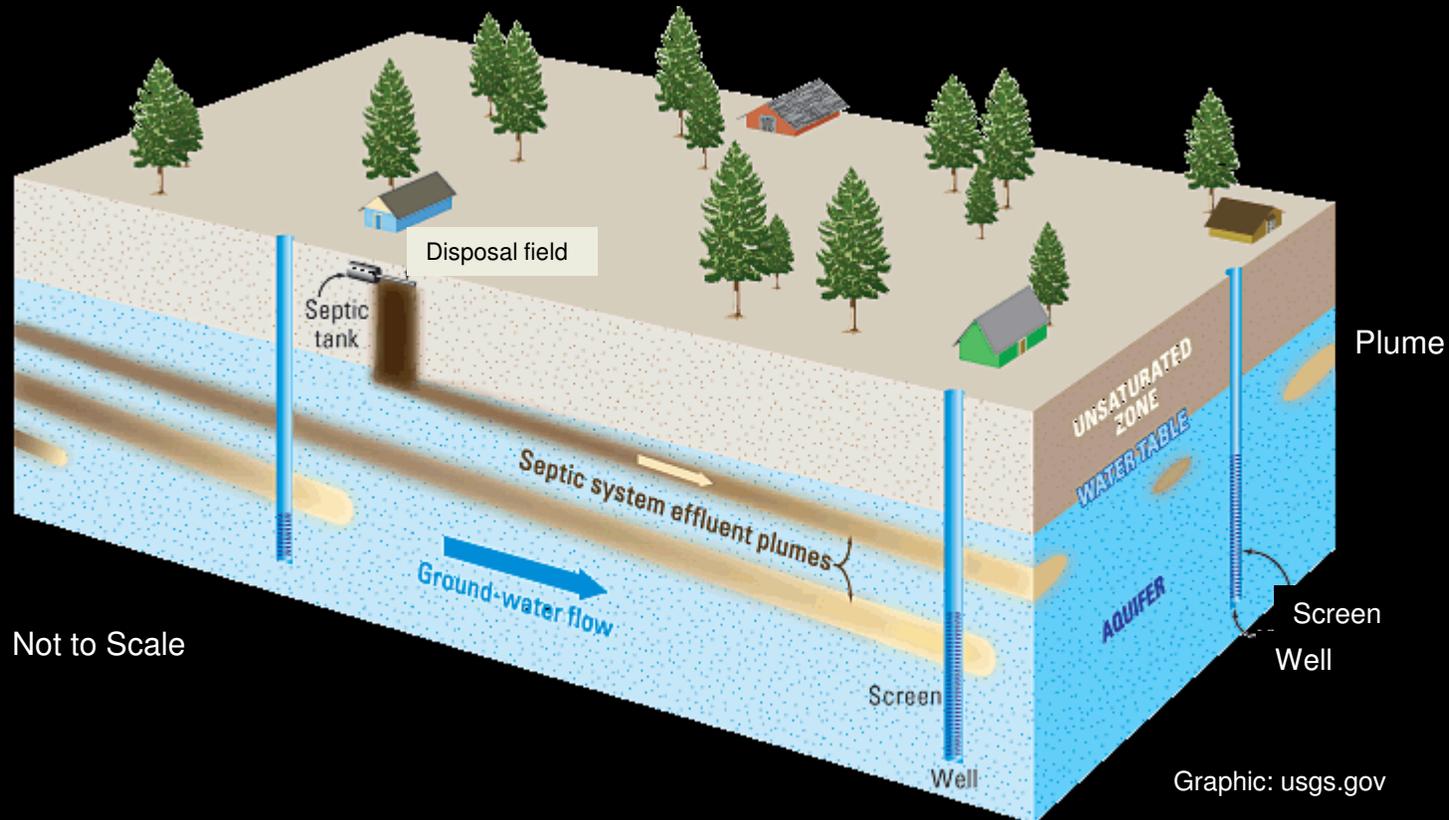


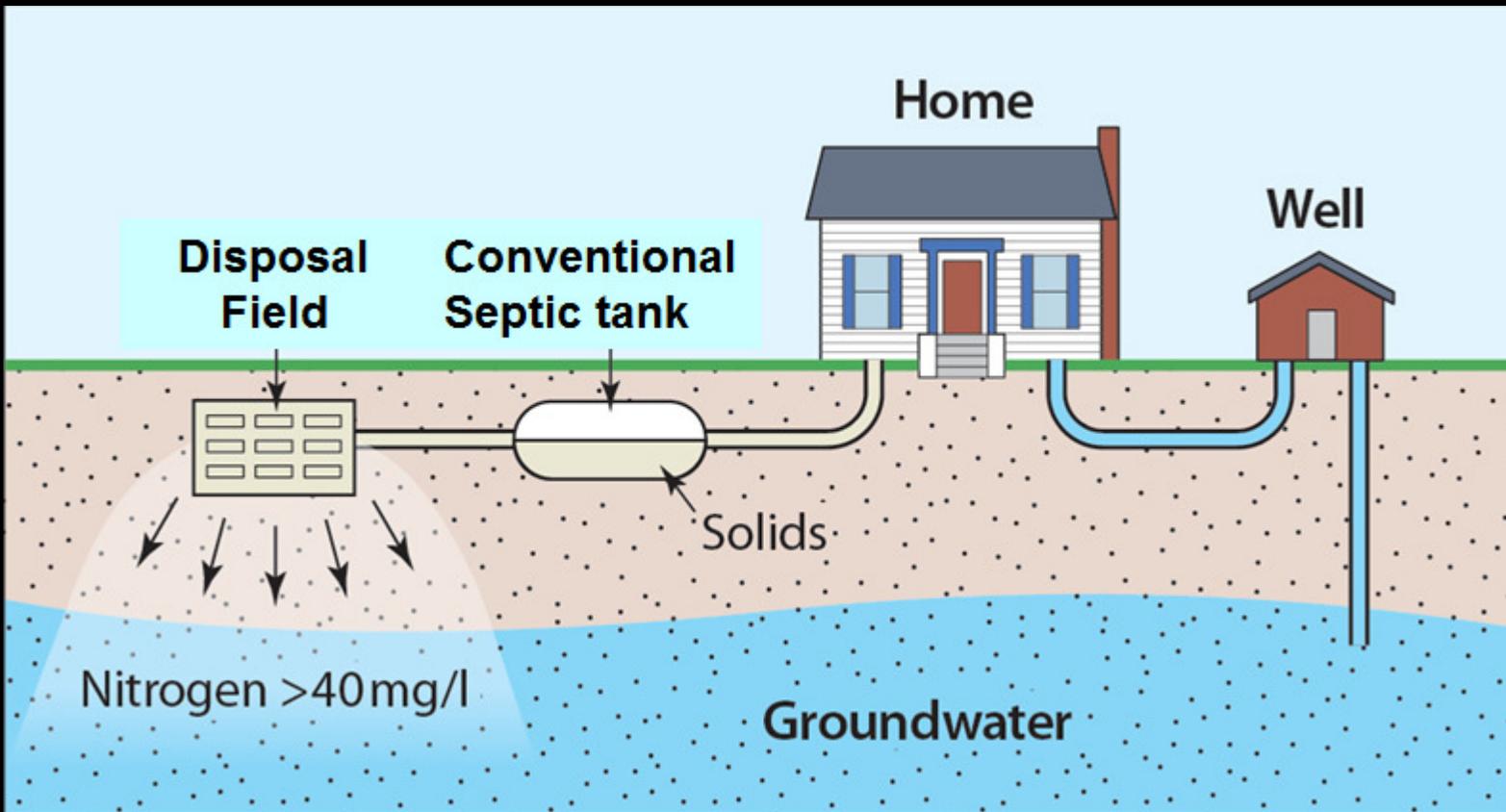
NJ PINELANDS COMMISSION ONSITE WASTEWATER TREATMENT SYSTEMS PILOT PROGRAM



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

APRIL 27, 2018

Septic Systems Contribute Nitrogen to Groundwater



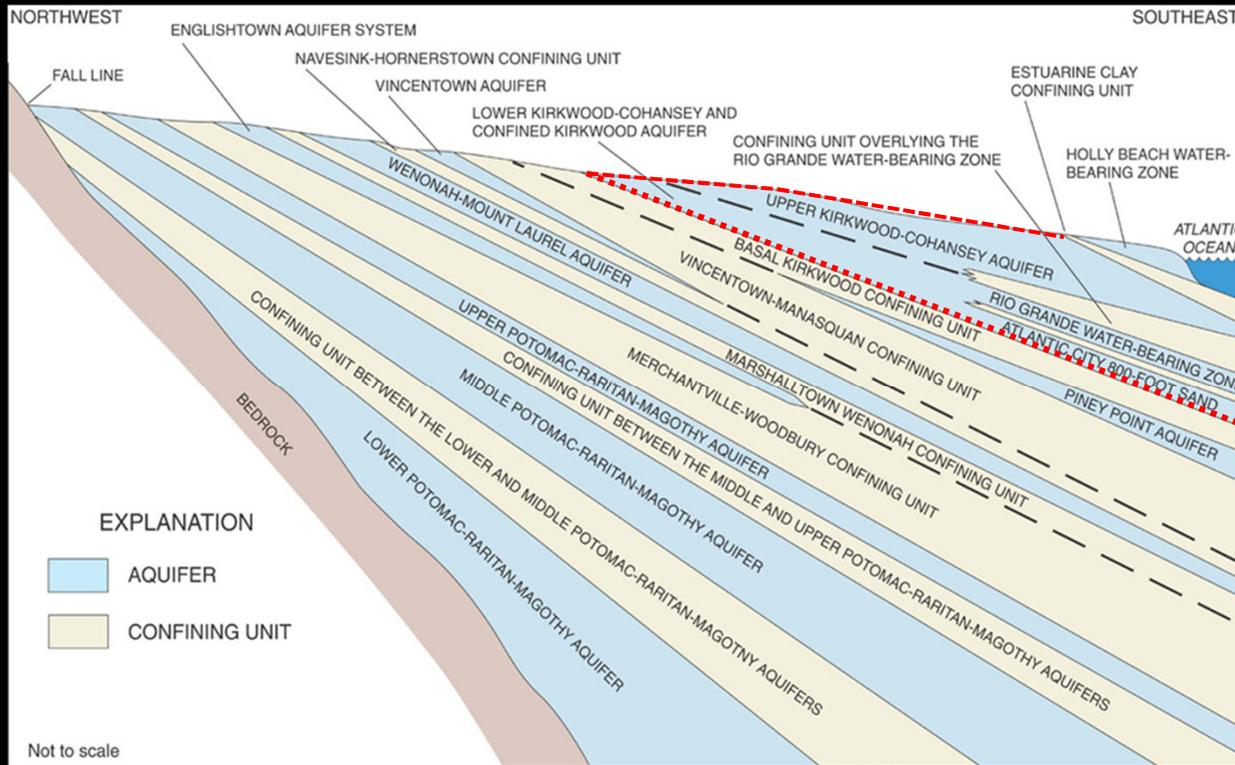
