# ANNUAL REPORT
# TO THE NEW JERSEY PINELANDS COMMISSION

## ALTERNATE DESIGN TREATMENT SYSTEMS
## PILOT PROGRAM

**August 5, 2015**

## Background

The Federal and New Jersey Pinelands statutes call for the preservation, protection and enhancement of the unique Pinelands ecosystem and its land and water resources. The exceptional quality of Pinelands water resources is protected and maintained through the control of development and other land uses and through close cooperation and coordination between local, state and federal agencies. To safeguard Pinelands water resources, the water quality provisions of the Pinelands Comprehensive Management Plan (CMP), (available for download at http://www.state.nj.us/pinelands/cmp/) focus on controlling the amount of nitrogen that enters the environment. Nitrogen is a significant point and nonpoint source pollutant due to its role in the eutrophication of surface water bodies. It is a useful indicator of overall Pinelands water quality and ecosystem health because it is naturally present in very low concentrations in the Pinelands environment. In recent years, there has been much attention focused on the role that excessive nitrogen has played in the decline of the Barnegat Bay ecosystem. The Pinelands Area accounts for 33% of Barnegat Bay's Watershed and efforts to control nitrogen releases in the Pinelands Area can have a significant impact on both the Pinelands and Barnegat Bay ecosystems. The Pinelands CMP has always recognized the importance of controlling nitrogen on both local and regional scales and provides for the establishment of land use policies and engineering solutions to protect the regions sensitive ecology.

The Commission's land use program discourages development in important ecological and agricultural areas while directing growth towards more suitable areas. While some of the designated growth areas are served by central sewer systems, others are not. In these unsewered growth areas, municipalities may zone for residential development on lots as small as one acre. One acre lots are also permitted in non-growth areas if certain cultural housing and grandfathered ownership conditions are met. In very limited instances, waivers of strict compliance allow for development of unsewered dwellings on lots as small as 20,000 square feet.

The CMP's water quality standards permit the use of on-site septic systems (individual subsurface sewage disposal systems) provided that the design of the system and the size of the parcel on which the system is located will ensure that the concentration of nitrogen in the ground water exiting the parcel or entering a surface water body will meet the Commission's water quality standard of two parts per million (ppm). The CMP uses the Pinelands Septic Dilution Model to calculate nitrogen loading to groundwater from septic systems and to confirm that proposed loadings do not exceed the assimilative capacity of the environment. When standard values for home occupancy, wastewater volume, wastewater strength and rainfall infiltration are used in solving the model, the model calculates that a minimum 3.2 acre parcel is required to dilute nitrogen to the required two ppm concentration when conventional septic system technology is used. Conventional septic system technology, typically consisting of a septic tank and effluent dispersal field (and sometimes a pump and dosing tank), is ineffective at removing or attenuating nitrogen levels in wastewater. Thus, unsewered residential development using standard (conventional) septic system technology is permitted only on minimum 3.2 acre parcels.

In order to comply with the Pinelands water quality standard, unsewered residential development on parcels smaller than 3.2 acres requires the use of high performance advanced onsite denitrifying wastewater treatment technology. If the mass of nitrogen contained in the wastewater discharged from an on-site septic system is sufficiently reduced through the use of an advanced treatment system, the CMP allows the minimum lot size required to meet the 2 ppm property line concentration to be reduced from 3.2 acres down to a minimum of 1.0 acre.

The basic principles of biological nitrogen reduction in wastewater are well documented in the engineering literature. In fact, biological nitrification and denitrification is now routinely employed at large centralized sewage treatment plants, especially those that discharge treated effluent to environmentally sensitive receiving waters. These large scale treatment facilities employ professionally trained and licensed operators and have the ability to enhance nitrogen removal through the use of chemical feed equipment and to make real time process modifications in response to changing influent wastewater characteristics.

The use of biological denitrification technologies at the much smaller scale of individual onsite systems is a relatively recent development. The US EPA as well as number of individual states and regions have developed and are currently administering programs to study the effectiveness of onsite wastewater denitrification treatment technologies. The Ad Hoc Committee On Alternative Septic Systems, convened by the Pinelands Commission in

March 2000, conducted a thorough review of this ongoing work to evaluate alternate treatment technologies nationwide, consulted with officials from other state and university programs involved with advanced on-site septic system technologies and management strategies, retained a consultant to assess the technical performance of selected technologies, met with treatment system manufacturers and county health officials, and coordinated research efforts with the New Jersey Department of Environmental Protection (NJDEP). After completing this research, the Committee recommended the establishment of a pilot program to test five specific onsite wastewater treatment systems. (The pilot program has subsequently been expanded to test an additional four advanced treatment technologies). The Alternative Design Wastewater Treatment Systems Pilot Program contained in the CMP at N.J.A.C. 7:50-10.21 is authorized as a means to test whether these systems can be operated and maintained so as to meet the Pinelands water quality standards, with maintenance requirements that a homeowner can reasonably be expected to follow.

Abridged timeline for the Pinelands Alternate Design Wastewater Treatment Systems Pilot Program:

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|---|---|
| Aug. 5, 2002 | Effective date of the pilot program; residential development applications received after this date for lots less than 3.2 acres that are not served by public sewer are required to use a Pinelands alternate design wastewater treatment system. Completed applications received prior to this date were permitted to use a pressure dosing septic system, provided the installation was completed by August 5, 2004. |
| Nov. 3, 2006 | Executive Director's Implementation Report issued to the Commission (available at: http://www.state.nj.us/pinelands/images/pdf%20files/Final_110306_Pilot_Septic_Implem_Rpt_.pdf.) The report recommended the removal of the Ashco RSFIII system from the pilot program due to its commercial unavailability, imposition of a temporary suspension of new Cromaglass installations based upon non-attainment of effluent total nitrogen targets and various deadlines in the pilot program to allow continued installation of the pilot program systems. |
| June 15, 2009 | Publication of proposed CMP amendments (N.J.A.C. 7:50-2.11, 3.39 and 6.85) addressing septic system management. |
| Nov. 5, 2009 | Executive Director's second Implementation Report issued to the Commission (available at http://www.state.nj.us/pinelands/landuse/waste/Final_Nov%202009_ImplementationReport.pdf). The November 5, 2009 Implementation Report discussed the nitrogen removal efficiencies of the treatment technologies, system maintenance requirements, treatment technology costs and system operational issues. The Report also contained an evaluation of the number of systems installed and a determination as to the adequacy of that number to render a final determination on the effectiveness of the treatment technologies in meeting the purposes and objectives of the State and Federal Pinelands Protection Acts. |
| June 7, 2010 | Effective date of CMP amendments that established requirements for the long-term management of Pinelands alternate design wastewater treatment systems. |
| Oct. 18, 2010 | Effective date of CMP amendments authorizing permanent approval of the Amphidrome and Bioclere technologies. The amendments also authorized the addition of up to four new NSF 245 USEPA ETV certified treatment technologies to the pilot program for installation through August 5, 2016. |
| Dec. 5, 2011 | Notice published in the New Jersey Register announcing acceptance of the four "new" technologies (BioBarrier, Busse Green, Hoot ANR and SeptiTech) for participation in the pilot program. |
| August 5, 2013 | Last date for new installations of the Cromaglass and FAST treatment systems due to a sunset provision in the CMP. |

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|---|---|
| September 2, 2014 | Effective date of CMP amendments to eliminate the Cromaglass technology from the pilot program and to extend until August 5, 2018, the last day to install a FAST, BioBarrier, Busse GT, Hoot ANR and SeptiTech treatment technology. |
| August 5, 2018 | Last day to install the FAST, BioBarrier, Busse GT, Hoot ANR and SeptiTech treatment technologies unless the Commission adopts an amendment to the CMP that expressly authorizes such installations beyond this date. |

## Introduction

Amendments to the CMP establishing the Pinelands Alternate Design Wastewater Treatment System Pilot Program became effective on August 5, 2002. The rule requires that the Executive Director submit an annual report to the Commission describing activity to date on the installation, maintenance and performance of each of the alternate design wastewater treatment technologies. This thirteenth annual report is submitted to fulfill the annual reporting requirement.

Before any of the approved technologies could be used within the Pinelands Area, the manufacturer of the treatment system had to first submit and the Executive Director had to first approve detailed engineering design plans and system specifications, details on the automatic alarm dialing system, a wastewater sampling protocol, an operation and maintenance manual, a sample five year warranty, a sample five year operation and maintenance contract, and a sample deed notice. In addition, the New Jersey Department of Environmental Protection (NJDEP) had to first issue a Treatment Works Approval (TWA) authorizing local/county health departments to approve such systems pursuant to N.J.A.C 7:9A Standards for Individual Subsurface Sewage Disposal Systems (7:9A-3.9(a)4).

Use of the high performance alternative onsite wastewater treatment systems is now authorized in each of the Pinelands Area municipalities as a result of amendments to the CMP that became effective on December 3, 2007. Prior to that amendment, the pilot program technologies were only authorized for use in municipalities that had adopted an ordinance to implement the pilot program. Although most municipalities had adopted the requisite ordinance (34 of 40) the Commission found that applicants in the non-adopting municipalities were subjected to considerable hardship. The December 3, 2007 amendments have proven to be effective in providing aggrieved applicants in those municipalities with needed relief. Details of this amendment are discussed below.

The CMP also requires that each technology manufacturer or its agent submit a semi-annual report to the Executive Director. Such reports must include information on the number of systems installed, a discussion on the installation of systems, an analysis and evaluation of wastewater monitoring results to date, and a discussion of any operational or maintenance issues experienced.

## Summary of Program Activity

The Pinelands Alternate Design Wastewater Treatment Systems Pilot Program was originally made possible as a result of grant funding that the NJDEP provided to the Pinelands Commission. In May 2009, Commission staff satisfied the final grant deliverable by providing the NJDEP, Division of Watershed Management with the Final Report on the "Atlantic Coastal Watershed Region Program Grant: Decentralized Wastewater Management in the Mullica River Basin and Other Pinelands Watersheds". The pilot program is now financed solely by the Pinelands Commission. The Commission posts the findings of the pilot program on its website to further the technology transfer goals of the program and to share relevant information with other entities engaged in protecting ecologically sensitive regions. The Commission also distributes copies of its annual report to the NJDEP and to the seven Pinelands Area county health departments having jurisdiction in the Pinelands Area.

## Septic System Management Initiatives

### Pinelands Commission [N.J.A.C 7:50] Pinelands Comprehensive Management Plan

Since 1980, the Pinelands Commission has recognized the environmental benefits of periodic septic system maintenance. From its beginnings, the CMP has required that septic systems in the Pinelands be inspected and pumped at least once every three years and that written proof of maintenance be submitted to the local boards of health. In June 2009, the Commission proposed several amendments to the CMP at N.J.A.C. 7:50-2.11, 3.35, and 6.85 to further address septic system management. Those proposed amendments were related to the management of both conventional septic systems as well as advanced pilot program treatment systems. The rule proposal aimed to establish a framework for institutional or governmental programs to ensure the proper long-term operation and maintenance of all onsite wastewater systems in the Pinelands.

The Commission received extensive public comment on the septic system management rule proposal. A great number of the comments were opposed to requirements for the management of conventional septic systems. Responding to public opposition, the Commission withdrew the section of the proposal related to conventional septic systems and adopted only those portions of the proposal that required long term management of the advanced pilot program technologies. This action resulted in the continuation of the existing CMP rule related to the triennial inspection and pumping of conventional septic systems.

In April 2013, Commission staff organized, hosted and led an interagency meeting between Commission staff, NJDEP and representatives of the seven Pinelands Area Health Departments to review the septic system management provisions of the Pinelands CMP and the NJDEP's Standards for Individual Subsurface Sewage Disposal Systems. NJDEP amended its standards on April 2, 2012. The NJDEP's septic system management requirements are codified at N.J.A.C 7:9A-12.3. This meeting was instrumental in clarifying the applicable rules and in raising awareness of the management obligations of the participating regulatory entities. A follow-up meeting is being planned for September 2015.

The Commission maintains and shares with each of the county health departments an inventory of all of the pilot program septic system installations. In addition, the county health departments are required by NJDEP regulations to retain all records pertaining to the design, installation, inspection and approval of each of these systems until the realty improvement served by the system is either removed or connected to a public sewer. The county health departments are further charged with the enforcement of mandatory operation and maintenance requirements applicable to "advanced wastewater pretreatment components", including the pilot program systems, as provided in the New Jersey Administrative Code at N.J.A.C 7:9A.

The Commission is also working with the alternative treatment system service providers to facilitate their compliance with N.J.A.C. 7:9A-12.3(d), which requires the service providers to send written notification to the county health departments of the non-renewal of an alternative treatment system service contract within 30 days of the contract expiration.

### NJDEP [N.J.A.C. 7:15] Water Quality Management Plan

The 2009 CMP septic management proposal for alternative septic systems was developed in harmony with NJDEP's Water Quality Management Planning (WQMP) rules (N.J.A.C 7:15-5.25(e)), adopted in 2008. These state-wide rules require that municipalities must demonstrate that areas served by septic systems are subject to a mandatory maintenance program to ensure that all septic systems are functioning properly. The NJDEP rule specifies that management programs must include requirements for periodic pump out and maintenance, as needed. The applicability of this NJDEP rule was discussed during the April 2013 interagency management meeting.

### NJDEP [N.JAC. 7:9A] Standards for Individual Subsurface Sewage Disposal Systems

In April 2012, the NJDEP readopted state-wide Standards for Individual Subsurface Sewage Disposal Systems

(Standards) (N.J.A.C 7:9A). These rules require that local/county health departments provide operation and maintenance information triennially to septic system owners whose systems were approved after January 1, 1990. The comprehensive notices must include:

1. A general outline of how septic systems work and the potential impact of improper operation on ground and surface water quality and public health;
2. The recommended frequency of septic tank and grease trap pumping and instructions on how to determine when pumping is necessary;
3. A list of materials containing toxic substances that are prohibited from being disposed of into a septic system;
4. A list of inert or non-biodegradable substances that should not be disposed of into a septic system;
5. Proper practices for maintaining the area of the septic leach field;
6. Negative impacts to a septic system resulting from excessive water use; and
7. Warning signs for poor system performance or malfunctions and recommended or required corrective actions.

The NJDEP Standards, as amended on April 2, 2012, for the first time, authorize the state-wide use of advanced onsite wastewater treatment systems for new construction without first requiring a Department-issued TWA permit. The Standards require that local or county health departments maintain records on each advanced treatment system in their jurisdiction and provide annual reports to the NJDEP with respect to the following:

i. The type of advanced wastewater treatment device installed;
ii. The location of each installed device;
iii. The type of use (e.g., residential or commercial);
iv. The type of disposal area (e.g., bed, trench, drip dispersal);
v. The date of installation and startup; and
vi. The date of each inspection and maintenance call.

The Standards are similar to the Commission's pilot program requirements. For example, the owner of each advanced treatment system must have a service contract in place throughout the live of the system with an authorized service provider. The NJDEP Standards require system owners to provide the local or county health department with a copy of the service contract prior to the health department's initial approval of the system. In the event that a property owner enters into a contract with a different service provider upon expiration of an existing contract, the homeowner must provide the health department with the new contract within 14 days of making the change. Importantly, if a property owner fails to renew a service contract, the previously authorized service provider is required to provide written notice to the health department within 30 days of the contract expiration. Authorized service providers must provide copies of system inspection forms to the health department within 30 days of the inspection. Pursuant to the NJDEP Standards, the failure of a property owner to maintain a service contract on an advanced treatment system constitutes a violation of the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq., and constitutes a noncompliance violation of N.J.A.C 7:9A.

The NJDEP Standards related to the installation and use of advanced treatment systems apply state-wide to all advanced treatment systems governed by the NJDEP Standards, including Pinelands alternate design pilot program wastewater treatment systems.

As previously noted, the Commission hosted an interagency septic system management meeting on April 10, 2013 to review these standards with each of the Pinelands Area health departments. The NJDEP provided a detailed presentation on their amended rules. This meeting and subsequent communications with the health departments, service providers, system owners and treatment system vendors are intended to help ensure that all of the Pinelands Area health departments, Pinelands alternate design treatment system manufacturers, service providers, and owners of Pinelands alternate design treatment systems are aware of the NJDEP's April 2, 2012 rule adoption, particularly with respect to the NJDEP's newly adopted enforcement provisions. Also as noted above, the Commission is coordinating a second interagency meeting in cooperation with NJDEP. This follow-up meeting is also being coordinated with the New Jersey Environmental Health Association (NJEHA). The NJEHA has agreed to assist Commission staff in arranging for continuing education credits to be awarded (by the New Jersey Department of

Health) to program participants. These continuing education credits can be applied toward the renewal of NJ Registered Environmental Health Specialist and Health Officer licenses issued by the New Jersey Department of Health. As noted, that program is anticipated to be held at the Commission's headquarters in September of 2015.

