A MULTI-STATE REGULATION AND POLICY SURVEY OF ONSITE WASTEWATER TREATMENT SYSTEM UPGRADE PROGRAMS

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Executive Summary

The EPA has recognized that decentralized onsite wastewater treatment systems (OWTS) can be an important alternative to centralized sewer systems by providing reliable wastewater treatment, public health benefits, and economic benefits to rural communities. However, conventional OWTS remove a limited amount of nutrients, especially within areas of permeable soils with little organic content, high oxygen levels, and poor mixing of receiving waters. Communities that face challenging nutrient loading issues may wish to evaluate many factors, including OWTS density and future climate change impacts such as sea-level rise prior to deciding which types of wastewater treatment systems would be most effective at removing nutrients for the cost.

The U.S. Environmental Protection Agency (EPA) concluded in its Guidance for Federal Land Management in the Chesapeake Bay Watershed that conventional onsite wastewater systems are not appropriate for communities with nutrient-sensitive watersheds. Many of the upgrade programs reviewed in this report recognized the need to use appropriate technologies aided by an evaluation of site-specific conditions when addressing nutrient pollution. The creation of model or pilot programs to test and evaluate new OWTS technologies with fast-track approval for validated technologies was observed in many of the states surveyed.

Innovative and advanced onsite wastewater treatment systems (I/A/E systems) can provide greater nutrient reduction, but there are many other variables to consider when choosing an appropriate replacement technology to upgrade an outdated OWTS. OWTS location, density, and maintenance schedule are all important factors when considering potential risks to groundwater supplies and designing wastewater management plans. Nitrogen removal effectiveness varies across OWTS type, residence time, climate, and location. OWTS Management programs, such as that in Barnstable County (Massachusetts), highlight the need and benefit of routine monitoring of systems combined with proactive management. Results have shown programs like these may maintain and improve nitrogen removal performance but may require repeated system checks and long-term monitoring.

The most common upgrade and conversion mechanism instituted by the states surveyed was the upgrade of OWTS at the time of the property transfer. Other common methods included upgrading OWTS if systems failed during inspections or through a blanket phase-out program of illegal waste disposal methods, such as cesspools. Many states set requirements for the timing and type of OWTS evaluations, operations and maintenance (O&M), enforcement, and options for upgrading failed or nonfunctioning OWTS. Additions to existing state and local regulations were often made to accommodate new and future wastewater technology needs. Some states incorporated sustainability and resilience elements into their plans to mitigate against climate change impacts, along with integrating

updated best management practices in the fields of construction, permitting, disposal, and servicing of OWTS.

Suffolk County New York was the only state of the six states analyzed created a single holistic program that managed all aspects of OWTS or cesspool upgrades. Creating a single program that includes elements of installation, permitting, technology approval, enforcement, and outreach may be beneficial. Many of these areas can become siloed in specific departments of state and local government offices depending on their individual mandates and politics. The state of Hawai‘i may wish to study and develop efficient methods to integrate interdepartmental aspects of management programs, including data, licensing, permitting, and compliance. One possible solution may be to create a separate entity that is wholly tasked with handling all aspects of an OWTS upgrade and conversion programs.

Compliance and enforcement methods varied across the conversion programs evaluated. Although some states like New Jersey have maintenance requirements written into the regulations, County governments are limited in tracking compliance due to staffing and budget constraints. Rhode Island cesspool regulations included a monetary fine of up to $2,500 for failing to comply with upgrade requirements after inspection. However, enforcement actions were rarely taken as the state sought to work with property owners to facilitate compliance.

Achieving complete compliance with regulations is likely impossible. Decisions to comply, evade, or violate obligations are often determined by multiple interacting influences. Therefore, it may benefit the Cesspool Conversion Working Group to evaluate, through public outreach, the interacting influences (financial, political, regulatory, social) of those that may be required to upgrade a cesspool or outdated OWTS system as a result of Act 125.

Getting citizens to spend money to upgrade an OWTS without a direct and visible benefit or service reciprocated may dissuade some from participating, even when penalties are assessed for noncompliance. Providing education and examples of the tangible benefits realized by upgrading an OWTS, reducing pollution, and preserving ecosystem services may improve compliance outcomes. For many citizens, understanding the concept of ecosystem services and the value they provide is often abstract and indirect. Solely communicating the monetary valuation of an ecosystem service like clean water, achieved through the reduction of nutrients by OWTS upgrades, may be inappropriate, or at the very least inefficient. One theme that resonated through all the OWTS programs surveyed is the need for and value of a robust education and outreach program that allows for improvements and adjustments as homeowner and stakeholder knowledge and needs shift. Responsible entities may wish to hold community workshops to introduce the concept of ecosystem

services -beyond monetary valuation- and listen to a broader range of stakeholder values associated with the targeted resources of that community. If OWTS upgrade programs can effectively communicate impacts with respect to community desires, concerns, and resource usage, they may have more success.

The ability of a responsible management entity or state to run a successful OWTS upgrade and conversion program will require obtaining, organizing, and managing a large amount of data about ecosystem impacts and current OWTS inventory, including geographic location, density, type, system age, hydrology, and servicing dates. Organizations can make more informed decisions about the management of decentralized OWTS by developing a robust dataset and improving data sharing coordination between multiple agencies and even regionally, if applicable.