Modified from:
http://www.stonybrook.edu/newsroom/general/2016_21_06_CleanWaterTechnology.php

The New Jersey Pinelands

An Ecologically Nitrogen-Sensitive Environment



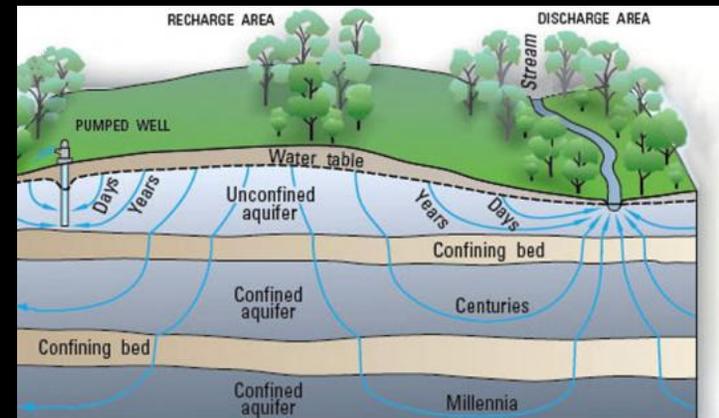
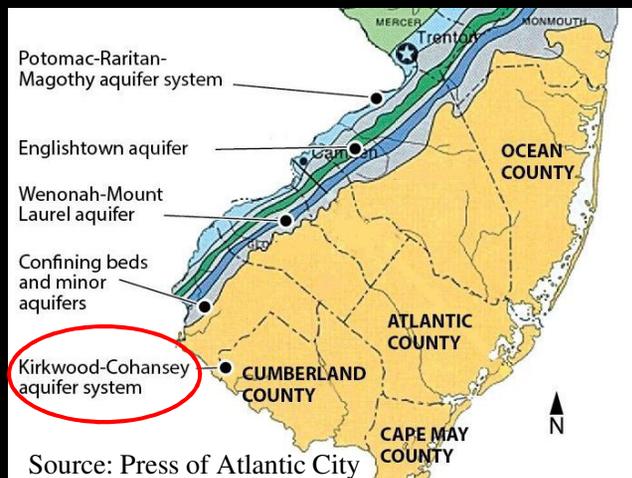
COASTAL PLAIN & PINELANDS AREA AQUIFER SYSTEMS