**Educational Resources**

The Commission staff continues to provide assistance to Pinelands Area municipalities and health departments to help them achieve compliance with the NJDEP's (N.J.A.C. 7:15 and N.J.A.C. 7:9A) septic system management requirements. The Commission has produced a number of useful educational documents for use by residents and public health officials.

Municipalities and health departments are encouraged to consult the *Onsite Wastewater Systems Management Manual for the New Jersey Pinelands*, (prepared by Stone Environmental, Inc. under contract to the Commission) http://www.state.nj.us/pinelands/landuse/current/septic/WW%20Mgt%20Manual_2008.09.05.pdf for guidance on the establishment of septic system management programs. This manual explores several management models for municipalities and others to consider and provides flexibility in the selection of any single model or any combination of model elements that are locally appropriate. In addition, municipalities and health departments are also encouraged to consult the report entitled *Legal Basis and Regulatory Framework of Onsite Wastewater Management in the New Jersey Pinelands* (also prepared by Stone Environmental, Inc. under contract to the Commission). http://www.state.nj.us/pinelands/landuse/current/septic/Pinelands_OWTS_Legal_Framework_Final.pdf These reports, as well as other related materials, including an informative septic system maintenance guidance document directed at homeowners, are posted on the Commission's website at www.nj.gov/pinelands. In addition, Commission staff produces and distributes training materials at the Rutgers Onsite Wastewater Treatment Systems seminars offered through the University's Office of Continuing Professional Education.

**Pilot Program Amendments**

Since the original adoption of the pilot program in August 2002, several pilot program related amendments to the CMP have been adopted. These include:

1. A remedy for land owners in municipalities that had not yet adopted ordinances to implement the pilot program;

2. Removal of one technology (ASHCO RFS III) from the pilot program due to the manufacturer's inability to provide its technology to Pinelands residents;

3. Providing for management of pilot program treatment systems beyond the original five year mandatory maintenance contract period;

4. Extending the period of the pilot program to better evaluate both existing and new treatment technologies;

5. Granting permanent approval status to two of the pilot program technologies (Bioclere and Amphidrome),

6. Eliminating Cromaglass from the pilot program due to its inability to meet Pinelands water quality standards;

7. Authorizing the Commission to approve up to four new pre-screened NSF International / American National Standards Institute (ANSI) Standard 245 and/or United States Environmental Protection Agency - Environmental Technology Verification (USEPA ETV) certified technologies to participate in the pilot program. The Commission has approved the BioBarrier, SeptiTech, Hoot ANR and Busse Green GT systems to participate in the pilot program;

8. Requiring that local boards of health withhold certificates of compliance or similar authorizations which

would permit the occupancy of a building served by an alternative design wastewater treatment system until such time as the Pinelands Commission provides written authorization to the local board of health that such a system may be authorized for use; and

9. Extending the duration of the pilot program until August 5, 2018.

**NJDEP Treatment Works Approvals**

The NJDEP has provided welcome assistance to the Commission throughout the development and implementation of the pilot program. As noted above, the NJDEP reissued a Generic TWA to expedite local health department approvals of all of the Pinelands pilot program systems. The TWA permit allows the use of the Pinelands pilot program systems without individual applicants being subject to the standard $850 NJDEP permit fee or the standard 90 day review period. The expedited NJDEP Generic TWA Permit has been well received by both the regulatory and development community. It has proven to be an effective instrument by allowing individual applications to be approved directly by the Pinelands county health departments, resulting in significant time and expense savings to the applicants

**Local and Regional Training and Technology Transfer**

In the current reporting year, Commission staff provided two public presentations on the pilot program to outside organizations. These included talks at the New Jersey Environmental Health Association's 2015 Annual Conference and at the Association of New Jersey Environmental Commission's Onsite Wastewater Management Workshop.

During the thirteen year duration of the pilot program, Commission staff has participated in a number of local, regional, and national educational conferences to share the Commission's experiences. Staff has organized targeted training sessions for each of the Pinelands Area Health Departments to review Pinelands and NJDEP septic system regulations, fundamentals of biological nutrient removal, and design, operation and maintenance requirements for advanced onsite treatment technologies. Representative regional training sessions include such conferences as a USEPA conference in Mt. Kisco, NY, a New Jersey Environmental Health Association conference in Atlantic City, NJ, a National Environmental Health Association conference in Atlantic City, NJ, a Massachusetts Health Officers Association conference in Springfield, MA, a New England Interstate Water Pollution Control Commission conference in Groton, CT, a National Environmental Health Association conference in Tucson, AZ, a Central Pine Barrens (Long Island) Joint Planning Commission conference in Brookhaven, NY, a Peconic Bay (Long Island) Advanced Wastewater Treatment Systems Water Quality Symposium in Hauppauge, NY, and a keynote address at the Onsite Water Protection Conference at North Carolina State University in Raleigh, N.C.

Commission staff has met with each of the Pinelands Area health departments to facilitate implementation of the pilot program and to assist the health departments in their review of plans and applications and to train inspectors on the alternative treatment technologies. In addition, Commission staff has presented annually at the Rutgers / NJDEP Onsite Wastewater Treatment Systems Seminars held in in New Brunswick and Bordentown, NJ. The Rutgers/ NJDEP program provides classroom training to professionals engaged in the onsite wastewater industry including state, local and regional public health professionals, septic system design engineers, system installers and other onsite system service providers. In addition, staff assists Pinelands Area residents by responding to questions related to the care and use of onsite wastewater systems. Moreover, Commission staff has conducted numerous evening workshops throughout the Pinelands Area to enhance awareness of the connection between septic system maintenance and clean water, property values and quality of life. Lastly, commission staff regularly provides telephone assistance to homeowners, builders, developers and consulting engineers in complying with the requirements of the pilot program.

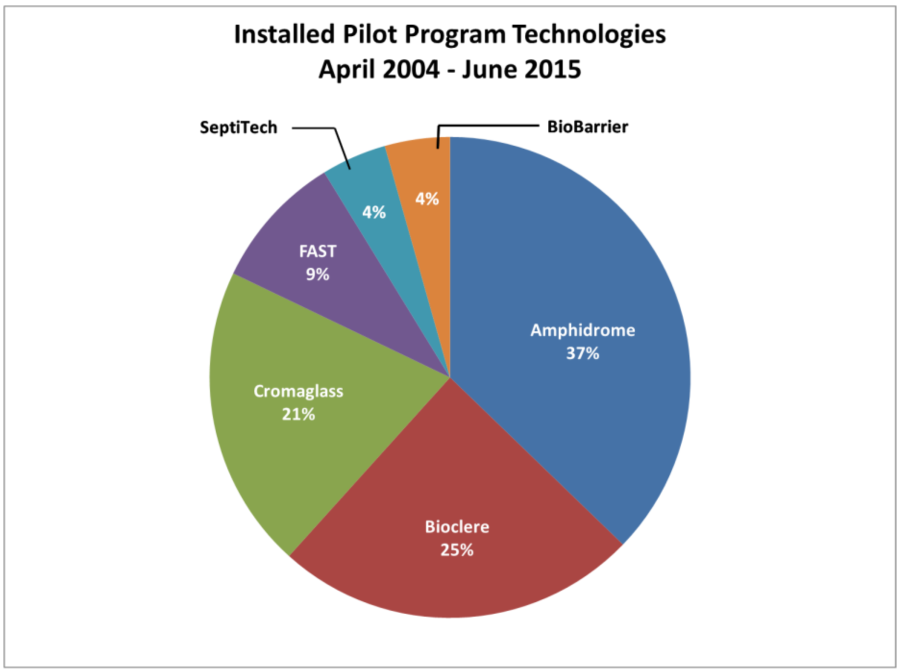
**Treatment Technologies Installation Summary**

The Alternate Design Treatment Systems Pilot Program was adopted through an August 5, 2002 amendment to the CMP. The pilot program originally included the first five technologies listed below. It has and since been expanded to include four additional NSF International, Standard 245 and USEPA ETV advanced treatment technologies.

These include:

1. ~~Ashco RFS III~~ [1]
2. Amphidrome
3. Bioclere
4. ~~Cromaglass~~[2]
5. FAST
6. BioBarrier
7. Hoot ANR
8. Busse GT
9. SeptiTech

Two hundred and seventy-four Pinelands alternate design treatment systems have been installed and activated through June 5, 2015. The first pilot program system came online in April 2004. Twenty-three alternate design systems were installed during the current reporting period (July 2014 through June 2015). The following tables and figures summarize annual installations of each technology and their location.




1 Amendments to the CMP, effective December 3, 2007, removed the Ashco RFS III from the pilot program due to the manufacturer's failure to make the system commercially available in the Pinelands during the initial five year period of the pilot program and to otherwise demonstrate the ability or intention for future participation in the program.

2 Amendments to the CMP, effective September 2, 2014, removed the Cromaglass technology from the pilot program due to the technology's inability to meet Pinelands water quality standards and to otherwise demonstrate the ability or intention for future participation in the program.

## Annual Installations of Pilot Program Technologies

| Technology | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total Installed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amphidrome | 7 | 10 | 11 | 29 | 13 | 7 | 5 | 8 | 4 | 6 | 1 | 1 | 102 |
| Bioclere | 0 | 2 | 11 | 9 | 7 | 9 | 6 | 5 | 3 | 5 | 6 | 4 | 67 |
| Cromaglass | 0 | 5 | 39 | 7 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 56 |
| FAST | 0 | 0 | 0 | 0 | 2 | 5 | 3 | 3 | 3 | 5 | 2 | 2 | 25 |
| SeptiTech | Not yet active in pilot program | | | | | | | | | | 3 | 9 | 12 |
| BioBarrier | Not yet active in pilot program | | | | | | | | | | 5 | 7 | 12 |
| **Total** | 7 | 17 | 61 | 45 | 26 | 22 | 14 | 16 | 10 | 16 | 17 | 23 | 274 |

Note: There have been no new installations of the Cromaglass technology since 2009 as a result of a temporary suspension instituted by the Commission on November 15, 2006. Twelve applicants with prior construction approvals were permitted to install the Cromaglass system after the imposition of the temporary suspension.

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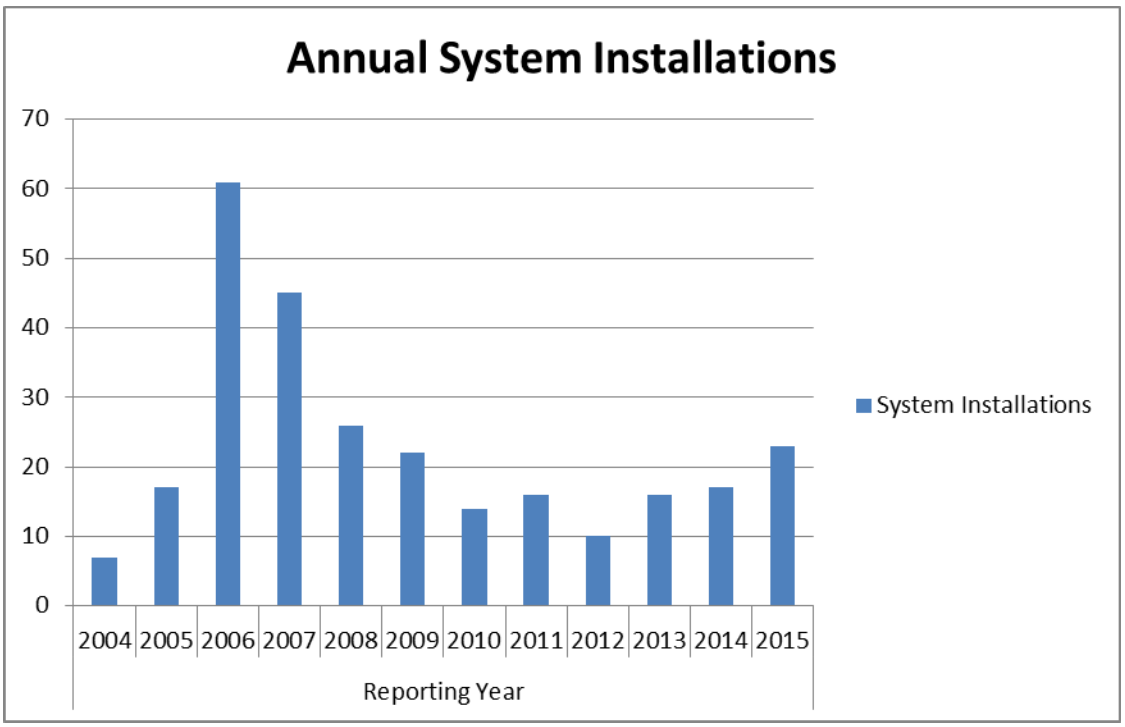


## Installed Pilot Program Technologies by Location
## April 2004 – June 2015

| | | Technology | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Municipality** | **Amphidrome** | **Bioclere** | **Cromaglass** | **FAST** | **SeptiTech** | **BioBarrier** | **Total** |
| **Atlantic County** | Egg Harbor Twp | 2 | 3 | | 1 | | | **6** |
| | Estell Manor | | 2 | | | | | **2** |
| | Folsom | 6 | 2 | 1 | 1 | | | **10** |
| | Galloway | 1 | 1 | | 1 | | | **3** |
| | Hamilton | 14 | 20 | 4 | 1 | | | **39** |
| | Hammonton | 5 | 1 | | | | | **6** |
| | Mullica | 3 | 6 | | | | | **9** |
| | Port Republic | | | | 1 | | | **1** |
| **Burlington County** | Evesham | | 1 | | | | | **1** |
| | Medford | 3 | | | 2 | 2 | | **7** |
| | Pemberton | 12 | 11 | 22 | | | | **45** |
| | Shamong | 2 | | | | | | **2** |
| | Tabernacle | 3 | 4 | 1 | | | 1 | **9** |
| | Washington | 1 | 1 | | | | | **2** |
| | Woodland | 2 | 2 | | 2 | | | **6** |
| **Camden County** | Chesilhurst | | 1 | | | | | **1** |
| | Waterford | 3 | | | | | | **3** |
| | Winslow | 10 | 6 | 4 | 6 | 7 | | **33** |
| **Cape May County** | Dennis | 1 | | | | | | **1** |
| | Upper | | 1 | | | | | **1** |
| | Woodbine | | 1 | | | | | **1** |
| **Gloucester County** | Franklin | 1 | | 1 | 3 | | | **5** |
| | Monroe | | | | 2 | | | **2** |
| **Ocean County** | Jackson | 13 | 2 | 13 | 5 | 3 | 11 | **47** |
| | Lacey | 1 | | | | | | **1** |
| | Manchester | 18 | 2 | 10 | | | | **30** |
| | Stafford | 1 | | | | | | **1** |
| | **Total** | **102** | **67** | **56** | **25** | **12** | **12** | **274** |

Note: The majority of systems installed in Pemberton Township are located in the Presidential Lakes subdivision, which was the subject of a prior Commission approval that required the use of pressure dosing septic systems. Pinelands alternate design treatment systems were not required but were used voluntarily by the developer in response to local water quality concerns.

**Administrative Approval of Technologies**

In accordance with the provisions of the pilot program, prior to being certified for use, the manufacturer of each alternate design treatment system had to submit specific documents to the Executive Director for review and approval. These documents included detailed engineering plans and specification, a Homeowners Manual on the proper use and operation of the system, a service provider's Operation and Maintenance Manual, a sample five year warranty, a sample five year operation and maintenance service contract, wastewater sampling and analysis protocols, and a sample deed notice to be filed with the County Clerk prior to the operation of each system to alert future property owners of the need to maintain the pilot program system. These record documents were distributed to each of the seven Pinelands Area health departments and are on file at the Commission's headquarters.

**Technology Approvals – First Round**

Ashco-A-Corporation provided the required documentation and based upon a detailed review by Commission staff, the Executive Director approved the Ashco RFS III Gravity system effective May 15, 2003. However, as noted above, the Ashco RFS III was subsequently eliminated from the pilot program due to the firm's inability to supply treatment units to the region.

F.R Mahony & Associates, the manufacturer of the Amphidrome system, provided the required documentation and, based upon a detailed review by Commission staff, the Executive Director approved the single family Amphidrome system effective July 24, 2003. Based upon the Pinelands Septic Dilution Model, each Amphidrome system must be located on a parcel containing at least one acre for each dwelling unit that will be served by the system. As noted above, the Amphidrome treatment technology has been released from the pilot program and granted permanent approval status in the CMP for residential use on minimum one acre parcels. As a result, F.R. Mahony & Associates is no longer required to submit monitoring and operational data to the Commission. The Amphidrome technology nevertheless must be designed to accommodate effluent sampling, certified prior to and after construction by the manufacturer or agent and by a NJ licensed professional engineer to be properly designed and operational, equipped with local and remote alarm functionality, sold with a five-year warranty and covered under a renewable operation and maintenance contract for as long as the system is in active use.

Aquapoint, Inc., the manufacturer of the Bioclere system, provided the required documentation and, based upon a detailed review by Commission staff, the Executive Director approved the single family Bioclere system effective November 18, 2003. Based upon the Pinelands Septic Dilution Model, each Bioclere system must be located on a parcel containing at least one acre for each dwelling unit that will be served by the system. As noted above, the Bioclere treatment technology has been released from the pilot program and granted permanent approval status in the CMP for residential use on minimum one acre parcels. As a result, Aquapoint is no longer required to submit monitoring and operational data to the Commission. The Bioclere technology nevertheless must be designed to accommodate effluent sampling, certified prior to and after construction by the manufacturer or agent and by a NJ licensed professional engineer to be properly designed and operational, equipped with local and remote alarm functionality, sold with a five-year warranty and covered under a renewable operation and maintenance contract for as long as the system is in active use.

Cromaglass, Inc., the manufacturer of the Cromaglass system, provided the required documentation and, based upon a detailed review by Commission staff, the Executive Director approved the Cromaglass system effective December 29, 2004. Based upon the Pinelands Septic Dilution Model, the pilot program originally required that each Cromaglass system be located on a parcel containing at least one acre for each dwelling unit that will be served by the system. As discussed herein, the Cromaglass technology was placed under a temporary suspension in November 2006 as a result of the technology's inability to meet expected total nitrogen concentrations in treated effluent. That suspension prohibited future installations of the Cromaglass technology. Effective September 2, 2014, the Cromaglass technology was removed from the pilot program due to the technology's inability to meet Pinelands water quality standards and the manufacture's failure to comply with the requirements of the pilot program. Homeowners in the Pinelands Area that currently use a Cromaglass system will not be required to replace it. They will have the option to continue to use the systems in a manner consistent with the operation and maintenance provisions of the CMP or, if they choose, they may replace the Cromaglass treatment tank with a conventional septic tank meeting the current requirements of N.J.A.C 7:9A, the NJDEP's Standards for Individual Subsurface Sewage Disposal Systems.

Bio-Microbics, Inc., the manufacturer of the FAST system, provided the required documentation and, based upon a detailed review by Commission staff, the Executive Director approved the FAST system effective June 9, 2005. Based upon the Pinelands Septic Dilution Model, the pilot program provided that each FAST system could be located on a parcel containing at least one acre for each dwelling unit that will be served by the system. Based upon a current comprehensive analysis of all effluent monitoring data collected to date, the FAST system has produced a grand median total nitrogen concentration of 19.0 mg/l. Application of the Pinelands Septic Dilution Model indicates that the FAST system can be expected to meet the Commission's 2 mg/l total nitrogen standard when it is used to serve residential development on a minimum **1.5 acre** parcel. As a result, Commission staff continues to recommend that the FAST system be released from the pilot program and granted permanent approval status to serve residential development on minimum **1.5 acre** parcels. An amendment to the CMP will be required to implement this recommendation. Once such an amendment has been adopted, the FAST technology would no longer be required to submit monitoring and operational data to the Commission. The FAST technology nevertheless would still need to be designed to accommodate effluent sampling, certified prior to and after construction by the manufacturer or agent and by a NJ licensed professional engineer to be properly designed and operational, equipped with local and remote alarm functionality, sold with a five-year warranty and covered under a renewable operation and maintenance contract for as long as the system is in active use. In the interim, local approvals involving the use of the FAST technology on parcels of less than 1.5 acres in size are subject to the Commission's "call up" process, including a public hearing pursuant to N.J.A.C. 7:50-10.22(a)3 and (a)5, and will be released only if additional contiguous lands are included in the application to achieve a 1.5 acre parcel size.

**Technology Approvals – Second Round**

Hoot Systems, LLC, the manufacturer of the Hoot ANR system, provided the required documentation (including the NSF Standard 245 certification report) and, based upon a detailed review by Commission staff, the Executive Director approved the single family Hoot ANR system effective September 14, 2011. Based upon the Pinelands Septic Dilution Model, each Hoot ANR system must be located on a parcel containing at least one acre for each dwelling unit that will be served by the system.

SeptiTech, LLC, the manufacturer of the SeptiTech system, provided the required documentation (including the NSF Standard 245 certification report) and, based upon a detailed review by Commission staff, the Executive Director approved the single family SeptiTech system effective September 14, 2011. Based upon the Pinelands Septic Dilution Model, each SeptiTech system must be located on a parcel containing at least one acre for each dwelling unit that will be served by the system.

Bio-Microbics, Inc., the manufacturer of the BioBarrier system, provided the required documentation (including the NSF Standard 245 certification report) and, based upon a detailed review by Commission staff, the Executive Director approved the single family BioBarrier system effective September 14, 2011. Based upon the Pinelands Septic Dilution Model, each BioBarrier system must be located on a parcel containing at least one acre for each dwelling unit that will be served by the system.

Busse Green Technologies, Inc., the manufacturer of the Busse Green MBR system, provided the required documentation (including the NSF Standard 245 certification report) and, based upon a detailed review by Commission staff, the Executive Director approved the single family Busse Green MBR system effective September 14, 2011. Based upon the Pinelands Septic Dilution Model, each Busse Green MBR system must be located on a parcel containing at least one acre for each dwelling unit that will be served by the system.

New installations of the Amphidrome, Bioclere, Fast, SeptiTech and BioBarrier technologies occurred during the current reporting period. To date, there have been no installations of the Hoot ANR and Busse GT technology systems.

## System Permitting and Local Approvals

The pilot program relies upon the cooperation of local construction code officials, county health officials, treatment system manufacturers, system installers, certifying engineers and Pinelands staff to coordinate the approval of wastewater system engineering plans, the issuance of building permits, the approval of wastewater system installations and the issuance of certificates to occupy residences served by the alternative treatment technologies. Prior to any Pinelands alternative treatment system being issued a final operational approval, the Pinelands Area health departments and the Pinelands Commission are to receive an executed five year maintenance contract, five year warranty, three year wastewater sample and analysis protocol, deed notice, as-built plan and construction certification from the technology manufacturer and the NJ licensed engineer of record. While these documents have been received in the majority of cases, there are occasional instances of certificates of occupancy being issued before all required documentation was received by the health departments and the Pinelands Commission. In these cases, Pinelands staff has to work with the technology vendors, homeowners and agency officials to obtain the needed documentation after the fact, often a difficult and time consuming task. Pinelands staff continues to work with the local agencies to educate them on the importance of assuring that all necessary documents are on file before issuing local approvals for home occupancy. To further help address this issue, amendments to the CMP were adopted in October 2010 to specifically require that local boards of health withhold certificates of compliance or similar authorizations which would permit the occupancy of a building served by an alternative design wastewater treatment system until such time as the Pinelands Commission provides written authorization to the local board of health that such a system may be authorized for use.

## Operation and Maintenance Summary

The manufacturer of the Amphidrome system, F.R. Mahony Associates, has instituted an effective program to assist contractors and engineers on the proper installation of the technology. The firm offers installer training with each system delivered and provides ongoing technical support to address contractor inquiries through its authorized service provider, Site Specific Design, Inc.

Aquapoint, the manufacturer of the Bioclere system, has also instituted an effective program to assist contractors and engineers on the proper installation of the technology and has utilized the services of Advanced Nitrate Solutions in the local sale, installation and operation of the Bioclere technology.

During the period of 2005-2009, Cromaglass systems were installed and serviced exclusively by Mid State Electric, Cromaglass' authorized treatment system installation and servicing contractor. Cromaglass Corporation discontinued using Mid-State as its serving agent and until going out of business, was servicing the units directly. Cromaglass is reportedly no longer servicing its treatment units. Pursuant to the CMP, owners of existing Cromaglass units may contract with service providers that hold a NJDEP public wastewater treatment system operator's license at the S2 level or higher. Alternately, these homeowners may elect to replace the Cromaglass treatment tank with a conventional septic tank that meets the requirements of N.J.A.C 7:9A-8.2.

Bio-Microbics, the manufacturer of the FAST and Bio Barrier systems, has designated Site Specific Design, Inc. as its authorized service agent for the servicing of the FAST Bio Barrier technologies. Site Specific Design reports no alarm related events during the current reporting period. The firm has previously repaired or replaced airlifts on eleven previously installed systems and extended recycling troughs on five systems to enhance the return of nitrified wastewater to the unit's anoxic chambers. Subsequent to these system repairs, the firm has addresses airlift issues during eight subsequent system installations.

SeptiTech, the manufacturer of the SeptiTech technology has designated both Site Specific Design, Inc. and South Jersey Engineers as authorized service agents providing operation and maintenance service on the SeptiTech system.

In addition to the servicing agents that are authorized by the technology manufacturers, both the Commission's and NJDEP's rules authorize individuals that possess a S2 or higher NJ wastewater treatment plant operator's license to provide operation and maintenance services on the Pinelands pilot program systems. In an effort to fosters consumer choice and competition, Commission staff continues to work with the New Jersey Water Environment Association, the professional association representing NJ's licensed wastewater operators to expand the number of licensed individuals that offer operation and maintenance service on the pilot program systems.

## Cost Summary

The pilot program provides for the collection and reporting of cost data for each treatment technology. To facilitate monitoring of treatment system costs, the CMP requires the technology vendors to report the cost of each individual treatment system installation to the Commission.

The total cost of an onsite wastewater treatment system consists of at least three components. These include the cost of the treatment unit and its 5 year service package, the cost of the soil absorption system (e.g., replacement soil, stone and pipe), and the cost of engineering, surveying, and other installation services. The treatment unit manufacturers can readily provide the Commission with information on the cost of their equipment and related support services, which in the case of the Pinelands pilot program includes a five year maintenance contract, five year warranty, and three years of quarterly effluent analysis. The vendors, however, do not have direct knowledge of the cost of the soil absorption field installation, other installation and labor costs, or the cost for engineering (soil testing, system design, as-built plans, etc.) of the system. This site specific information is typically supplied by the homeowner or builder to the treatment system vendor who in turn supplies it to the Commission.

Table 1 on the following page summarizes average treatment system costs based upon information provided to the Commission by the system vendors, as supplemented by the homeowner or builder. Actual treatment unit costs, including equipment, five year operation and maintenance service contracts, five year warranties and the three year sampling program have remained relatively stable or have declined since the inception of the pilot program. Both FR Mahony and Aqua Point report that they have lowered the cost for their equipment since having attained permanent approval status and the discontinuation of required wastewater effluent sampling and reporting to the Commission. The average cost of each of the treatment technologies has remained virtually unchanged from the 2013 reported levels.

Annual fluctuations in the average total system installation cost (including construction related expenses) have occurred since the inception of the pilot program. This variability is generally attributable to differences in the cost of non-treatment unit components, including material quantities and labor that vary on a system by system basis. Rarely are two individual system designs and material quantities identical. Variability is in the cost and quantity of replacement soil, (select fill) stone aggregate, pipe, geo-textiles, labor, excavation, trucking, engineering, etc.) is common on a system by system basis. As a rule, larger and deeper systems typically cost more to construct than smaller, shallower systems. Average overall costs will be higher in a year in which a greater number of larger systems were installed than in a year when a greater number of smaller systems were built.

In time, the overall construction cost of advanced treatment systems is expected to decline as system designers take advantage of disposal field size reductions that are now incorporated in the NJDEP's April 2012 revisions to N.J.A.C. 7:9A. The allowable size reductions are granted as a result of the relatively high quality effluent quality (e.g. reduced BOD and TSS levels) produced by advanced onsite treatment technologies. It is likely that additional cost savings may also result from the use of these advanced treatment technologies due to the significantly "cleaner" effluent that these systems produce. Cleaner effluent reduces the likelihood of premature hydraulic soil absorption field failure, which translates into potential cost savings through extended disposal field longevity.

Table 1. Average Total Cost of Pinelands Alternate Design Wastewater Treatment Systems
Note: Cost information is derived from a variety of sources and should be considered to represent approximate cost estimates.

| 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. (7) | Average Reported Total Cost of the Advanced Onsite Treatment Systems |
|---|---|---|---|---|
| Amphidrome (1) | 66 | $ 19,241 (3) | $ 12,261 | $31,502 |
| Bioclere (2) | 57 | $ 17,586 (4) | $ 10,217 | $27,803 |
| Cromaglass | 41 | $22,553 (5) | $12,712 | $ 35,265 |
| FAST | 25 | $ 17,892 (6) | $ 11,616 | $29,508 |
| BioBarrier | 11 | $ 18,708(8) | $10,075 | $28,783 |
| SeptiTech | 12 | $ 19,519(9) | $9,300 | $28,819 |
| Busse Green | N/A | $ 24,000(10) | N/A | N/A |
| Hoot ANR | N/A | $ 14,500(10) | N/A | N/A |

1) Based on last reported cost for the Amphidrome system as provided in Aug. 5, 2013 Annual Report, and supplemented by installations in the current reporting period of July 2014 through June 2015.
2) Based on last reported cost for the Bioclere system as provided in Aug. 5, 2013 Annual Report and supplemented by installations in the current reporting period of July 2014 through June 2015.
3) Includes reported cost of the Amphidrome Treatment Unit (through June 2015) including hardware and equipment, 5 year annual maintenance contract, 5 year warranty, pumping of 2000 gallon anoxic tank as necessary for 5 years, and delivery of equipment to job plus the average cost of concrete tankage (2000 gal. concrete anoxic tank, concrete reactor vessel and 1000 gal. concrete clearwell), purchased separately from local suppliers, including delivery to the job site. Tank cost varies depending on precast supplier and distance to shipping location.
4) Includes reported cost of the Bioclere treatment unit (through June 2015) including hardware and equipment, 5 year annual maintenance contract, 5 year warranty, pumping of 2000 gallon anoxic tank for 5 years, as needed, and delivery of equipment to job site.
5) Includes reported cost of the Cromaglass treatment unit (through July 2010) including hardware and equipment, 5 year annual maintenance contract, 5 year warranty, 3 years quarterly effluent analysis, pumping of anoxic tank for 5 years, as needed, and delivery of equipment to job site and electrical hookup of unit by Cromaglass mandatory mechanicals installer. There were no Cromaglass units installed in the current reporting period.
6) Includes reported cost of the FAST treatment unit (through June 2015) including hardware equipment, 5 year annual maintenance contract, 5 year warranty, 3 years quarterly effluent analysis, pumping of residuals for 5 years, as needed, and delivery of equipment to job site.
7) Reported engineering and construction costs including soil and site suitability investigations (soil logs and “perc”/permeability tests), preparation of engineering plans, completion of NJDEP standard application forms, excavation for soil absorption system and tank placement, soil absorption system materials (suitable “K4" replacement soil, stone filter materials and lateral piping, or gravel free chambers, geotextile fabric), installation of all components, electrical connections, surveyor services, as-built plans, engineering construction observation and engineering certifications.
8) Includes reported cost for the BioBarrier treatment unit, 5 year warranty, 5 year O&M contract and 3 year effluent sampling program and delivery of equipment to the job site.
9) Includes reported cost for the SeptiTech treatment unit, (through June 2015) 5 year warranty, 5 year O&M contract and 3 year effluent sampling program and delivery to the job site.
10) Cost for treatment unit, 5 year warranty, 5 year O&M contract and 3 year effluent sampling program as reported by the equipment manufacturers in their application to participate in the pilot program. No Busse Green or Hoot ANR systems were installed during the current reporting period.

## Treatment System Nitrogen Attenuation Summary

The pilot program requires that the technology suppliers arrange for samples of treated effluent to be collected from each system on at least a quarterly basis [approximately every ninety (90) days] for at least three years, yielding a total of at least 12 samples per system. Pursuant to the pilot program sampling and testing protocols, samples of treated effluent are collected from a sample collection port located between the treatment unit and the soil dispersal field. Sample procurement is to comply with the latest version (currently Aug. 2005 with updates through April 2011) of the NJDEP Field Sampling Procedures Manual. The laboratory analysis of effluent samples must be performed by laboratories certified by the NJDEP employing analytical methodologies accepted by NJDEP. To permit the establishment of microbial cultures necessary for the treatment process to develop and stabilize, no samples are required during the first ninety days from system start-up. In most instances, technology vendors have adjusted sampling schedules to provide for more efficient, synchronized sample collection from multiple systems.

As discussed previously, a total of 274 Pinelands alternate design wastewater treatment systems have beeninstalled and activated in the Pinelands Area thus far.