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

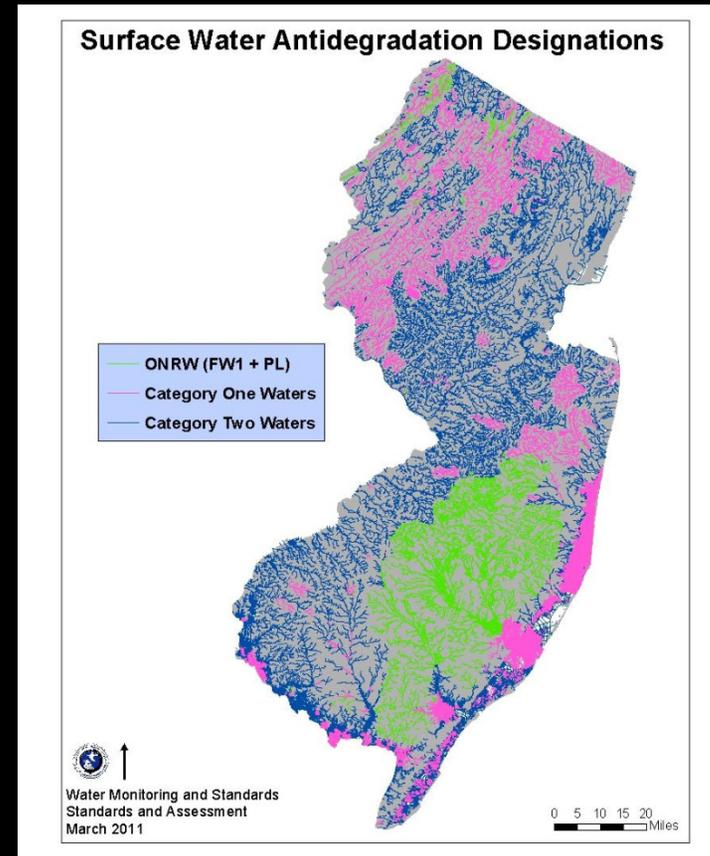
Public Health Implications & Ecological Concerns in the Nitrogen-Sensitive Environments of the Pinelands and Throughout NJ



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)

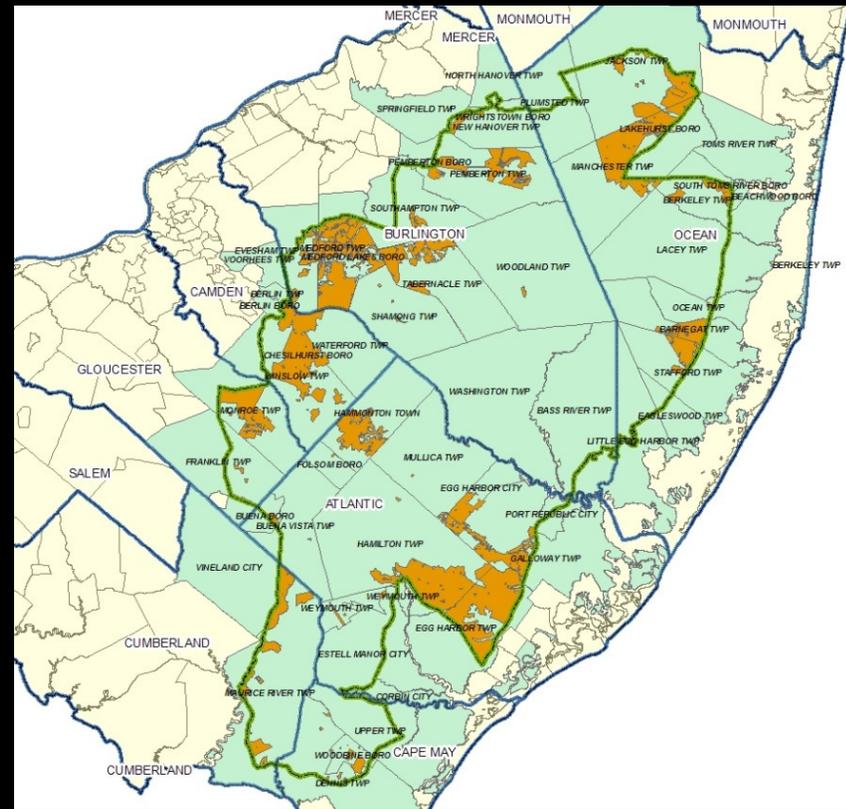
- Afforded the highest level of protection-set aside for posterity
 - FW1 Nondegradation waters
 - PL waters