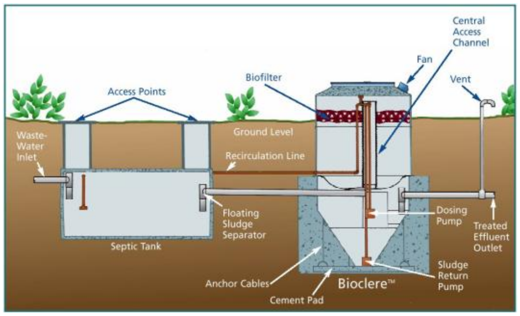
Amphidrome®

## Amphidrome Technology

The Amphidrome process is an advanced biological treatment that utilizes an attached growth treatment concept and is an example of a biologically aerated filter system. This is a patented treatment system. The system is pre-engineered and designed for the removal of soluble organic nitrogen, and for the nitrification and denitrification processes to occur simultaneously in a single reactor. The process begins operating in an aerobic mode and gradually progresses to an anoxic mode. The cyclical action is created by allowing a batch of wastewater to pass from the anoxic/equalization tank through the granular biological filter into the clear well. The batch of wastewater is then pumped back from the clear well up through the filter, where it overflows into a trough that carries it back to the anoxic/equalization tank. These cycles are repeated multiple times, while the treatment is allowed to progress from aerobic to anoxic conditions within the filter. Once sufficient cycles have been repeated to insure the degree of treatment required, a batch of effluent is discharged. A control system operates the system based on predetermined settings. The Amphidrome reactor consists of: an underdrain, support gravel, filter media, and backwash trough. The underdrain is located at the bottom of the reactor and provides support for the media and distribution of liquid into the reactor during a reverse flow or backwash. It is also designed as a manifold to distribute air evenly over the entire filter bottom during the aerobic portion of the cycle. On top of the underdrain is approximately 18” of gravel. Several layers of different size gravel are used. Above the gravel is a deep bed of coarse, round silica sand. The deep bed filter design employed in this manner significantly reduces suspended solids and allows for adequate growth of microorganisms for treating wastewater. In order to achieve the necessary degree of nitrogen reduction under a wide range of conditions, this system is equipped with chemical addition pumps that allow the addition of alkalinity for nitrification and/or methanol for denitrification, when necessary.

**The Amphidrome technology is no longer subject to effluent TN concentration analysis and reporting as a result of its release from the pilot program.** It is now authorized for permanent use subject to the provisions of N.J.A.C 7:50-6.84(a)5iv(3). Table 2 provides the running median and grand median values for total nitrogen concentrations (mg/l) from 74 monitored Amphidrome units. The Amphidrome technology produced a grand median total nitrogen concentration of **11.9 mg/l,** satisfying the Commission’s 14.0 total nitrogen standards for use on minimum one-acre parcels.

# Bioclere

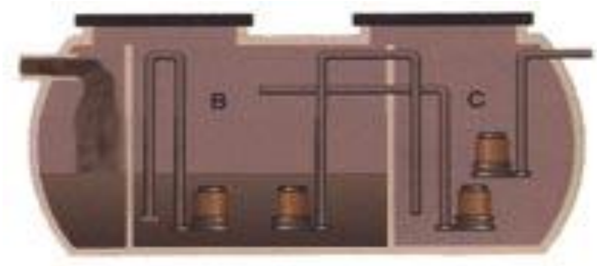



## Bioclere Technology

The Bioclere system utilizes an attached growth trickling filter concept for wastewater treatment for residential or commercial facilities. A trickling filter typically consists of a bed of highly permeable media to which microorganisms are attached and through which wastewater is percolated. The Bioclere unit utilizes a patented plastic media in a randomly packed configuration. The incoming wastewater is passed from the primary settling tank to a baffled area in the sump of the Bioclere in which a dosing pump is located. The dosing pump doses the trickling filter at a predetermined frequency. A forced draught ventilation system provides adequate airflow for maintaining aerobic conditions in the trickling filter. In the tricking filter unit, the organic material present in the wastewater is degraded by microorganisms attached to the filter media. Organic material from the wastewater is converted into bio-mass or a slime layer. As the organisms grow, the thickness of slime layer increases and diffused oxygen is consumed before it can penetrate the full depth of the slime layer. Thus, an anaerobic condition is developed near the surface of the media and the microorganisms near the surface of the media enter into an endogenous phase of their growth and lose their ability to cling to the media. Eventually, the wastewater washes the slime off the media while a new slime layer starts establishing and the process continues. The excess bio-mass or the slime would settle in the bottom and the sludge return pump would pump it back to the primary settling tank. The return of the sludge also enables the nitrates to be combined with a carbon source in the primary tank, allowing denitrification and achieving reduction in total nitrogen concentration.

**The Bioclere technology is no longer subject to effluent TN concentration analysis and reporting as a result of its release from the pilot program.** It is now authorized for permanent use subject to the provisions of N.J.A.C 7:50-6.84(a)5iv(3). Table 3 provides the running median and grand median values for total nitrogen concentrations (mg/l) from 41 monitored Bioclere units. The Bioclere technology produced a grand median total nitrogen concentration of **11.2 mg/l**, satisfying the Commission's 14.0 total nitrogen standards for use on minimum one-acre parcels.

Cromaglass




## Cromaglass Technology

In August 2013, the Executive Director recommended that the Cromaglass technology be removed from the Pilot Program entirely, with no further installations permitted. A temporary suspension barring new installations of the Cromaglass technology has been in place since November 15, 2006. This suspension was imposed as a result of the Commission's prior finding that the Cromaglass technology had not met CMP groundwater quality standards. The Cromaglass technology produced a grand median total nitrogen concentration of 31.5 mg/l, failing to meet the CMP's 14.0 mg/l total nitrogen standard for unsewered residential development on a minimum one acre parcel.

The Alternate Design Treatment Systems Pilot Program requires technology manufacturers to troubleshoot and remediate substandard treatment system performance. At the Commission's direction, Cromaglass undertook studies to determine the cause of inadequate nitrogen attenuation and recommended a number of remedial measures to improve nitrogen attenuation in its existing Pinelands treatment units. After reviewing Cromaglass' findings and recommendations, the Commission issued correspondence in 2011 requiring that Cromaglass implement a two-phase remediation program. Phase I was to include the retrofitting of 28 systems by March 1, 2012. Effluent sampling of the Phase I retrofit systems was to commence within two months of the completion of the Phase I retrofits and was to continue every two months for a total of six samples per system.

Cromaglass completed the Phase I retrofits by the March 1, 2012 deadline but has not complied with the system sampling requirements. The first round samples were collected on May 2, 2012 and produced a grand median total nitrogen value of 18.0 mg/l. The second round samples were collected five months later included only 20 systems and resulted in a grand median total nitrogen value of 19.2 mg/l. Nearly two years have elapsed since Cromaglass' last sampling event. In summary, Cromaglass has been delinquent in sampling the retrofitted systems and has failed to demonstrate the Cromaglass technology's capability to meet CMP water quality standards.

The Commission afforded the Cromaglass Corporation multiple opportunities to improve the technology's nitrogen attenuation. However, Cromaglass Corporation's inconsistent compliance with the pilot program's sampling and reporting requirements remained problematic. Further, the company failed to fully comply with the Commission's sampling and reporting requirements applicable to retrofitted Cromaglass units. The Commission therefore had no choice but to find that the Cromaglass Corporation's participation in the pilot program was not in substantial compliance with the sampling and reporting requirements of the CMP. Further the Cromaglass technology had not made satisfactory progress in attaining compliance with CMP water quality standards. **As a result, the Executive Director recommended and the Pinelands Commission endorsed the discontinuation of the Cromaglass technology's continued participation in the pilot program.**

The Executive Director's recommendations were discussed at three public meetings of the CMP Policy & Implementation Committee in November 2012, February 2013 and August 2013. All of the input that the Committee received at these public meetings was in support of the Pilot Program, its further extension and the removal of the Cromaglass technology. The Commission then proceeded to adopt amendments to the CMP in June of 2014 to implement the Executive Director's recommendations. Specifically, N.J.A.C. 7:50-2.11 was amended to remove the

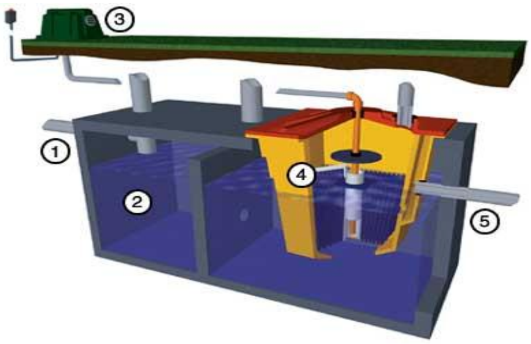
Cromaglass technology from the definition of “alternate design pilot program treatment system”. Similarly, N.J.A.C. 7:50-10.21(c) and 10.22(a)3 were amended to reflect the removal of the Cromaglass technology from the pilot program. N.J.A.C. 7:50-10.22(a)4 and 10.23(i) were also amended to remove the Cromaglass technology.

The Cromaglass system is a Sequencing Batch Reactor (SBR) that is designed as a continuously fed activated sludge process with clarifiers that are operated on a batch basis. Treatment is achieved by turbulent aeration of incoming wastewater, and batch treatment of bio-mass (sludge) in a separate aeration and quiescent settling chamber within a single vessel. Cromaglass systems are capable of achieving denitrification with the addition of an anoxic cycle following aeration. Air and mixing are provided by submersible pumps with venturi aspirators that receive air through a pipe intake from the atmosphere. Anoxic conditions are created by closing the air intakes of aeration pumps with electric valves, thus stopping aeration but the system continues mixing. Per-batch cycling time is 120 to 240 minutes and there are five cycles to and discharge. The system is operated using a programmable logical control (PLC) that can store a record of all operational functions, thus providing information on each function of each cycle to the operator. Such information can indicate if service or maintenance is needed.

Table 4 presents sample results for 62 Cromaglass systems through July 5, 2010. Total reported nitrogen values for each of these Cromaglass systems represents the sum of reported laboratory values for total Kjeldahl nitrogen plus nitrite nitrogen plus nitrate nitrogen. The Cromaglass technology produced a grand median total nitrogen concentration of **31.5 mg/l**, failing to meet the Commission’s 14.0 total nitrogen standard for unsewered residential development on a minimum one acre parcel.

The Executive Director recommended and the Pinelands Commission endorsed a policy that provides for homeowners who are presently using the Cromaglass technology to be given the option to continue to use it in a manner that is consistent with the operation and maintenance provisions of the CMP or if they so choose, to convert the system to function as a septic tank or to otherwise replace it with a conventional septic tank meeting the current requirements of N.J.A.C 7:9A, the NJDEP’s Standards for Individual Subsurface Sewage Disposal Systems.

# FAST



## FAST Technology

The FAST (Fixed Activated Sludge Treatment) system is a pre-engineered modular system designed to treat wastewater from a single home, a group of homes, or commercial facilities. FAST is a fixed film, aerated system utilizing a combination of attached and suspended growth treatment principles capable of achieving nitrification and denitrification in a single tank. This combination offers the stability of fixed film media and the effectiveness of activated sludge treatment principles. A typical FAST system provides adequate volume for microorganisms in the aerated media chamber to treat wastewater. The attached growth system functioning on and around the plastic media assures that microorganisms remain inside the system instead of being flushed out, even during the peak hydraulic flow conditions. During the times of low flow, the large volume of thriving microorganisms prevent a dying-off of the system, making the system well suited to intermittent use applications.

As illustrated in Table 5, sample results have been evaluated for 25 FAST systems to date. A total of 378 samples have been used to evaluate these 25 FAST systems. Total reported nitrogen values for each of these FAST systems represents the sum of reported laboratory values of reported laboratory values for total Kjeldahl nitrogen plus total nitrite and nitrate nitrogen. The FAST technology has produced a grand median total nitrogen concentration of **19.0 mg/l** based upon all samples to date, demonstrating the technology's ability to meet Pinelands water quality standards when used to serve residential development on minimum 1.5 acre parcels but not on one acre parcels as originally expected. A technology must produce a grand median total nitrogen concentration of 14.0 mg/l in order to meet Pinelands water quality standards when used to serve residential development on a minimum one acre parcel.

As noted, Commission staff has recommended that the FAST system be released from the pilot program and be granted permanent approval status to serve residential development on minimum 1.5 acre lots. An amendment to the CMP will be required to implement this recommendation. Once such an amendment has been adopted, the FAST technology would no longer be required to submit monitoring and operational data to the Commission. The FAST technology nevertheless would still need to be designed to accommodate effluent sampling, certified prior to and after construction by the manufacturer or agent and by a NJ licensed professional engineer to be properly designed and operational, equipped with local and remote alarm functionality, sold with a five-year warranty and covered under a renewable operation and maintenance contract for as long as the system is in active use. In the interim, local approvals involving the use of the FAST technology on parcels of less than 1.5 acres in size will be subject to the Commission's "call up" process, including a public hearing pursuant to N.J.A.C. 7:50-10.22(a)3 and (a)5, and will be released only if additional contiguous lands are included in the application to achieve a 1.5 acre parcel size.

The CMP currently authorizes the FAST technology to be installed until August 5, 2018 unless extended by amendment to the CMP.

# BioBarrier

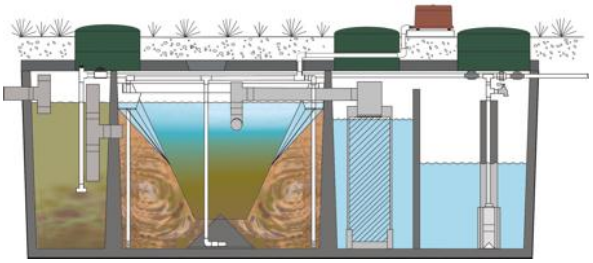
## BioBarrier Technology

The BioBarrier® MBR is a membrane bioreactor that combines activated sludge treatment processes with solids separation via membrane filter technology. The system employs flat sheet membranes with pore sizes ranging between of 0.02 to 1.4 µm. The membranes are housed in an aerated membrane cartridge which is submerged in the wastewater. The membranes provide a barrier that retains wastewater microorganisms within the treatment unit. The large mass of retained microbes provides an effective buffer against shock loadings to the system. The long microbial residence time in the treatment system allows the microorganisms to undergo endogenous respiration, reducing the total amount of solids produced by the treatment process.

The system consists of a tank with three compartments. The first compartment provides primary treatment – sedimentation and separation of floatables and solids, and is equipped with a proprietary outlet screening device. A solid wall separates the first compartment from the second, in which the system's nitrogen reduction capabilities may be enhanced under anoxic conditions. The third compartment, the "aeration/membrane zone", is separated from the anoxic zone by a baffle wall with openings between the two zones. The BioBarrier® Membrane module is located in the third compartment. Aeration is provided to the third compartment by a blower which serves two functions. First, the blower provides mixing of the wastewater and biomass to allow complete contact between the bacteria and organic material in the wastewater, while supplying oxygen that is critical to the process. Second, the positioning of the aeration under the membrane sheets helps to remove solids that collect on the surface of the sheets. The membranes sheets, having microscopic pore size openings, separate the water from the solids in the aeration zone. An effluent pump provides a slight negative pressure on the "clean" side of the membrane, pulling filtered water through the membrane. The solids that are sloughed by aeration and membrane cleaning are retained in the aeration compartment.

As illustrated in Table 6, sample results have been evaluated for 10 BioBarrier systems to date. A total of 25 samples have been used to evaluate these 10 BioBarrier systems. Total reported nitrogen values for each of the BioBarrier systems represents the sum of reported laboratory values of reported laboratory values for total Kjeldahl nitrogen plus total nitrite and nitrate nitrogen. The BioBarrier technology has produced a grand median total nitrogen concentration of **19.7 mg/l** based upon all samples to date. This result in based upon a limited number of sampling events, with no more than two sampling rounds having been conducted on any of the individual systems. Commission staff will continue to monitor the performance of the BioBarrier systems as additional sampling results are received to determine technology's ability to meet Pinelands water quality standards. As previously noted, the system will need to attain a grand median total nitrogen concentration of 14.0 mg/l in order to meet Pinelands water quality standards when used to serve residential development on a minimum one acre parcel.

**HOOT**

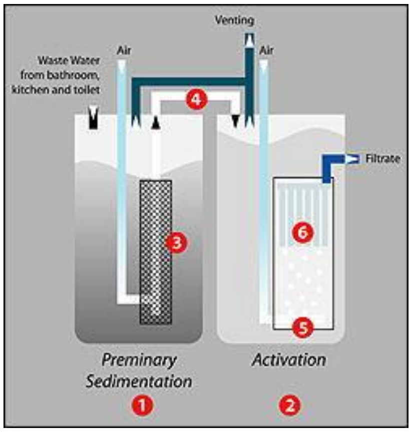


## Hoot ANR Technology

The Hoot ANR treatment system is an extended aeration/activated sludge treatment process coupled with anaerobic denitrification. The unit is comprised of five principal components, a Pretreatment Tank, Aeration Chamber, Clarifier, Media Tank and Final Clarifier/Pump Tank.

The Pre-Treatment tank provides separation and anaerobic digestion of influent solids and functions much like a septic tank by reducing up to 50% Total Settable Solids (TSS) and approximately 25% of Biochemical Oxygen Demand (BOD5). Liquid waste flows out of the pretreatment tank through a baffled outlet and into the aeration chamber. The activated sludge treatment process occurs in the aeration chamber through the introduction of oxygen into the mixed liquor to enable the conversion of soluble material into biomass. In addition, oxygen enables nitrifying bacteria to convert ammonia-nitrogen to nitrate-nitrogen. Wastewater then flow to a clarifier for additional solids settling. From the clarifier, wastewater is transferred to a media tank where an attached growth treatment process occurs. Here, a proprietary carbon source is added. In the presence of the supplemental carbon source, denitrifying bacteria release free nitrogen to the atmosphere. A final clarifier/pump tank constitutes the last treatment component before discharge to the soil absorption field. A portion of the daily flow of the system is recirculated from this chamber to the pre-treatment tank where it is reprocessed through the system. This technology is relatively new to the pilot program; therefore, the Commission has no performance data to report at this time.

# Busse Green MBR




## Busse Green MBR Technology

The Busse Innovative Wastewater Treatment System is a small scale membrane bioreactor. The Busse system provides treatment in a 3-stage, 4 tank process. Wastewater enters an intermittently aerated first tank and is then transferred by an airlift through a mesh filter to an identical second tank. Wastewater in the second tank is divided evenly between two membrane tanks, again with a screened airlift transfer. The membrane bioreactor tanks house 24 Kubota flat sheet membranes. The Kubota membranes units are comprised of two sections: the lower section contains the air piping and the upper section contains the membrane panels. The membrane units are submerged in activated sludge within the reactor tanks. The tanks are aerated by coarse and fine bubbles that provide a cross flow of liquid over the surface of the membrane panels. Cross flow circulation reduces membrane fouling and provides oxygen for microbial degradation of wastewater organics. The liquid head above the membrane drives permeate from the wastewater mixture through the membrane, where it flows via a manifold through the tank wall and is discharged. A return sludge airlift is activated by a programmable logic controller and is controlled by level sensors located in tanks two through four. A third air pump provides aeration to the airlifts in the first two tanks.

The bioreactor provides an aerobic environment where microorganisms present in the wastewater remove soluble contaminants, using them as a source of energy for growth and production of new microorganisms. The organisms flocculate and form aggregations that further physically entrap particulate organic matter. The organic matter is attacked by extracellular enzymes that solubilize the solids to make them available to the microorganisms as a food source. The conversion of the organic matter from soluble to biological solids allows for removal of the organic matter by settling and filtration of the solids in the treatment process. This technology is relatively new to the pilot program; therefore, the Commission has no performance data to report at this time.

# SeptiTech

## SeptiTech Technology

The SeptiTech® wastewater treatment system is a two-stage treatment technology, based on a fixed film trickling filter, using a patented highly permeable hydrophobic media. The first stage of treatment occurs in the primary tank in which the solids are settled and partially digested. The second stage of the system is a processor that provides secondary wastewater treatment. Microorganisms present in the wastewater grow within the media, using nutrients and organic materials provided by the constant supply of fresh wastewater to form new cell mass. Air is drawn into the system via an air intake pipe at the top of the SeptiTech® System. Venturis located in the sprinkler head distribution piping aerate the wastewater sprayed onto the media. The system operates without a fan or compressor.

The SeptiTech® System is designed to remove total nitrogen from wastewater by nitrification and denitrification. Nitrification occurs in the second stage of the system, where ammonia –nitrogen is converted to nitrite and nitrate (predominately nitrate), while denitrification occurs in the anaerobic/anoxic primary tank. Denitrification also occurs in a stacked media module that floats in the reservoir below the aerobic media.

Wastewater from the primary tank flows by gravity to the processor reservoir section, located below the filter media. The second and third pumps are used to return wastewater and solids from the reservoir back to the primary tank. The forth pump is used to discharge treated wastewater to the disposal location.

As illustrated in Table 7, sample results have been evaluated for ninr SeptiTech systems to date. A total of 30 samples have been used to evaluate these nine SeptiTech systems. Total reported nitrogen values for each of the SeptiTech systems represents the sum of reported laboratory values of reported laboratory values for total Kjeldahl nitrogen plus total nitrite and nitrate nitrogen. The SeptiTech technology has produced a grand median total nitrogen concentration of **18.5 mg/l** based upon all samples to date. This result in based upon a limited number of systems and a limited number of sampling events. Commission staff will continue to monitor the performance of the SeptiTech systems as additional sampling results are received to determine technology's ability to meet Pinelands water quality standards. As previously noted, the system will need to attain a grand median total nitrogen concentration of 14.0 mg/l in order to meet Pinelands water quality standards when used to serve residential development on a minimum one acre parcel.

## Household Variability and Concentration vs. Mass Loading

When evaluating data from single family wastewater treatment systems, it is important to recognize that home occupancy, water use, pharmaceutical use and cleaning and laundry product usage may vary greatly from one residence to another. These and other variables can markedly impact the concentration of nitrogen in wastewater and can adversely affect the ability of a treatment system to meet established discharge limits. The number of individuals occupying a dwelling can result in abnormally high or low levels of nitrogen in wastewater given that each person contributes approximately 9 lbs. of nitrogen to the system annually. Water conservation, while certainly desirable, has the potential to result in higher concentrations of pollutants in the wastewater (but not greater mass loading) because less water is available to dilute the pollutants. As a result of significant advances in water conservation, including the use of water conserving fixtures and appliances as well as behavior modifications, assumed values for total nitrogen concentration in domestic effluent, established during the 1960's and 1970's at 40 ppm, may under-estimate actual concentrations present in domestic wastewater streams. It is important to note however, that estimates of the total mass of nitrogen excreted by humans remain constant at approximately 9 lbs per year. It is evident from wastewater analyses conducted for the pilot program that there is a wide range in the concentration of total nitrogen in septic tank effluent. However, even if concentrations of nitrogen in domestic wastewater frequently exceed 40 ppm, the total mass of nitrogen in the effluent is likely consistent with estimated values utilized in the Pinelands septic dilution model due to the use of less water. As a result, even where effluent values exceed assumed post treatment concentrations, system discharges may still be meeting total nitrogen mass loading targets, even if the observed concentrations do not.

At the outset of the pilot program, four of the five original treatment technologies (Amphidrome, Bioclere, Cromaglass and FAST) were assigned an estimated total nitrogen removal efficiency of 65%. The fifth technology (Ashco RSFIII) was assigned an estimated total nitrogen removal efficiency of 50%. The four new technologies added to the pilot program in 2013 (BioBarrier, Busse GT, Hoot ANR and SeptiTech) each have an assumed nitrogen removal efficiency of 65%. Based upon these estimates, if the total nitrogen contained in the raw influent is 40 ppm, a 65% reduction would result in a concentration of 14 ppm in the treated effluent (and a 50% reduction would result in a concentration of 20 ppm). These effluent concentrations would be reduced to 2 ppm at the parcel line of a one acre lot based upon the Pinelands septic dilution model. Similarly, if influent nitrogen levels range up to 80 ppm, the same 65% removal efficiency would result in effluent concentrations of 28 ppm. By monitoring only the effluent concentration and determining that it meets the required 14 ppm, the pilot program is able to ensure compliance with the Commission's 2 ppm standard at the parcel boundary without regard to influent concentrations.

Excessive use of certain cleaning and laundry products as well as the use of certain medications can stress the bacteria that provide biological nitrification and denitrification. Because of this, education of system users is an important component of any wastewater management program.

In recognition of these factors, all of the alternative treatment system vendors have developed homeowner user manuals that provide critical information to the owners of the alternative treatment systems. In addition, several vendors have developed and provided system owners with questionnaires that are aimed at identifying laundry and cleaning product usage and any other condition that might lead to non-compliant sample results. Staff encourages all of the technology vendors to collect and analyze this type of information to better understand user characteristics and to enhance compliance with effluent discharge limits.

## Effluent Monitoring Data

Effluent sampling data submitted to date have been analyzed and presented in this report. Tables 2, 3, 4, 5, 6 and 7 provide the running median and grand median values for total nitrogen concentrations (mg/l)[1] and the number of samples taken for the Amphidrome, Bioclere, Cromaglass, FAST, BioBarrier and SeptiTech wastewater treatment systems respectively. The Commission does not yet have effluent monitoring data for the Busse GT and Hoot wastewater systems. The analysis indicates a grand median of 11.9 mg/l for the Amphidrome system and 11.2 mg/l for the Bioclere system. Both of these grand median concentrations are below the 14 mg/l target, which is based

[1] One (1) mg/l = one (1) ppm

upon the Pinelands septic dilution model and an influent concentration of approximately 40 mg/l. These technologies have been granted permanent approval status for residential use on minimum 1 acre parcels and are no longer subject to required effluent TN analysis and reporting. The TN grand median concentration for the Cromaglass system is 31.5mg/l, and as a result of this value and Cromaglass Corporation's failure to comply with the requirements of the pilot program, new installations of the Cromaglass technology are no longer permitted in the Pinelands Area. The TN grand median concentration for the FAST system is 19.0. While not meeting the Commission's required TN concentration for residential use on one-acre parcels, the FAST system has been demonstrated to meet the Commission's water quality standard if used on minimum 1.5 acre parcels. As noted, the Executive Director is recommending that the FAST system be advanced from the pilot program and, subject to Commission approval, approved for residential use on minimum 1.5 acre parcels. The BioBarrier and SeptiTech systems are relatively new to the pilot program and have produced TN grand median concentrations of 19.7 and 18.5 respectively. As noted, the performance of these technologies will continue to be monitored by Commission staff to determine the capability of these systems to meet the Pinelands water quality standards when used on one-acre parcels.

Table 2. **Amphidrome** running median of total nitrogen (mg $L^{-1}$) by number of sampling events for each wastewater treatment system. The grand median, 25th percentile, 75th percentile, and number of systems sampled (N) per event are provided. (See Appendix 1 for discussion of data editing.)