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

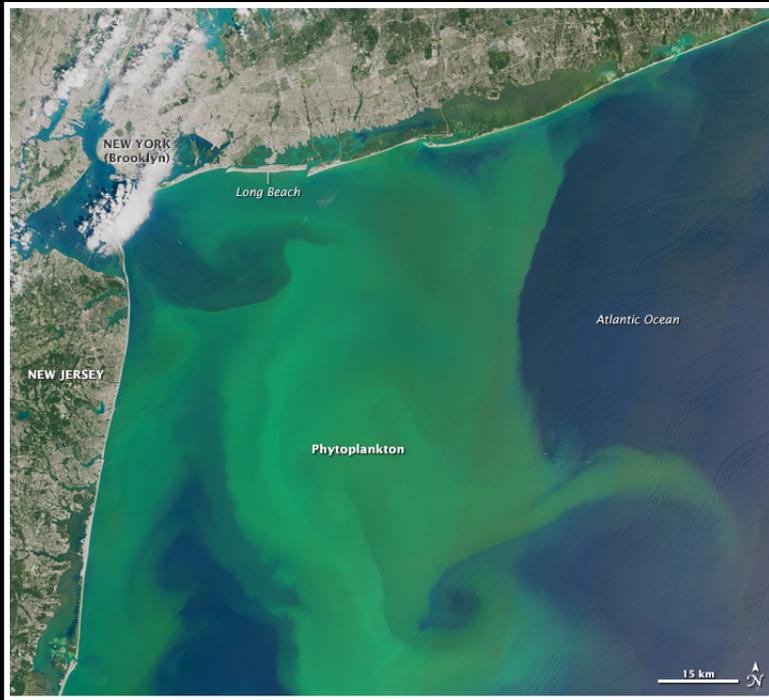
- **Eutrophication of surface waters - nitrogen from septic systems (and other sources) “fertilize” the waters increasing algae and phytoplankton growth**
- **Phytoplankton and algae blooms increase turbidity, decrease sunlight penetration: stress and kill benthic vegetation that serves as fish nurseries 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.**



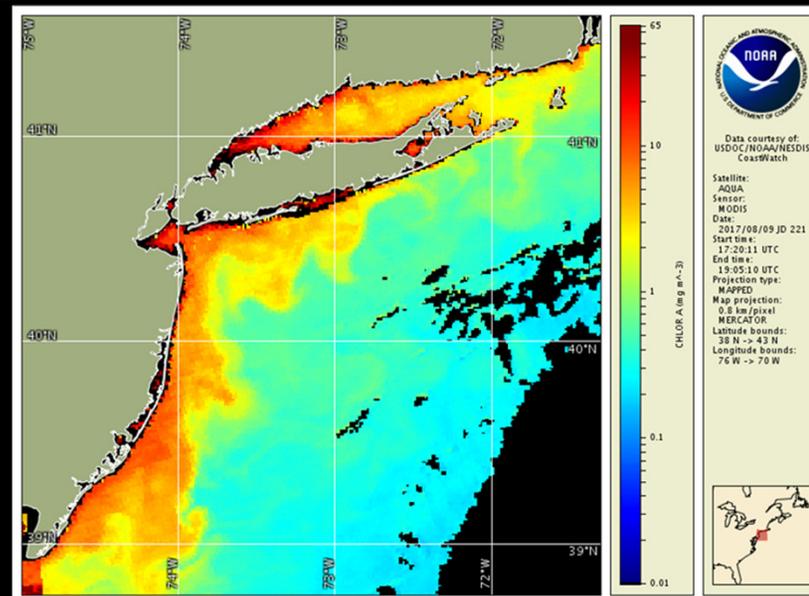
(lake → marsh → dry land)