**Total Nitrogen Running Median**

| | | Number of Sampling Events | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Technology | System | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Grand Median |
| Amphidrome | 1 | 18.5 | 25.3 | 32.1 | 25.3 | 20.7 | 19.6 | 18.5 | 17.7 | 16.9 | 16.0 | 16.9 | | | 18.5 |
| Amphidrome | 2 | 9.5 | 9.1 | 9.4 | 9.5 | 9.5 | 9.7 | 9.5 | 9.5 | 9.4 | 9.4 | 9.4 | 9.5 | 9.5 | 9.5 |
| Amphidrome | 3 | 18.4 | 12.1 | 18.4 | 50.4 | 18.4 | 14.9 | 12.6 | 12.0 | 11.5 | | 12.0 | 12.6 | 12.9 | 12.7 |
| Amphidrome | 4 | 35.2 | 29.2 | 23.2 | 16.4 | 9.7 | 8.4 | 7.8 | 7.5 | 7.2 | 7.5 | 7.8 | 7.6 | | 8.1 |
| Amphidrome | 5 | 10.0 | 42.3 | 51.3 | 31.8 | 12.3 | 31.8 | 17.8 | 16.0 | 15.8 | 16.8 | 15.8 | 16.2 | 15.8 | 16.2 |
| Amphidrome | 6 | 6.0 | 33.8 | 6.9 | 9.8 | 12.7 | 14.8 | 12.7 | 11.1 | 9.5 | 11.1 | 12.1 | 10.8 | | 11.1 |
| Amphidrome | 7 | 12.7 | 11.8 | 11.0 | 9.2 | 8.5 | 9.6 | 9.5 | 10.1 | 10.7 | 10.8 | 10.7 | 10.1 | | 10.4 |
| Amphidrome | 8 | 15.2 | 19.3 | 15.2 | 12.1 | 9.1 | 9.5 | 9.1 | 9.0 | 8.9 | 9.0 | 8.9 | 8.7 | | 9.1 |
| Amphidrome | 9 | 143.9 | 79.5 | 15.1 | 12.5 | 9.8 | 10.1 | 10.3 | 10.1 | 9.8 | 10.1 | 10.3 | 10.1 | 10.3 | 10.3 |
| Amphidrome | 10 | 5.8 | 4.9 | 5.8 | 6.6 | 7.0 | 6.7 | 7.0 | 7.1 | 7.0 | 7.2 | 7.3 | | | 7.0 |
| Amphidrome | 11 | 14.9 | 10.1 | 6.0 | 8.4 | 10.8 | 12.2 | 10.8 | 9.8 | 10.0 | 9.5 | 8.9 | 8.4 | | 9.9 |
| Amphidrome | 12 | 18.8 | 27.6 | 36.4 | 33.6 | 36.4 | 38.3 | 36.4 | 33.6 | 30.8 | 24.8 | 30.8 | | | 33.6 |
| Amphidrome | 13 | 4.7 | 5.4 | 4.7 | 5.2 | 5.7 | 5.2 | 5.3 | 5.5 | 5.7 | 5.8 | 5.7 | 5.8 | | 5.4 |
| Amphidrome | 14 | 24.5 | 17.2 | 9.8 | 9.7 | 9.5 | 9.4 | 9.4 | 9.4 | 9.5 | 9.4 | | | | 9.5 |
| Amphidrome | 15 | 4.0 | 6.3 | 5.3 | 5.4 | 5.3 | 5.4 | 5.5 | 5.4 | 5.5 | 5.7 | 5.9 | | | 5.4 |
| Amphidrome | 16 | 11.7 | 16.7 | 11.7 | 11.4 | 11.2 | 11.4 | 11.7 | 12.5 | 13.3 | 12.5 | 11.7 | 11.8 | | 11.7 |
| Amphidrome | 17 | 27.0 | 47.2 | 58.2 | 56.5 | 54.8 | 54.5 | 54.2 | 54.0 | 53.8 | 53.1 | 52.3 | | | 54.0 |
| Amphidrome | 18 | 11.1 | 12.9 | 11.1 | 10.3 | 9.4 | 10.3 | 11.1 | 11.8 | 12.3 | 12.4 | 12.3 | 12.1 | 11.9 | 11.8 |
| Amphidrome | 20 | 16.0 | 13.4 | 16.0 | 14.9 | 16.0 | 14.9 | 16.0 | 14.9 | 13.9 | 14.9 | 16.0 | | | 14.9 |
| Amphidrome | 21 | 7.5 | 8.1 | 8.8 | 10.3 | 11.9 | 13.0 | 11.9 | 10.6 | 11.9 | 13.0 | 14.0 | | | 11.9 |
| Amphidrome | 22 | 36.8 | 49.3 | 55.0 | 45.9 | 36.8 | 28.1 | 19.5 | 19.4 | 19.5 | 23.0 | 26.6 | | | 28.1 |
| Amphidrome | 23 | 25.4 | 16.2 | 11.0 | 10.3 | 11.0 | 11.3 | 11.6 | 11.9 | 12.3 | 11.9 | 11.6 | 11.5 | 11.5 | 11.6 |
| Amphidrome | 24 | 7.3 | 5.7 | 6.5 | 6.9 | 6.5 | 6.2 | 6.5 | 6.9 | 7.3 | 6.9 | | | | 6.7 |
| Amphidrome | 25 | 11.6 | 13.5 | 15.3 | 15.7 | 15.9 | 16.0 | 16.1 | 16.4 | 16.1 | 16.4 | 16.8 | 16.4 | 16.8 | 16.1 |
| Amphidrome | 26 | 14.2 | 19.1 | 23.9 | | | | | | | | | | | 19.1 |
| Amphidrome | 28 | 23.9 | 32.6 | 41.4 | 32.6 | 23.9 | 23.3 | 23.9 | 23.3 | | | | | | 23.9 |
| Amphidrome | 29 | 7.6 | 17.6 | 7.6 | 9.1 | 7.6 | 7.5 | 7.6 | 7.5 | 7.4 | 6.8 | 6.3 | | | 7.6 |
| Amphidrome | 30 | 97.1 | 53.2 | 9.3 | 9.0 | 9.3 | 9.9 | 9.3 | 9.0 | 9.3 | 9.9 | 9.3 | 9.0 | 9.3 | 9.3 |
| Amphidrome | 31 | 11.8 | 13.5 | 12.3 | 12.9 | 13.5 | 12.9 | 12.3 | 12.6 | 12.3 | 12.3 | 12.3 | 12.1 | | 12.3 |
| Amphidrome | 32 | 7.4 | 7.7 | 8.0 | 11.3 | 8.0 | 9.8 | 8.0 | 7.7 | 7.4 | 7.7 | | | | 7.8 |
| Amphidrome | 33 | 6.4 | 5.0 | 6.4 | 6.0 | 6.4 | 6.3 | 6.1 | 6.3 | 6.4 | 6.5 | 6.6 | | | 6.4 |
| Amphidrome | 34 | 13.9 | 20.0 | 13.9 | 18.3 | 18.3 | 16.1 | 18.3 | 20.5 | 22.7 | 20.5 | 18.3 | | | 18.3 |
| Amphidrome | 35 | 9.0 | 11.5 | 13.9 | 16.0 | 13.9 | 12.8 | 13.9 | 16.0 | 13.9 | 16.0 | 18.1 | | | 13.9 |
| Amphidrome | 36 | 11.7 | 12.9 | 13.6 | 12.9 | 13.6 | 13.8 | 14.1 | 14.1 | 14.1 | 14.1 | 14.1 | 13.8 | | 13.8 |
| Amphidrome | 37 | 9.9 | 9.5 | 9.9 | 10.8 | 11.7 | 11.2 | 10.6 | 11.2 | 11.7 | 11.3 | 11.7 | 11.8 | 11.7 | 11.2 |
| Amphidrome | 38 | 17.3 | 13.9 | 10.5 | 13.2 | 10.5 | 9.1 | 7.7 | 7.0 | 7.7 | | | | | 10.5 |
| Amphidrome | 41 | 27.4 | 26.7 | 25.9 | 26.7 | 25.9 | 22.0 | 19.1 | 18.6 | 19.1 | 19.1 | | | | 24.0 |
| Amphidrome | 43 | 17.2 | 17.5 | 17.2 | 17.5 | 17.8 | 19.0 | 20.1 | 19.0 | 17.9 | 18.1 | 18.3 | 18.5 | 18.7 | 18.1 |
| Amphidrome | 44 | 11.9 | 13.6 | 15.3 | 15.9 | 16.5 | 15.9 | 15.3 | 15.1 | 15.0 | 13.4 | 13.7 | 14.3 | | 15.1 |
| Amphidrome | 45 | 26.6 | 16.7 | 20.4 | 22.9 | 20.4 | 14.9 | 15.4 | 12.4 | 9.5 | 9.5 | 9.6 | 10.2 | 10.9 | 14.9 |
| Amphidrome | 46 | 9.0 | 9.7 | 10.4 | 10.9 | 10.4 | 10.4 | 10.4 | 10.4 | 10.4 | 10.8 | 10.4 | | | 10.4 |
| Amphidrome | 47 | 15.2 | 16.2 | 15.2 | 13.5 | 11.8 | 13.5 | 11.8 | 11.8 | 11.8 | 11.8 | 11.8 | | | 11.8 |
| Amphidrome | 48 | 37.6 | 28.3 | 24.2 | 23.8 | 24.2 | 23.8 | 23.4 | 23.8 | 24.2 | 23.8 | | | | 24.0 |
| Amphidrome | 49 | 12.0 | 21.5 | 14.7 | 15.0 | 15.2 | 16.8 | 15.2 | | | | | | | 15.2 |
| Amphidrome | 50 | 22.9 | 19.0 | 22.9 | 25.1 | 27.3 | 25.6 | 23.9 | 25.6 | 23.9 | 23.4 | | | | 23.9 |
| Amphidrome | 51 | 82.0 | 75.1 | 68.2 | 39.1 | 22.5 | 17.0 | 12.6 | | | | | | | 39.1 |
| Amphidrome | 53 | 12.0 | 13.9 | 12.6 | 12.3 | 12.0 | 10.0 | 12.0 | 10.1 | | | | | | 12.0 |
| Amphidrome | 54 | 9.8 | 9.5 | 9.3 | 9.5 | 9.3 | 9.5 | 9.8 | | | | | | | 9.5 |
| Amphidrome | 55 | 23.2 | 18.6 | 16.6 | 15.3 | 14.0 | 14.0 | | | | | | | | 15.9 |
| Amphidrome | 56 | 18.3 | 28.7 | 20.9 | 27.8 | 20.9 | 27.8 | | | | | | | | 24.4 |
| Amphidrome | 57 | 56.0 | 50.7 | 56.0 | 52.5 | 49.0 | | | | | | | | | 52.5 |
| Amphidrome | 58 | 31.8 | 38.3 | 31.8 | 22.0 | 15.1 | | | | | | | | | 31.8 |
| Amphidrome | 59 | 28.1 | 30.6 | 33.0 | 32.6 | 32.3 | | | | | | | | | 32.3 |
| Amphidrome | 60 | 18.1 | 15.6 | 14.2 | 16.1 | 18.1 | 16.1 | | | | | | | | 16.1 |
| Amphidrome | 61 | 6.7 | 7.9 | 7.2 | 8.2 | 8.2 | 8.1 | | | | | | | | 8.0 |
| Amphidrome | 62 | 3.7 | 9.7 | 12.6 | 9.5 | | | | | | | | | | 9.6 |
| Amphidrome | 63 | 5.9 | 6.0 | 6.0 | 8.6 | | | | | | | | | | 6.0 |
| Amphidrome | 64 | 8.3 | 8.7 | 9.1 | 8.7 | | | | | | | | | | 8.7 |
| Amphidrome | 65 | 48.0 | 27.3 | 47.5 | 29.2 | 34.4 | | | | | | | | | 34.4 |
| Amphidrome | 66 | 13.1 | 41.4 | 51.4 | 37.3 | | | | | | | | | | 39.4 |
| Amphidrome | 67 | 18.8 | 15.8 | 16.1 | | | | | | | | | | | 16.1 |
| Amphidrome | 68 | 10.0 | 9.4 | 10.0 | | | | | | | | | | | 10.0 |
| Amphidrome | 69 | 52.1 | 30.5 | | | | | | | | | | | | 41.3 |
| Amphidrome | 70 | 25.5 | | | | | | | | | | | | | 25.5 |
| Amphidrome | 71 | 5.8 | 7.7 | 6.3 | | | | | | | | | | | 6.3 |
| Amphidrome | 72 | 36.0 | 38.8 | | | | | | | | | | | | 37.4 |
| Amphidrome | 73 | 24.2 | 22.4 | 20.5 | | | | | | | | | | | 22.4 |
| Amphidrome | 74 | 7.2 | | | | | | | | | | | | | 7.2 |
| Sample # Median | | 14.6 | 16.5 | 14.0 | 13.2 | 12.7 | 12.9 | 11.9 | 11.8 | 11.7 | 11.8 | 11.8 | 11.5 | 11.7 | **11.9** |
| 25th Percentile | | 9.4 | 9.8 | 9.4 | 9.6 | 9.5 | 9.6 | 9.5 | 9.3 | 9.3 | 9.4 | 9.3 | 9.5 | 10.6 | 9.5 |
| 75th Percentile | | 24.7 | 28.1 | 23.0 | 24.4 | 19.4 | 16.4 | 16.0 | 16.1 | 15.6 | 16.1 | 15.9 | 12.6 | 14.3 | 16.1 |
| n | | 68 | 66 | 64 | 59 | 55 | 51 | 47 | 44 | 42 | 40 | 35 | 21 | 11 | |

Table 3. **Bioclere** running median of total nitrogen (mg $L^{-1}$) by number of sampling events for each wastewater treatment system. The grand median, 25th percentile, 75th percentile, and number of systems sampled (N) per event are provided. (See Appendix 1 for discussion of data editing.)

**Total Nitrogen Running Median**

| | | Number of Sampling Events | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Technology | System | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Grand Median |
| Bioclere | 1 | 22.3 | 13.4 | 8.8 | 8.9 | 8.8 | 7.8 | 8.8 | 7.8 | 7.8 | | | | 8.8 |
| Bioclere | 2 | 10.7 | 9.8 | 8.9 | 9.8 | 8.9 | 9.8 | 10.7 | 10.8 | 10.7 | | | | 9.8 |
| Bioclere | 6 | 17.0 | 11.4 | 17.0 | 12.7 | 14.4 | 13.3 | 12.2 | 10.3 | | | | | 13.0 |
| Bioclere | 7 | 10.4 | 14.9 | 10.4 | 10.2 | 10.4 | 10.8 | 10.4 | 10.2 | 10.1 | 10.2 | 10.4 | 10.8 | 10.4 |
| Bioclere | 8 | 11.2 | 9.6 | 10.5 | 9.3 | 8.6 | 9.6 | 10.5 | 9.6 | 10.4 | | | | 9.6 |
| Bioclere | 9 | 8.6 | 8.4 | 8.6 | 9.5 | 10.4 | 10.7 | 10.4 | 9.5 | 10.4 | | | | 9.5 |
| Bioclere | 10 | 8.4 | 8.4 | 8.4 | 9.9 | 9.2 | 9.7 | 10.1 | 9.8 | 9.6 | 9.5 | 9.4 | 9.5 | 9.5 |
| Bioclere | 11 | 25.0 | 17.8 | 15.4 | 13.2 | 15.4 | 13.2 | 13.8 | 14.6 | 13.8 | 12.4 | 10.9 | | 13.8 |
| Bioclere | 12 | 52.8 | 55.5 | 52.8 | 33.0 | 13.1 | 12.3 | 13.1 | 12.3 | 13.1 | 12.3 | 13.1 | 13.5 | 13.1 |
| Bioclere | 13 | 14.2 | 14.2 | 14.2 | 11.4 | 11.9 | 11.1 | 11.9 | 11.5 | 11.1 | 11.2 | | | 11.7 |
| Bioclere | 14 | 16.2 | 24.7 | 16.2 | 17.1 | 16.2 | 14.5 | 12.9 | 12.2 | 11.4 | 11.0 | 10.7 | 11.0 | 13.7 |
| Bioclere | 15 | 5.2 | 13.2 | 10.6 | 13.0 | 10.6 | 13.0 | 15.3 | 13.8 | 15.3 | 13.8 | | | 13.1 |
| Bioclere | 16 | 28.1 | 25.0 | 22.0 | 18.5 | 15.1 | 18.5 | 15.1 | 14.3 | 13.4 | 14.3 | 13.4 | 14.3 | 15.1 |
| Bioclere | 17 | 79.8 | 48.0 | 16.2 | 16.2 | 16.2 | 16.1 | 16.0 | 14.4 | 12.8 | 12.9 | 12.785 | | 16.1 |
| Bioclere | 18 | 13.2 | 10.5 | 10.3 | 9.3 | 10.3 | 9.7 | 9.2 | 9.3 | 9.4 | 9.8 | 9.5 | 9.9 | 9.8 |
| Bioclere | 19 | 29.4 | 30.2 | 29.4 | 19.6 | 9.8 | 12.5 | 11.9 | 13.6 | 11.9 | | | | 13.6 |
| Bioclere | 20 | 52.8 | 42.2 | 31.6 | 26.4 | 21.2 | 26.4 | 21.2 | 17.8 | 14.5 | | | | 26.4 |
| Bioclere | 21 | 10.2 | 10.2 | 10.3 | 11.7 | 10.3 | 10.2 | 10.2 | 9.6 | | | | | 10.2 |
| Bioclere | 22 | 9.7 | 9.8 | 10.0 | 10.1 | 10.0 | 9.8 | 9.7 | 9.8 | 10.0 | 10.1 | 10.1 | | 10.0 |
| Bioclere | 23 | 27.3 | 18.2 | 9.1 | 11.1 | 9.1 | 8.8 | 9.1 | | | | | | 9.1 |
| Bioclere | 24 | 2.4 | 2.5 | 2.5 | | | | | | | | | | 2.5 |
| Bioclere | 25 | 25.9 | 16.7 | 9.7 | 11.3 | 9.7 | 11.3 | 12.8 | | | | | | 11.3 |
| Bioclere | 26 | 1.9 | 18.9 | 4.9 | 8.5 | 12.1 | 8.5 | 10.3 | | | | | | 8.5 |
| Bioclere | 27 | 34.6 | 23.9 | 13.2 | 13.1 | 13.1 | 12.7 | 12.3 | | | | | | 13.1 |
| Bioclere | 28 | 24.8 | 17.3 | 11.6 | 10.7 | 9.7 | 10.7 | | | | | | | 11.2 |
| Bioclere | 29 | 10.3 | 13.1 | 11.0 | 12.2 | 12.0 | | | | | | | | 12.0 |
| Bioclere | 30 | 24.9 | 21.5 | 18.0 | 14.1 | 13.3 | | | | | | | | 18.0 |
| Bioclere | 31 | 4.5 | 23.1 | 5.8 | 9.2 | | | | | | | | | 7.5 |
| Bioclere | 32 | 47.0 | 42.1 | 37.3 | 26.5 | | | | | | | | | 39.7 |
| Bioclere | 33 | 48.1 | 31.2 | 14.3 | 13.2 | 13.1 | | | | | | | | 14.3 |
| Bioclere | 34 | 20.8 | 17.7 | 14.6 | 13.8 | | | | | | | | | 16.1 |
| Bioclere | 35 | 7.3 | 19.0 | 18.2 | | | | | | | | | | 18.2 |
| Bioclere | 36 | 5.1 | | | | | | | | | | | | 5.1 |
| Bioclere | 37 | 12.0 | | | | | | | | | | | | 12.0 |
| Bioclere | 38 | 13.8 | | | | | | | | | | | | 13.8 |
| Bioclere | 39 | 8.5 | | | | | | | | | | | | 8.5 |
| Bioclere | 40 | 11.9 | | | | | | | | | | | | 11.9 |
| Bioclere | 41 | 12.3 | | | | | | | | | | | | 12.3 |
| Sample # Median | | 13.5 | 17.5 | 11.3 | 12.0 | 10.6 | 11.0 | 11.9 | 10.8 | 11.1 | 11.2 | 10.7 | 10.9 | **11.2** |
| 25th Percentile | | 9.8 | 11.2 | 9.6 | 9.9 | 9.8 | 9.8 | 10.2 | 9.7 | 10.1 | 10.1 | 10.1 | 10.1 | 10.0 |
| 75th Percentile | | 25.7 | 24.1 | 16.4 | 14.0 | 13.2 | 13.0 | 13.0 | 13.7 | 13.1 | 12.6 | 12.8 | 12.9 | 13.1 |
| n | | 38 | 32 | 32 | 30 | 27 | 24 | 23 | 19 | 17 | 11 | 9 | 6 | |

Table 4. **Cromaglass** running median of total nitrogen (mg $L^{-1}$) by number of sampling events for each wastewater treatment system. The grand median, 25th percentile, 75th percentile, and number of systems sampled (N) per event are provided. (See Appendix 1 for discussion of data editing.)