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>

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

Nutrients +
Sunlight =
Phytoplankton
& Algae
Blooms

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

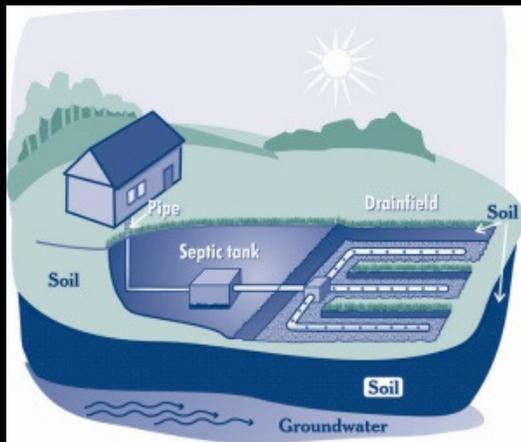
Septic System Effluent Monitoring

- 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

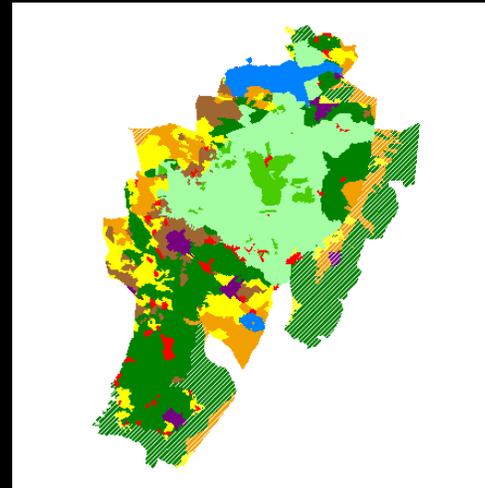


New Jersey Department
Of Environmental
Protection
N.J.A.C 7:9A



Treatment and isolation of pathogens to
prevent disease transmission

PINELANDS COMPREHENSIVE MANAGEMENT PLAN

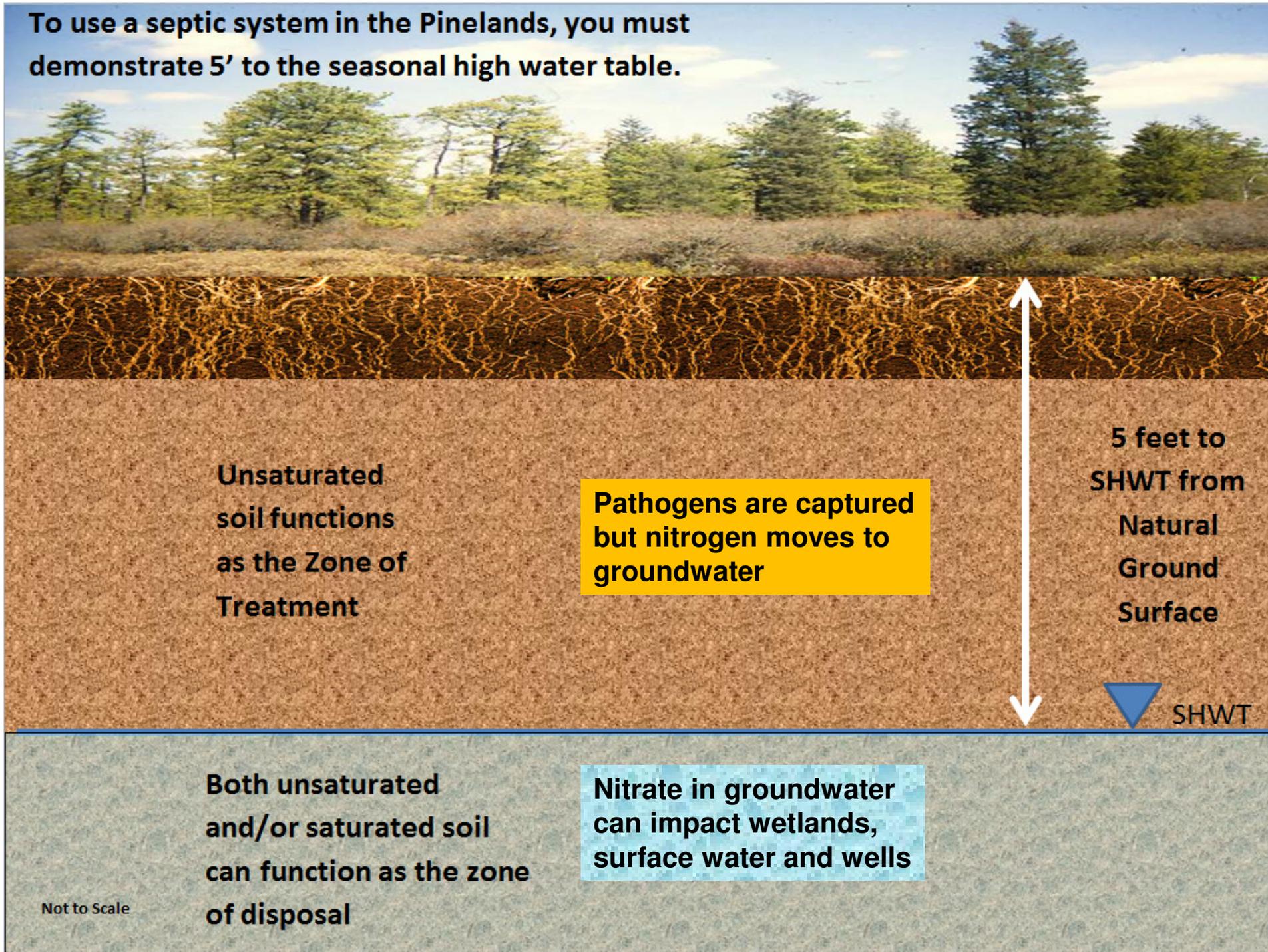


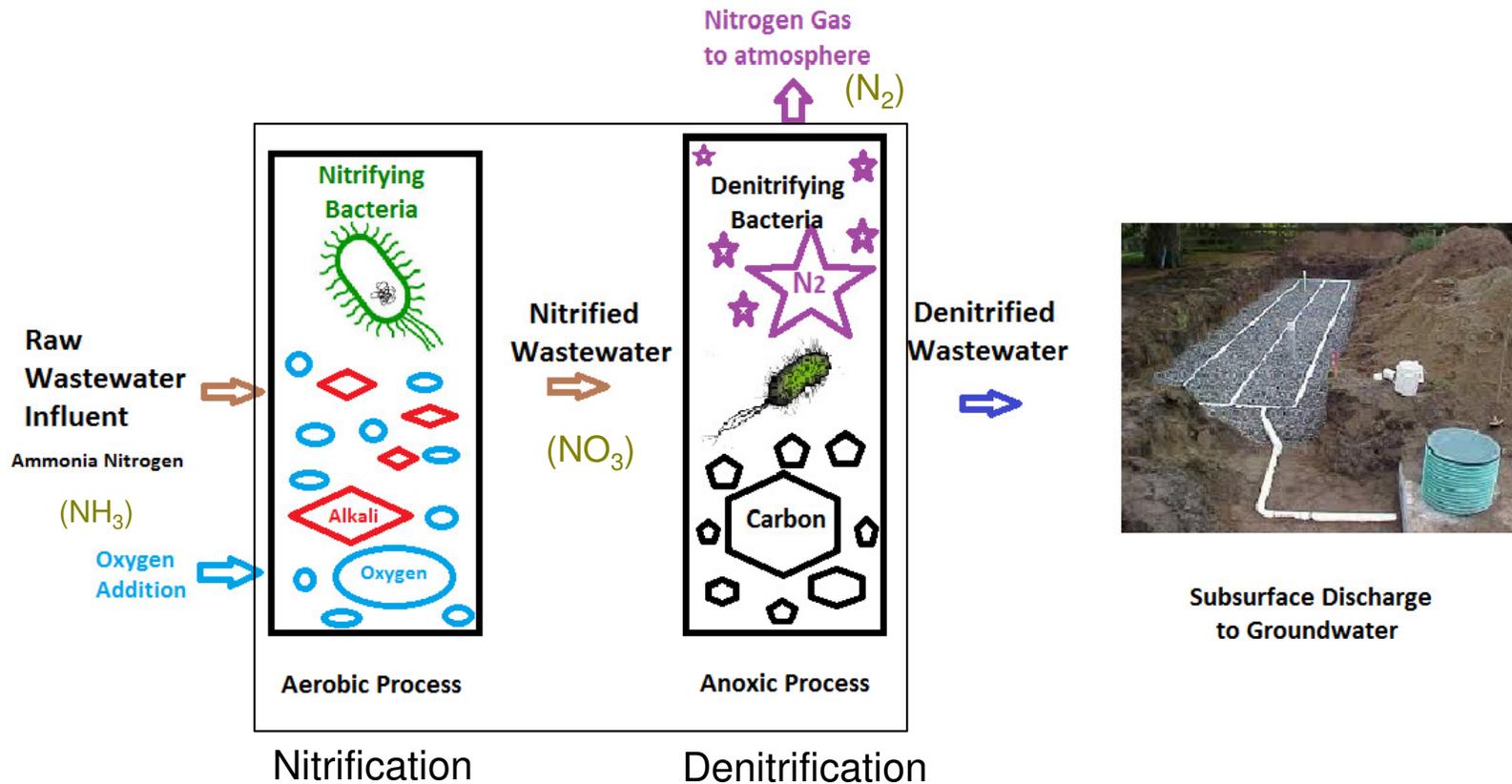
New Jersey
Pinelands Commission
N.J.A.C 7:50