**Total Nitrogen Running Median**

| | | Number of Sampling Events | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Technology | System | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Grand Median |
| Cromaglass | 1 | 140.1 | 78.6 | 17.1 | 32.2 | 26.3 | 36.9 | 43.6 | 41.0 | 38.5 | 35.5 | 32.5 | | 36.9 |
| Cromaglass | 2 | 49.0 | 45.0 | 49.0 | 45.0 | 49.0 | 45.0 | 41.0 | 43.8 | 44.9 | 43.0 | 44.9 | 43.0 | 45.0 |
| Cromaglass | 3 | 76.5 | 58.2 | 50.4 | 45.2 | 50.4 | 47.6 | 50.4 | 55.9 | 50.4 | 47.6 | 44.9 | | 50.4 |
| Cromaglass | 4 | 77.2 | 55.7 | 77.2 | 64.4 | 77.2 | 83.6 | 78.8 | 78.0 | 77.2 | 69.1 | 61.0 | | 77.2 |
| Cromaglass | 5 | 110.6 | 99.0 | 87.4 | 71.8 | 56.2 | 45.7 | 35.1 | 30.3 | 25.5 | 26.5 | 25.5 | | 45.7 |
| Cromaglass | 6 | 61.6 | 44.7 | 47.3 | 39.0 | 47.3 | 50.0 | 52.7 | 50.0 | 47.3 | 47.3 | 47.3 | 47.7 | 47.3 |
| Cromaglass | 7 | 67.5 | 52.3 | 37.1 | 50.1 | 42.6 | 47.8 | 46.8 | 49.9 | 53.0 | 49.9 | 51.3 | | 49.9 |
| Cromaglass | 8 | 85.5 | 61.9 | 38.3 | 37.0 | 38.3 | 39.9 | 40.7 | 41.1 | 40.7 | 41.1 | | | 40.7 |
| Cromaglass | 9 | 19.7 | 39.7 | 19.7 | 19.6 | 19.7 | 19.6 | 19.5 | 18.5 | 19.5 | 18.5 | 17.6 | | 19.6 |
| Cromaglass | 10 | 58.5 | 61.3 | 58.5 | 42.2 | 25.9 | 23.0 | 20.1 | 18.1 | 20.1 | 18.1 | 20.1 | 18.634 | 21.5 |
| Cromaglass | 11 | 35.1 | 47.2 | 35.1 | 34.3 | 35.1 | 34.3 | 35.1 | 37.4 | 39.8 | 40.1 | 40.5 | | 35.1 |
| Cromaglass | 12 | 30.6 | 26.5 | 22.5 | 19.5 | 22.5 | 26.5 | 22.5 | 19.5 | 16.5 | 15.0 | 13.6 | | 22.5 |
| Cromaglass | 13 | 17.4 | 10.8 | 12.4 | 14.9 | 17.4 | 16.0 | 14.6 | 14.0 | 13.5 | 14.0 | 13.5 | 14.0 | 14.0 |
| Cromaglass | 14 | 31.7 | 28.7 | 31.7 | 30.9 | 30.0 | 29.9 | 29.7 | 27.7 | 25.8 | 26.6 | | | 29.8 |
| Cromaglass | 15 | 18.0 | 64.0 | 32.1 | 38.3 | 32.1 | 30.1 | 28.2 | 30.1 | 32.1 | 30.1 | 28.2 | | 30.1 |
| Cromaglass | 16 | 25.5 | 17.1 | 14.4 | 17.2 | 14.4 | 14.3 | 14.2 | 14.3 | 14.2 | 13.3 | | | 14.4 |
| Cromaglass | 17 | 43.5 | 56.7 | 43.5 | 32.4 | 43.5 | 41.6 | 43.5 | 52.9 | 62.3 | 66.2 | | | 43.5 |
| Cromaglass | 18 | 104.4 | 85.3 | 66.1 | 57.6 | 66.1 | 60.6 | 56.3 | 55.7 | 55.2 | 52.1 | 49.0 | 40.9 | 56.9 |
| Cromaglass | 19 | 67.5 | 71.7 | 67.5 | 42.8 | 67.5 | 62.8 | 58.1 | 39.6 | 21.1 | 39.6 | 31.1 | 26.1 | 50.4 |
| Cromaglass | 20 | 46.3 | 32.5 | 18.6 | 15.2 | 18.6 | 28.8 | 39.0 | 31.2 | 23.4 | 27.3 | | | 28.1 |
| Cromaglass | 21 | 45.9 | 64.2 | 45.9 | 38.4 | 30.9 | 21.8 | 14.7 | 22.8 | 14.7 | 15.6 | 14.7 | 14.0 | 22.3 |
| Cromaglass | 22 | 57.6 | 49.7 | 41.7 | 31.0 | 41.7 | 40.2 | 41.7 | 40.2 | 38.7 | 38.2 | 37.8 | | 40.2 |
| Cromaglass | 23 | 37.4 | 73.3 | 37.4 | 32.7 | 28.1 | 32.7 | 37.4 | 32.7 | 37.4 | 43.7 | 37.4 | 32.7 | 37.4 |
| Cromaglass | 24 | 31.8 | 32.6 | 33.5 | 32.6 | 31.8 | 31.2 | 30.6 | 28.0 | 25.5 | 19.5 | 24.8 | 19.2 | 30.9 |
| Cromaglass | 25 | 52.8 | 42.8 | 32.8 | 35.0 | 37.3 | 42.6 | 47.9 | 50.3 | 52.8 | 53.1 | | | 45.3 |
| Cromaglass | 26 | 74.3 | 68.7 | 63.2 | 43.5 | 23.7 | 20.2 | 16.8 | 16.5 | 16.8 | | | | 23.7 |
| Cromaglass | 27 | 90.3 | 73.2 | 56.1 | 70.7 | 56.1 | 54.9 | 56.1 | 57.7 | 59.3 | 60.4 | | | 58.5 |
| Cromaglass | 28 | 86.7 | 56.8 | 29.6 | 29.1 | 28.6 | 27.8 | 28.6 | 29.1 | 29.6 | 38.0 | | | 29.3 |
| Cromaglass | 29 | 23.5 | 20.7 | 23.5 | 21.1 | 18.7 | 18.4 | 18.7 | 18.4 | 18.0 | 18.4 | 18.7 | | 18.7 |
| Cromaglass | 30 | 103.3 | 64.6 | 25.9 | 29.6 | 25.9 | 29.6 | 33.4 | 32.2 | 31.0 | 32.2 | 33.4 | 32.2 | 32.2 |
| Cromaglass | 31 | 7.4 | 34.6 | 61.9 | 37.3 | 32.4 | 38.5 | 44.7 | 44.8 | 44.7 | 41.8 | | | 40.2 |
| Cromaglass | 32 | 78.3 | 63.0 | 50.6 | 49.1 | 47.7 | 34.5 | 25.3 | 23.3 | 21.3 | 23.3 | | | 41.1 |
| Cromaglass | 33 | 76.1 | 48.0 | 31.6 | 25.8 | 31.6 | 31.7 | 31.7 | 31.7 | 31.6 | | | | 31.7 |
| Cromaglass | 34 | 49.5 | 114.9 | 49.5 | 47.8 | 49.5 | 51.6 | 53.8 | 61.0 | 68.3 | 74.1 | | | 52.7 |
| Cromaglass | 35 | 43.0 | 42.9 | 43.0 | 47.4 | 43.0 | 43.8 | 44.6 | 43.8 | 44.6 | 43.8 | | | 43.8 |
| Cromaglass | 36 | 100.1 | 90.1 | 80.1 | 78.9 | 77.8 | 78.9 | 77.8 | 63.7 | 77.8 | 76.3 | 74.8 | | 77.8 |
| Cromaglass | 37 | 24.1 | 21.7 | 19.3 | 18.7 | 18.0 | 18.7 | 18.0 | 18.0 | 18.0 | 17.3 | 16.7 | | 18.0 |
| Cromaglass | 38 | 61.3 | 49.0 | 36.8 | 35.1 | 33.4 | 24.5 | 15.7 | 16.0 | 16.3 | | | | 33.4 |
| Cromaglass | 39 | 11.3 | 26.3 | 24.9 | 26.3 | 27.7 | 28.0 | 28.4 | 34.8 | 31.6 | 30.0 | 31.6 | | 28.0 |
| Cromaglass | 40 | 17.2 | 13.5 | 17.2 | 18.9 | 17.2 | 18.9 | 17.2 | 15.5 | 17.2 | 17.9 | | | 17.2 |
| Cromaglass | 41 | 35.8 | 23.3 | 35.8 | 23.3 | 15.1 | 13.1 | 11.2 | 12.9 | 11.2 | 12.9 | | | 14.1 |
| Cromaglass | 42 | 48.2 | 29.2 | 10.2 | 11.6 | 10.2 | 11.6 | 13.1 | 11.6 | 10.2 | 11.6 | | | 11.6 |
| Cromaglass | 43 | 79.2 | 46.9 | 79.2 | 47.2 | 31.4 | 23.3 | 15.2 | 14.9 | 15.2 | | | | 31.4 |
| Cromaglass | 44 | 8.3 | 11.5 | 14.6 | 14.6 | 14.6 | 14.6 | 14.5 | 12.6 | 10.6 | 9.8 | 9.1 | 9.9 | 12.0 |
| Cromaglass | 45 | 69.1 | 46.2 | 30.6 | 27.0 | 23.3 | 16.8 | 23.3 | 27.0 | 23.3 | 16.8 | 23.3 | | 23.3 |
| Cromaglass | 46 | 29.1 | 24.0 | 29.1 | 29.7 | 29.1 | 29.7 | 30.3 | 31.8 | 33.4 | 38.4 | | | 29.7 |
| Cromaglass | 47 | 75.1 | 56.7 | 38.3 | 33.7 | 32.6 | 35.4 | 38.3 | 45.5 | 52.7 | 53.7 | | | 41.9 |
| Cromaglass | 48 | 30.1 | 48.0 | 65.9 | 48.0 | 52.7 | 59.3 | 52.7 | 54.6 | 56.5 | 60.6 | | | 53.7 |
| Cromaglass | 49 | 46.6 | 26.7 | 6.8 | 21.0 | 28.3 | 22.7 | 17.2 | 22.7 | | | | | 22.7 |
| Cromaglass | 50 | 18.0 | 22.0 | 18.0 | 21.1 | | | | | | | | | 19.5 |
| Cromaglass | 51 | 51.6 | 36.3 | 21.0 | 23.0 | 25.1 | 23.0 | 21.0 | | | | | | 23.0 |
| Cromaglass | 52 | 18.1 | 16.6 | 18.1 | 29.0 | | | | | | | | | 18.1 |
| Cromaglass | 53 | 8.9 | 8.3 | 8.9 | 15.2 | | | | | | | | | 8.9 |
| Cromaglass | 54 | 21.2 | | | | | | | | | | | | 21.2 |
| Cromaglass | 55 | 22.0 | 22.3 | | | | | | | | | | | 22.1 |
| Cromaglass | 56 | 21.5 | | | | | | | | | | | | 21.5 |
| Cromaglass | 57 | 11.7 | 17.3 | 11.9 | 17.3 | | | | | | | | | 14.6 |
| Cromaglass | 58 | 7.1 | 16.6 | 26.1 | | | | | | | | | | 16.6 |
| Cromaglass | 59 | 9.0 | | | | | | | | | | | | 9.0 |
| Cromaglass | 60 | 41.5 | | | | | | | | | | | | 41.5 |
| Cromaglass | 61 | 39.1 | | | | | | | | | | | | 39.1 |
| Cromaglass | 62 | 18.4 | 18.1 | 18.4 | 18.3 | 18.4 | | | | | | | | 18.4 |
| Sample # Median | | 43.2 | 45.0 | 33.1 | 32.4 | 31.4 | 30.7 | 31.1 | 31.7 | 31.3 | 36.7 | 31.3 | 26.1 | **31.5** |
| 25th Percentile | | 21.6 | 24.0 | 19.6 | 21.1 | 23.5 | 22.8 | 18.9 | 18.5 | 18.0 | 18.3 | 19.0 | 16.3 | 19.3 |
| 75th Percentile | | 68.7 | 61.3 | 49.1 | 43.1 | 43.2 | 43.5 | 44.3 | 44.8 | 45.5 | 47.4 | 43.8 | 36.8 | 44.6 |
| n | | 62 | 57 | 56 | 55 | 51 | 50 | 50 | 49 | 48 | 44 | 26 | 11 | |

Table 5. **FAST** running median of total nitrogen (mg $L^{-1}$) by number of sampling events for each wastewater treatment system. The grand median, 25th percentile, 75th percentile, and number of systems sampled (N) per event are provided. (See Appendix 1 for discussion of data editing.)

| | | Number of Sampling Events | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Technology | System | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | Grand Median |
| FAST | 1 | 31.3 | 45.4 | 37.9 | 34.6 | 37.9 | 37.4 | 37.0 | 34.1 | 31.3 | 30.7 | 30.0 | 28.4 | 26.8 | 28.4 | 26.8 | 25.7 | 24.6 | 23.9 | 23.1 | 21.8 | 23.1 | 21.8 | 21.8 | | 28.4 |
| FAST | 2 | 27.1 | 25.8 | 27.1 | 34.6 | 27.1 | 27.7 | 27.1 | 27.7 | 28.2 | 27.7 | 27.1 | 26.1 | 25.0 | 24.8 | 24.5 | 24.1 | 24.1 | 23.4 | 23.1 | 22.1 | 20.7 | 19.3 | 18.1 | 17.8 | 25.4 |
| FAST | 3 | 39.3 | 34.5 | 29.6 | 29.6 | 29.6 | 27.2 | 29.6 | 29.6 | 29.6 | 29.6 | 29.6 | 28.5 | 29.6 | 28.5 | 27.4 | 26.1 | 24.8 | 24.5 | 24.2 | 24.1 | 24.0 | 23.2 | | | 29.1 |
| FAST | 4 | 32.4 | 23.0 | 23.9 | 25.1 | 23.9 | 18.9 | 15.9 | 15.5 | 15.9 | 15.5 | 15.0 | 15.5 | 15.9 | 17.5 | 15.9 | 15.5 | 15.0 | 14.4 | 13.8 | 13.7 | 13.8 | 13.7 | | | 15.7 |
| FAST | 5 | 30.1 | 24.4 | 30.1 | 24.9 | 19.6 | 20.6 | 20.7 | 20.2 | 19.6 | 19.2 | 18.7 | 19.2 | 18.7 | 18.5 | 18.2 | 18.0 | 17.7 | 17.6 | 17.5 | 17.3 | 17.1 | | | | 19.2 |
| FAST | 6 | 12.4 | 16.6 | 20.7 | 21.4 | 20.8 | 21.4 | 22.0 | 22.3 | 22.0 | 22.2 | 22.4 | 22.5 | 22.4 | 22.2 | 22.0 | 21.4 | 20.8 | 20.8 | 20.8 | 20.8 | 20.7 | 20.3 | | | 21.4 |
| FAST | 7 | 33.3 | 30.6 | 27.8 | 24.6 | 21.3 | 17.1 | 12.9 | 11.9 | 12.2 | 12.6 | 12.9 | 13.4 | 12.9 | 13.4 | 13.9 | 13.4 | 13.9 | 15.0 | 16.1 | 16.0 | | | | | 13.9 |
| FAST | 8 | 48.6 | 40.7 | 32.7 | 29.5 | 29.8 | 31.0 | 29.8 | 29.4 | 29.8 | 31.0 | 32.2 | 31.0 | 29.8 | 29.4 | 28.9 | 27.6 | 26.2 | 26.2 | 26.1 | 20.9 | 15.6 | | | | 29.8 |
| FAST | 9 | 28.1 | 29.6 | 28.1 | 25.7 | 23.2 | 25.5 | 23.2 | 21.4 | 19.6 | 19.0 | 18.3 | 16.9 | 17.0 | 17.7 | 17.0 | 16.3 | 15.5 | 16.3 | 15.5 | | | | | | 19.0 |
| FAST | 10 | 16.5 | 17.1 | 17.6 | 24.7 | 17.6 | 17.1 | 17.6 | 17.1 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 17.1 | | | | | | | | | 16.8 |
| FAST | 11 | 21.9 | 22.0 | 21.9 | 20.4 | 21.9 | 20.4 | 18.8 | 18.7 | 18.6 | 17.5 | 16.3 | 15.4 | 14.5 | 13.4 | 12.3 | | | | | | | | | | 18.7 |
| FAST | 12 | 44.5 | 27.4 | 13.1 | 19.9 | 25.2 | 19.2 | 15.4 | 20.3 | 22.1 | 18.8 | 22.1 | 18.8 | 15.4 | | | | | | | | | | | | 19.9 |
| FAST | 13 | 23.2 | 19.3 | 23.0 | 23.1 | 23.2 | 23.1 | 23.0 | 19.2 | 15.4 | 15.0 | 15.4 | 19.2 | 15.4 | | | | | | | | | | | | 19.3 |
| FAST | 14 | 13.5 | 11.0 | 13.5 | 18.0 | 15.9 | 14.7 | 13.5 | 14.7 | 13.5 | 11.0 | 13.5 | 14.0 | 14.5 | | | | | | | | | | | | 13.5 |
| FAST | 15 | 14.2 | 14.2 | 14.2 | 13.1 | 14.2 | 13.7 | 14.2 | 14.3 | 14.4 | 14.6 | 14.7 | 16.0 | 14.9 | | | | | | | | | | | | 14.2 |
| FAST | 16 | 28.6 | 17.5 | 28.6 | 31.3 | 30.9 | 29.8 | 28.6 | 29.8 | 28.6 | 21.8 | | | | | | | | | | | | | | | 28.6 |
| FAST | 17 | 29.2 | 32.6 | 29.2 | 22.7 | 17.8 | 17.8 | 17.8 | 17.9 | 17.8 | 17.9 | 17.8 | | | | | | | | | | | | | | 17.9 |
| FAST | 18 | 25.2 | 16.4 | 13.7 | 19.5 | 13.7 | 12.2 | 11.1 | 12.4 | 11.1 | 10.9 | | | | | | | | | | | | | | | 13.1 |
| FAST | 19 | 29.6 | 20.3 | 10.9 | 10.9 | 10.9 | 11.0 | 10.9 | 10.9 | | | | | | | | | | | | | | | | | 10.9 |
| FAST | 20 | 20.8 | 21.0 | 21.1 | 22.8 | 21.1 | 21.0 | 20.8 | | | | | | | | | | | | | | | | | | 21.0 |
| FAST | 21 | 23.9 | 20.3 | 22.6 | 23.3 | 22.6 | 21.5 | 20.3 | | | | | | | | | | | | | | | | | | 22.6 |
| FAST | 22 | 26.3 | 35.0 | 26.3 | 19.2 | 26.3 | | | | | | | | | | | | | | | | | | | | 26.3 |
| FAST | 23 | 18.7 | 13.5 | 8.2 | 13.0 | 13.9 | | | | | | | | | | | | | | | | | | | | 13.5 |
| FAST | 24 | 6.5 | 7.5 | 8.4 | 14.5 | 20.6 | 20.4 | | | | | | | | | | | | | | | | | | | 11.5 |
| FAST | 25 | 17.1 | 13.6 | 17.1 | 19.2 | 17.1 | 19.2 | | | | | | | | | | | | | | | | | | | 17.1 |
| Sample# Median | | 26.3 | 21.0 | 22.6 | 22.8 | 21.3 | 20.4 | 20.3 | 19.2 | 19.1 | 18.3 | 18.1 | 18.8 | 16.5 | 18.5 | 18.2 | 19.7 | 20.8 | 20.8 | 20.8 | 20.8 | 20.7 | 20.3 | 19.9 | 17.8 | **19.0** |
| 25th Percentile | | 18.7 | 16.6 | 14.2 | 19.2 | 17.6 | 17.4 | 15.4 | 15.1 | 15.5 | 15.1 | 15.3 | 15.7 | 15.2 | 17.0 | 16.2 | 16.5 | 15.5 | 16.3 | 16.1 | 17.0 | 16.4 | 19.3 | 19.0 | 17.8 | |
| 75th Percentile | | 30.1 | 29.6 | 28.1 | 25.1 | 25.2 | 24.3 | 23.2 | 25.0 | 26.7 | 22.1 | 23.6 | 24.3 | 23.7 | 26.6 | 25.7 | 25.3 | 24.6 | 23.9 | 23.1 | 21.8 | 21.9 | 21.8 | 20.9 | 17.8 | |
| n | 25 | 25 | 25 | 25 | 25 | 25 | 23 | 21 | 19 | 18 | 19 | 16 | 15 | 15 | 11 | 11 | 10 | 9 | 9 | 9 | 8 | 7 | 5 | 2 | 1 | |

Table 6. **BioBarrier** running median of total nitrogen (mg L-1) by number of sampling events for each wastewater treatment system.
The grand median, 25th percentile, 75th percentile, and number of systems sampled (N) per event are provided. (See Appendix 1 for discussion of data editing.)

| | Number of Sampling Events | | | |
|---|---|---|---|---|
| Technology | System | 1 | 2 | Grand Median |
| BioBarrier | 1 | 14.9 | 24.8 | 19.9 |
| BioBarrier | 2 | 12.6 | 15.1 | 13.8 |
| BioBarrier | 3 | 11.8 | 27.3 | 19.5 |
| BioBarrier | 4 | 23.4 | 25.8 | 24.6 |
| BioBarrier | 5 | 22.8 | 24.3 | 23.5 |
| BioBarrier | 6 | 37.8 | 34.9 | 36.4 |
| BioBarrier | 7 | 28.4 | 36.4 | 32.4 |
| BioBarrier | 8 | 13.3 | 25.9 | 19.6 |
| BioBarrier | 9 | 13.6 | 14.3 | 14.0 |
| BioBarrier | 10 | 11.8 | | 11.8 |
| Sample# Median | | 14.3 | 25.8 | **19.7** |
| 25th Percentile | | 12.8 | 24.3 | |
| 75th Percentile | | 23.3 | 27.3 | |
| n | 10 | | | |

Table 7. **SeptiTech** running median of total nitrogen (mg L-1) by number of sampling events for each wastewater treatment system.
The grand median, 25th percentile, 75th percentile, and number of systems sampled (N) per event are provided. (See Appendix 1 for discussion of data editing.)

| | | Number of Sampling Events | | | | | |
|---|---|---|---|---|---|---|---|
| Technology | System | 1 | 2 | 3 | 4 | 5 | Grand Median |
| SeptiTech | 1 | 8.7 | 8.8 | 8.7 | 7.3 | 9.6 | 8.7 |
| SeptiTech | 2 | 33.4 | 2.0 | 28.8 | 26.7 | | 27.7 |
| SeptiTech | 3 | 24.6 | 19.0 | 15.2 | 15.2 | | 17.1 |
| SeptiTech | 4 | 18.7 | | | | | 18.7 |
| SeptiTech | 5 | 18.5 | | | | | 18.5 |
| SeptiTech | 6 | 22.1 | | | | | 22.1 |
| SeptiTech | 7 | 44.6 | | | | | 44.6 |
| SeptiTech | 11 | 10.7 | 16.0 | | | | 13.4 |
| SeptiTech | 12 | 13.1 | 15.0 | | | | 14.0 |
| Sample# Median | | 18.7 | 15.0 | 15.2 | 15.2 | 9.6 | **18.5** |
| 25th Percentile | | 13.1 | 8.8 | 12.0 | 13.2 | 9.6 | |
| 75th Percentile | | 24.6 | 16.0 | 22.0 | 20.9 | 9.6 | |
| n | 9 | 9 | 5 | 3 | 3 | 1 | |

Other Issues in 2015

**Existing Residential Program**

Commission staff was successful in working with the NJDEP to secure generic treatment works approvals (TWA) for the four new NSF Standard 245 advanced treatment systems that have been authorized to participate in the Commission's pilot program. The revised TWA authorizes local administrative authorities (generally County Health Departments) to approve the use of those advanced treatment technologies that are authorized for participation in the Commission's pilot program. The Commission appreciates the cooperation it continues to receive from NJDEP in all aspects of administering the pilot program.

On June 7, 2010, CMP amendments related to the management of Pinelands pilot program wastewater treatment systems took effect. These rules require Pinelands Area municipalities to implement management programs ensuring that all advanced wastewater treatment systems (those subject of the Pinelands Alternate Design Wastewater Treatment Systems Pilot Program) are covered under an approved operation and maintenance agreement. Details of the Commission's rule adoption may be viewed on the Commission's web site at http://www.state.nj.us/pinelands/cmp/amend/042810Septicadoption.pdf.

On April 2, 2012, the NJDEP adopted amendments to N.J.A.C 7:9A, the statewide Standards for Individual Subsurface Sewage Disposal Systems. The amendments require perpetual professional management of advanced wastewater pretreatment components, including the Pinelands Alternate Design Wastewater Treatment Systems. Details of the DEP's rule adoption may be viewed on the DEP's web site at http://www.nj.gov/dep/dwq/pdf/njac79a.pdf.

There are now three separate New Jersey Administrative Code provisions requiring mandatory septic system management. The third is the New Jersey Water Quality Management Planning (WQMP) rules adopted by the NJDEP at N.J.A.C 7:15-5.25(e).

The Commission remains committed to working with each of the Pinelands Area municipalities and the Pinelands Area County Health Departments to assist them in complying with these requirements.

As noted above, the Commission's most recent CMP amendments relating to the Pinelands alternate design wastewater treatment systems pilot program took effect in September 2014. These amendments extend the participation of the FAST system and new NSF Standard 245/ USEPA ETV Program certified technologies in the pilot program until August 5, 2018 and permanently eliminate the Cromaglass technology from the pilot program.

Of particular importance to the success of the pilot program and to Pinelands water quality protections in general is the strict adherence to the requirement for the advanced wastewater treatment systems to be regularly inspected and serviced by qualified service providers. Of paramount importance is the timely renewal of requisite operation and maintenance contracts by system owners. The NJDEP's rules provide the county health departments with a variety of administrative tools to ensure compliance with this requirement. N.J.A.C 7:9A-12.3(b) provides that system owners that fail possess a valid service contract are in violation of the Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.). Further, N.J.A.C 7:9A-8.3(e) provides that administrative authorities (health departments) shall track and manage all advanced wastewater treatment systems with respect to the type and location of system, the date of system startup and the inspection and maintenance calls conducted on each system. The rule further requires that this information be reported to the NJDEP annually.

**Non-Residential Activities**

The existing pilot program is limited to residential development because the Pinelands Ad Hoc Septic System Committee determined that insufficient data were available to establish specific nitrogen removal efficiencies for the highly variable characteristics of non-residential (commercial and institutional) wastewater. The CMP allows non-residential applicants to propose to use an advanced treatment system (in lieu of dilution based upon parcel size) only on a case by case basis. Many Pinelands Towns and Villages without sewer systems could benefit from the use of pre-approved alternative treatment technologies by commercial establishments. The Commission staff remains ready to assist municipalities explore the use of "community" systems to serve multiple residential and commercial buildings, and is pleased that a 2012 Memorandum of Understanding (MOU) between the NJDEP and the Commission now addresses this issue which results from NJDEP's WQMP rules, adopted in 2004. The updated WQMP rules and the subsequent MOU have the potential to minimize the use of multiple individual septic systems (which provide no nutrient reduction) in sewer service areas and increase the use of nutrient reducing advanced treatment systems through Treatment Works and New Jersey Pollutant Discharge Elimination System (NJPDES) permitting. The Commission may wish at some future point to authorize pre-approved specific advanced treatment technologies for commercial uses or clustering as part of a closely monitored pilot program.

To date, the Commission has approved three advanced onsite wastewater treatment systems (two Amphidrome Plus systems and one non-proprietary generic system) for use by commercial operations (three retail establishments) as a means to meet ground water quality standards in unsewered Regional Growth Areas and Pinelands Towns. Monitoring of the two Amphidrome systems confirms that the Pinelands water quality standards are being achieved. The third system is not in use. The two monitored systems continue to meet stringent Pinelands total nitrogen standards.

**Cooperation with Local Government and Health Departments**

Through its June 7, 2010 adoption of new septic system management rules applicable to alternative (advanced) onsite wastewater treatment technologies, the Commission continues to reaffirm its desire to assist the Pinelands Area municipalities in complying with the new NJDEP WQMP rules and the NJDEP Standards for Individual Subsurface Sewage Disposal Systems. These rules require all New Jersey municipalities to implement septic system management programs, for both traditional/conventional septic systems as well as advanced treatment technologies. Locally administered management programs help to ensure proper operation and maintenance of alternative treatment technologies as well as conventional or traditional septic systems. In the absence of septic system management programs, homeowners and businesses may neglect to perform the maintenance necessary to attain maximum longevity of their wastewater systems.

To advance the transfer of information acquired through the Pinelands alternate design treatment systems pilot program, Commission staff continues to share data with NJDEP and posts data from the annual reports on the Commission's web site.

Commission staff will continue to work with the local government officials, especially the Pinelands Area health officials and construction code officials, to achieve the objectives of the pilot program and assure required documentation is received prior to the issuance of construction approvals and certificates of occupancy. In addition, Commission staff will continue to work with the alternate design treatment systems technology vendors and their agents to assure adherence to the requisite sampling, analysis and reporting requirements of the pilot program.

Questions related to the Pinelands Alternate Design Treatment Systems Pilot Program should be directed to Ed Wengrowski, Environmental Technologies Coordinator, at ed.wengrowski@njpines.state.nj.us or 609-894-7300.

# Appendix 1

**Data Editing**

Total nitrogen (TN) is reported herein as the sum of Kjeldahl nitrogen plus nitrate nitrogen plus nitrite nitrogen. It should be noted that the retained data set includes instances where analyses for multiple parameters (from a single sampling event) were performed by different (DEP certified) laboratories under subcontract, i.e. nitrate and nitrite by one lab and total Kjeldahl nitrogen by another lab, and where different (NJDEP approved) methodologies were used on various sampling dates from a single system location. In all of these instances, both the laboratories and analytical methods utilized were DEP approved and/or certified. In some instances, these state certified laboratories reported Kjeldahl nitrogen values (sum on ammonia nitrogen plus organic nitrogen) at higher levels than ammonia values. Laboratory managers consistently reported that such variation is consistent with standard laboratory reporting protocols and does not constitute lab error. Nevertheless, where such reporting occurred, the data was not included in this analysis. Where laboratories reported analyte values as "Not Detected" the Commission's analysis assigned a concentration of one-half the laboratory reporting limit to that parameter when computing the total nitrogen mass in the sample.

Prior to conducting the data analysis, data were edited, sorted and evaluated by Commission staff. Where obvious errors in the data were evident, i.e. exceeding a maximum sample holding time or a lab reporting error, such data were discarded. When values for the various nitrogen parameters, (e.g. nitrate, nitrate, total Kjeldahl nitrogen) were not collected during a single sampling event, the results of the individual parameters were not used in computing total nitrogen concentrations. After discarding such data and consulting with NJDEP's Office of Quality Assurance and Division of Water Quality, Bureau of Nonpoint Pollution Control, more than 85 % of the submitted laboratory results were retained for analysis. The Commission continues to see improved conformance by analytical laboratories with regard to data reporting.

**Data Accuracy**

It is typical for a regulatory pilot program of this nature to generate data that would not meet the rigorous standards required of a peer reviewed research project. Because of the uncontrolled variables associated with such a pilot program, the reader should understand that a pilot program of this nature is not research. Uncontrolled variables are significant and numerous where treatment technologies are operating under real world conditions. Apart from these real world pilot programs, a number of technology test centers (National Sanitation Foundation (NSF), US Environmental Protection Agency Environmental Technology Verification (ETV)) routinely conduct benchmark tests to determine what a treatment system is capable of doing. Such trials are conducted under rigidly controlled conditions. While these benchmark studies measure what a technology is capable of achieving, they do not assess what a technology actually achieves in widely ranging real world applications. Moreover, while standard assessment protocols are well developed for test center benchmark trials, there are currently no similar standard assessment protocols for evaluating actual field performance of treatment technologies. As recently as September 2006, the NSF's Joint Wastewater Committee formed a Field Performance Task Group to address this issue and the group hopes to develop a draft field performance protocol by September 2007. In December 1999, New Jersey, Massachusetts and Pennsylvania, acting under a Memorandum of Understanding (MOU) originally entered into in June 1996, agreed to work on the development of a standard protocol for approving innovative and alternate onsite wastewater treatment technologies. In its September 2005 report, released as a result of that MOU, this multi-state consortium acknowledged the dearth of third-party peer-reviewed, replicable data related to field trials of onsite wastewater systems. The group advises however, that even in the absence of "pure" data, regulators should exercise caution before throwing out "imperfect" data while assessing onsite system performance. The consortium instead recommends that regulators rank data on the basis of a hierarchy of strength, and to not to allow the perfect to be the enemy of the good. The consortium produced a report for the New England Interstate Water Pollution Control Commission, entitled *Variability and Reliability of Test Center and Field Data: Definition of Proven Technology From a Regulatory Program Viewpoint.* In its report, the consortium concludes that all non-fraudulent field performance data on alternate design wastewater treatment systems is valuable in regulatory decision making, even if that data is not gathered in a completely controlled study.[2]

On April 16, 2007, the NJDEP, Division of Watershed Management, Bureau of Environmental Analysis and Restoration issued a technical report entitled Nitrate as a Surrogate of Assessing Impact of Development Using Individual Subsurface Sewage Disposal Systems on Ground Water Quality. In that report, NJDEP relied upon datasets from the USGS National Water Information System (NWIS) and the New Jersey Ambient Ground Water Quality Monitoring Network (AGWQMN) to establish an ambient nitrate concentration of 2 mg/L in NJ groundwater. In that analysis, DEP acknowledges retaining data with questionable precision, rather than abandoning data, to conduct its analysis**.**

In assessing onsite wastewater treatment technologies, the Pinelands pilot program's methodology necessarily includes multiple uncontrolled variables. These include unique residential occupancies and personal practices, multiple private laboratories conducting effluent analyses, various operation/maintenance firms, and eight different wastewater technology vendors. These variables represent real world conditions and reflect standard industry and marketplace practices. Some of these practices are regulated, such as laboratory certifications and analytical methods, while others are not. As a result of these real world circumstances, it should be emphasized that the monitoring provisions of this pilot program do not rise to the level of peer-reviewed, journal-published research, but instead are intended to provide a statistically sound measure of the field performance of the pilot program systems. Specific examples of variables that were not controlled in the pilot program assessment include variability in the make up of households serviced by the systems, variability of wastewater flow and strength characteristics, variability in individuals involved in sample collection, variability in laboratories performing the analyses (including subcontracting between laboratories), and variability in laboratory personnel, equipment and analytical methods. Additionally, all samples were collected as grab samples (as opposed to composite samples) and are thus greatly affected by wastewater usage conditions that prevailed just prior to the sampling event and do not necessarily characterize long term effluent characteristics.

[2] Groves. T.W., F. Bowers, E. Corriveau, J. Higgens, J. Heltshe, and M. Hoover. 2005. Variability and Reliability of Test Center and Field Data: Definition of Proven Technology From a Regulatory Program Viewpoint. Project No. WU-HT-03-35. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO, by the New England Interstate Water Pollution Control Commission