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

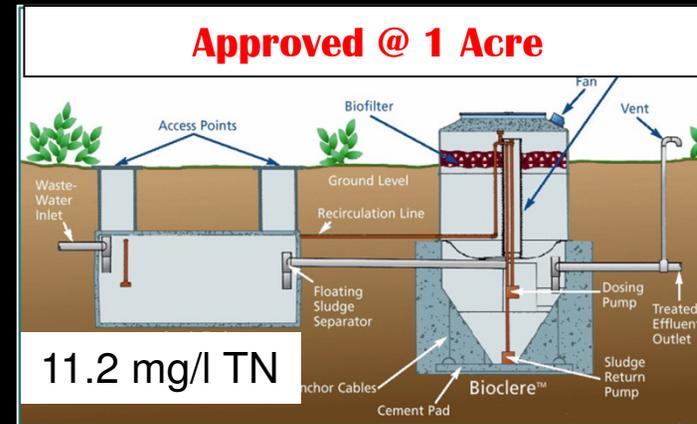
| <u>System Name</u> | <u>Pilot Program Status</u> |
|--------------------------|---|
| Amphidrome | Permanently approved for use on min. 1.0 acre lots |
| Bioclere | Permanently approved for use on min. 1.0 acre lots |
| Fast | Permanently approved for use on minimum 1.4 acre lots |
| Cromaglass | Removed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

Original Pilot Program Technologies

Amphidrome



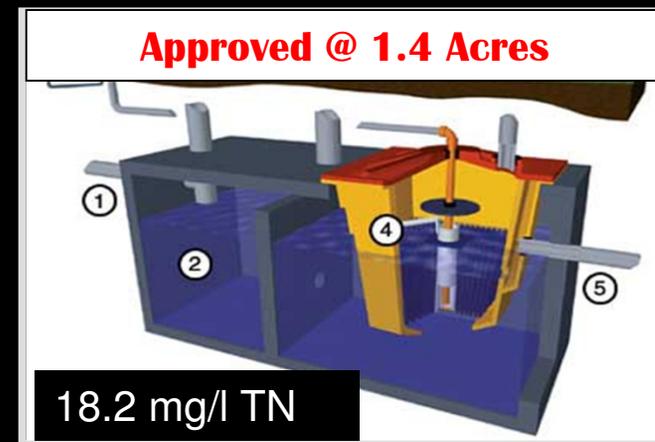
Bioclere



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 |

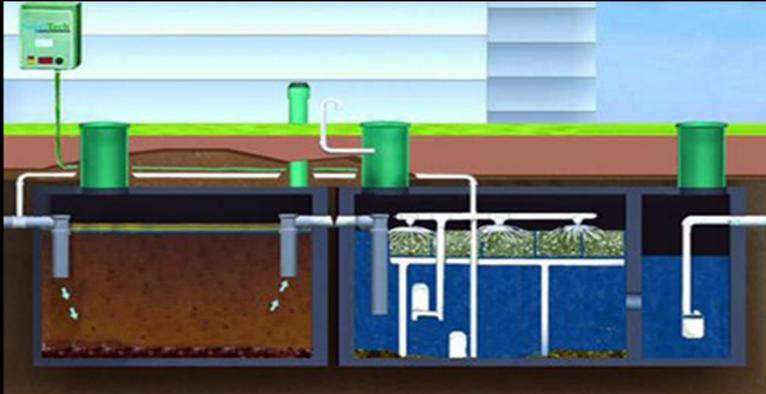
Four New NSF 245 Pilot Program Systems

| <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

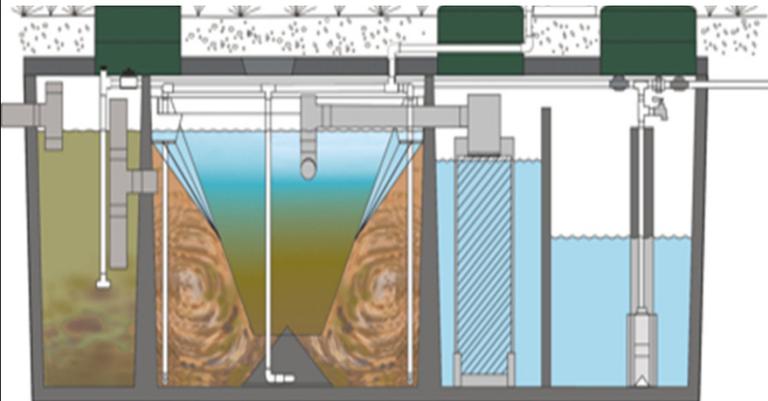
Recommend continued piloting on 1.7 acre parcels



15.7 mg/l TN

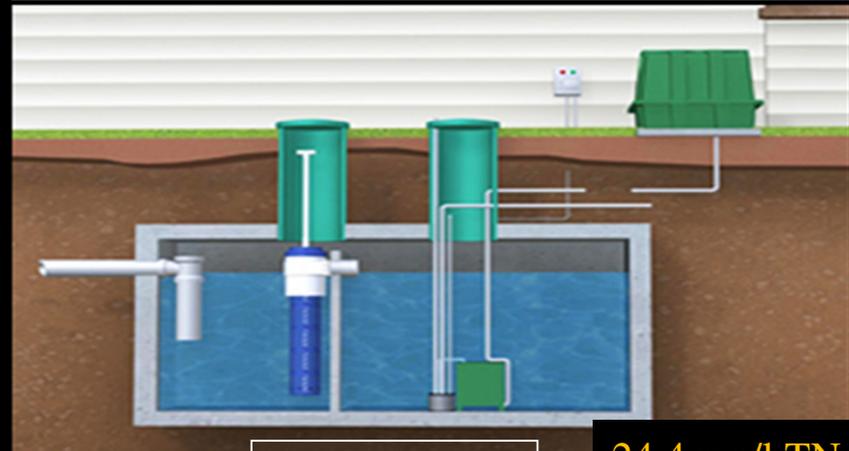
Hoot ANR

Recommend continued participation on 1.0 acre parcels subject to effluent monitoring



Bio Barrier

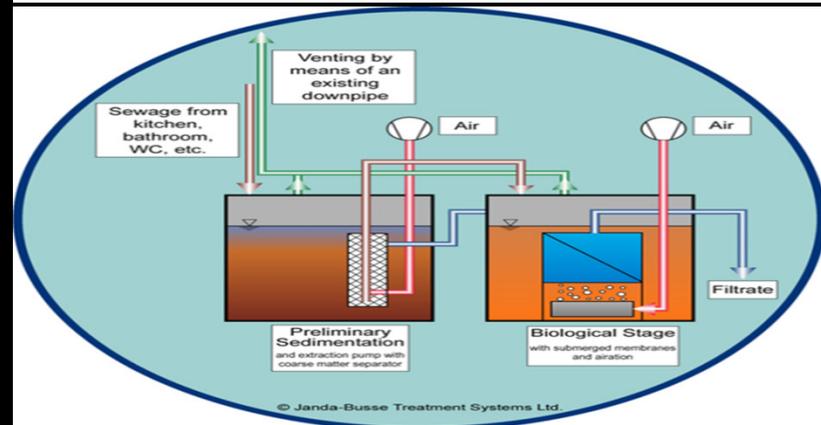
Recommend continued piloting on 1.7 acre parcels



24.4 mg/l TN

Busse GT

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



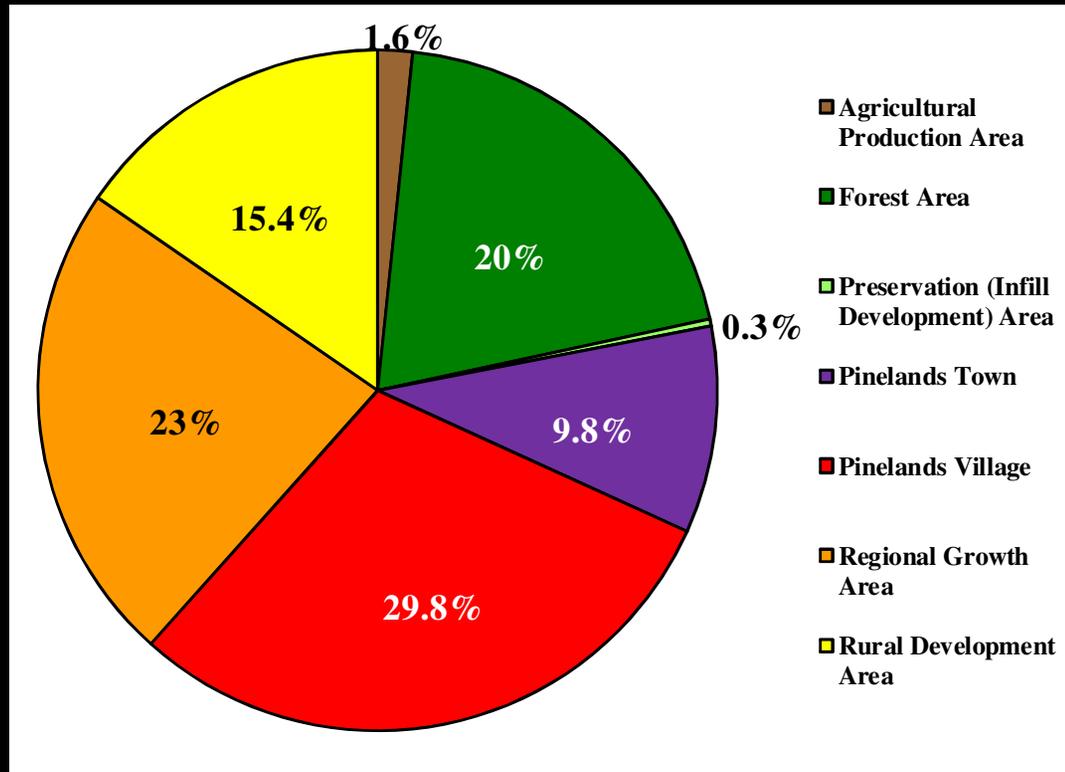
Installed Pilot Program Technologies

| 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 |

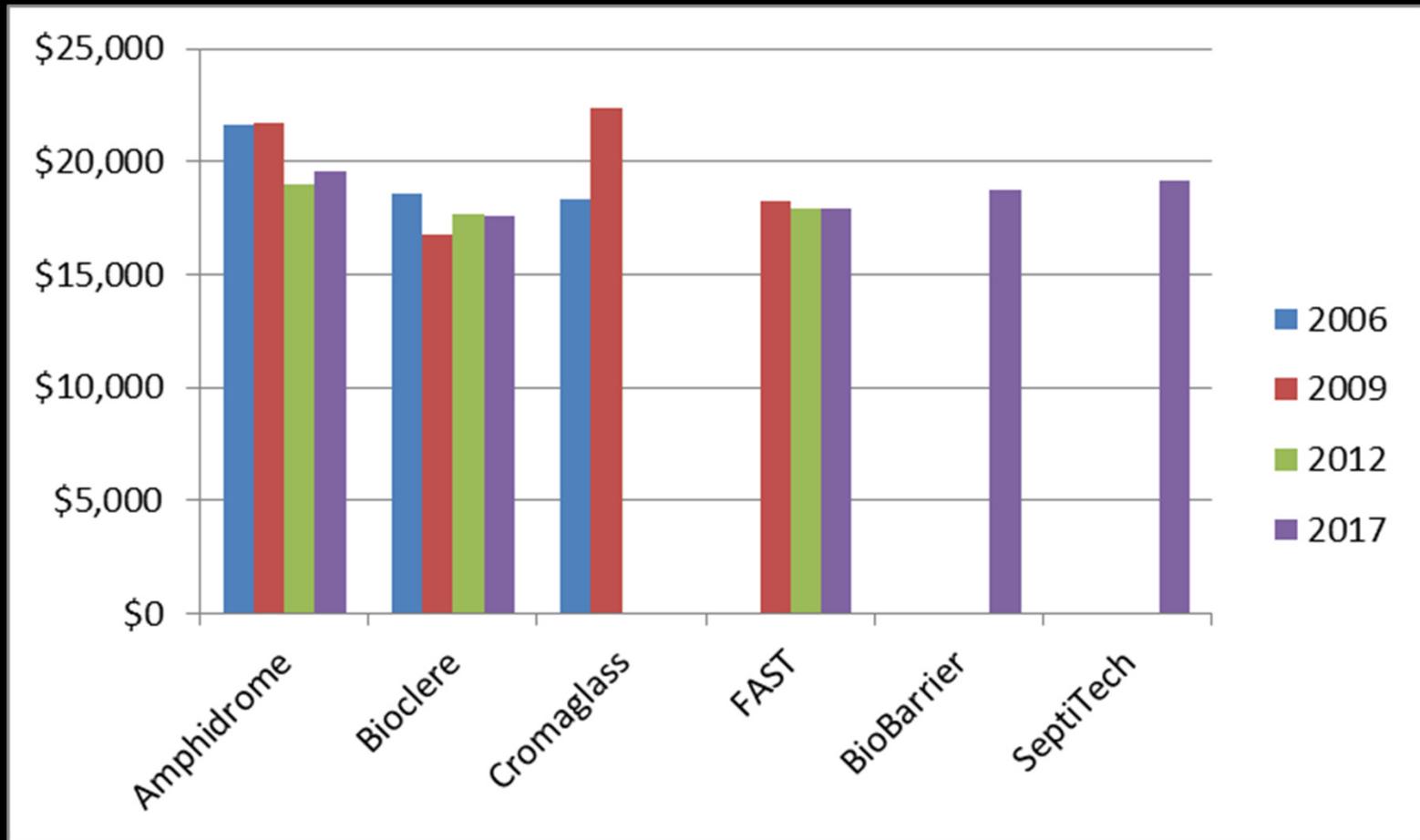
Pilot Program Technologies - Installations by Management Area



* 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

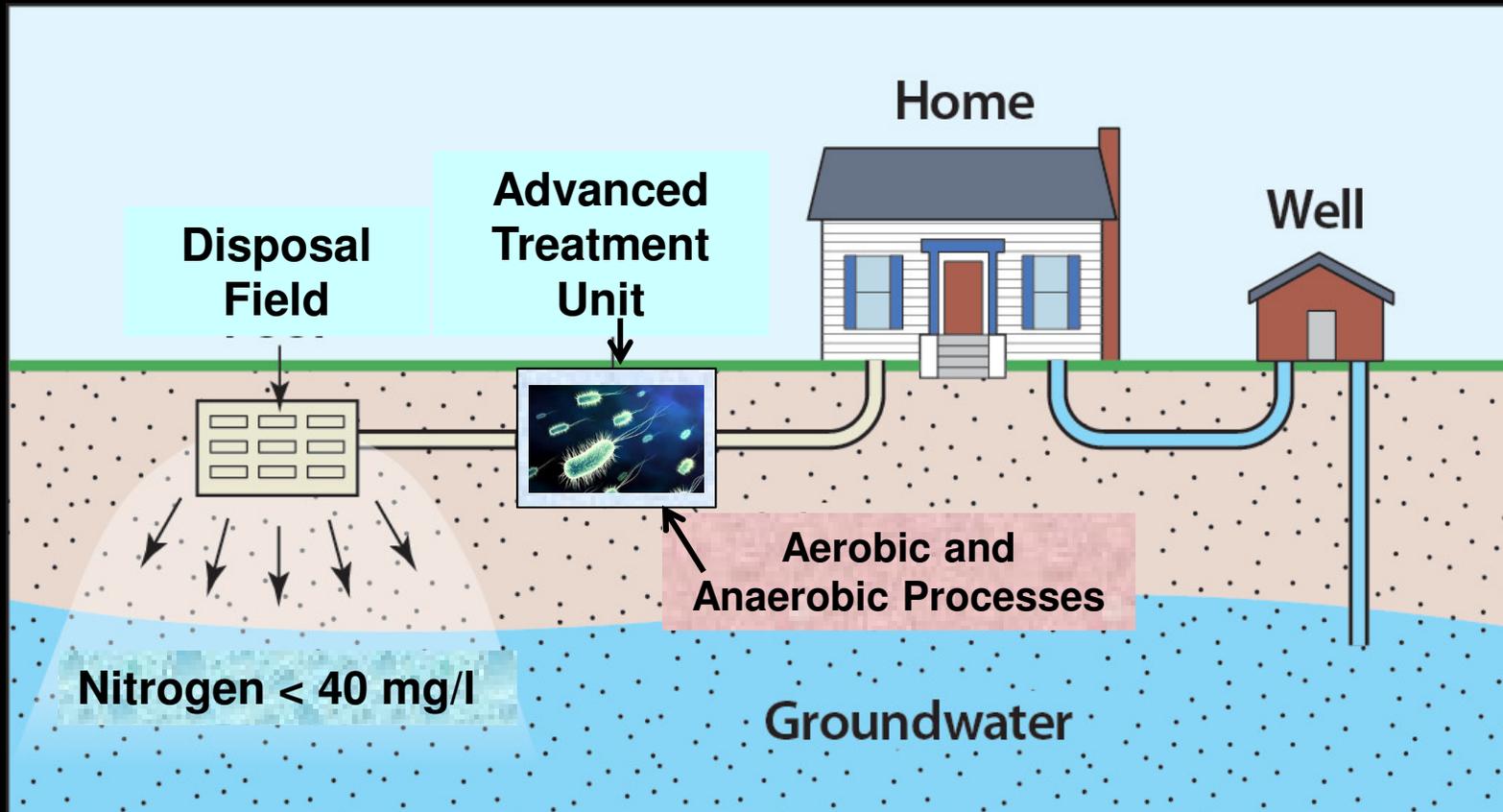
- Introduce two new NSF Standard 245 / US EPA ETV certified technologies to the pilot program. (CMP permits up to six piloted technologies at one time).
- Notify the manufacturer of the Busse GT technology that the system will be suspended from participating in the pilot program unless the system is 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



Ed Wengrowski, REHS

Environmental Technologies Coordinator

Ed.Wengrowski@pinelands.nj.gov

www.nj.gov/pinelands

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