A poorly executed management plan, lack of data, or poor communication between organizations and departments might cause the performance of individual OWTS to be adversely affected and ultimately impact overall nutrient reduction goals.

States and counties such as Rhode Island, Massachusetts, and Suffolk County (New York) require or entice (through funding opportunities) communities to create OWTS management plans which outline strategies and implementation measures to ensure the proper management, inspection, use and maintenance of I/A/E systems and sometimes conventional OWTS. In Rhode Island, communities were unable to obtain state grant funding to upgrade systems without a proper management plan. States such as Massachusetts and Rhode Island delegate local health departments to oversee elements of OWTS management plans, including enforcement. The OWTS management plans analyzed were typically limited to geographical community boundaries and often did not cover not an entire watershed. Due to the unique geography and hydrology, the state of Hawai'i may wish to consider creating plans around watershed boundaries if OWTS management plans are instituted.

OWTS management plans will require significant financial and public support. Homeowners, maintenance providers, and other stakeholders should be involved in the development process of OWTS management plans from the beginning. Without stakeholders understanding why a management program is important, there is little chance it will be adopted. After a program has been chosen and adopted, the management entity must keep stakeholders engaged, involved, and informed. Consistent and engaging education, messaging and outreach programs that explain the needs and benefits of new requirements and rules may increase the chances of a program's success. OWTS conversion programs are often long-term efforts that move at a slow pace. Many of the states evaluated converted only a couple thousand OWTS units per year; therefore, it will be critical to developing a program that continuously engages homeowners and stakeholders over the long-term. An

effective learning and outreach program may consider using a centralized website alongside diverse methods of communications that are tailored for a public audience allowing all aspects of the wastewater management plan to be viewed. This approach was taken by Suffolk County (New York) with the Reclaim Our Water Initiative.

Installing an OWTS requires a substantial monetary investment by the homeowner. Five of the six states surveyed created robust financial programs and incentives to ease the high cost of upgrading to innovative and advanced technologies. Programs in New York, Maryland, and Rhode Island offered homeowners modest grants and low-interest loans. Other financial incentive options included tax betterment arrangements or annual tax breaks. Conversion to innovative and advanced systems may hinge on a homeowner's ability to cover the cost difference of conventional OWTS upgrade versus nitrogen reducing technologies. Therefore, states may wish to identify and address long-term funding challenges, including identifying sustainable sources and revenue streams to cover program administration and upgrade costs. Maryland's Bay Restoration Fund is unique in that it charges a user fee to OWTS and municipal sewer customers to cover the cost of program administration and grant upgrade programs. The method of monetary dispersal also varied across the states with Maryland directly compensating contractors when upgrading I/A/E systems through grant funding, and others like Rhode Island distributing money directly to homeowners.

Finally, each state faced unique challenges that represented the political, financial, and cultural climate of that region. For example, Suffolk County (New York) studied many other state programs and gained information pertaining to failures and successes that informed the development of their own cesspool conversion and innovative and advanced technology upgrade program. Many of the states in this report have developed a basic foundation for a successful conversion and OWTS upgrade program. It may be advantageous for the state of Hawai‘i to borrow successful elements from other state programs while simultaneously delegating local control of program elements to the counties to adjust for differences in the unique geology, hydrology, and cultural aspects of the islands.

Acronyms/Abbreviations

ANSI	American National Standards Institute
BAT	Best Available Technology
BRF	Bay Restoration Fund
CAP	Community Aggregation Plan
CBRF	Chesapeake Bay Restoration Fund
CCWG	Cesspool Conversion Working Group
CCWT	Center for Clean Water Technology
CDBG	Community Development Block Grant
CIOWTS	Certified Installer of Onsite Wastewater Treatment
CIP	Community Inspection Plan
CO	Certificate of Occupancy
COC	Certificate of Compliance
CRA	Critical Resource Area
CSMP	Community Septic Management Program
CSSLP	Community Septic System Loan Program
CWA	Clean Water Act
CWCA	Clean Water Commerce Act
CWSRF	Clean Water State Revolving Fund
DCA	Department of Community Affairs
DEM	Department of Environmental Management
DNREC	Department of Natural Resources and Environmental Control
DOH	Department of Health
EPA	(U.S.) Environmental Protection Agency
ETV	Environmental Technology Verification
FEMA	Federal Emergency Management Agency
GIS	Geographical Information Systems
GPD	Gallons Per Day
GWMZ	Groundwater Management Zone
HSRLP	Home Septic Repair Loan Program
HTP	Homeowner Training Program
I/A/E	Innovative, Advanced or Experimental (Onsite Wastewater System)
LBH	Local Board of Health
LINAP	Long Island Nitrogen Action Plan
LSMP	Local Septic Management Plan
MASSDEP	Massachusetts Department of Environmental Protection
MASSTC	Massachusetts Alternative Septic System Test Center
MHFA	Massachusetts Housing Finance Agency
NEHA	National Environmental Health Association
NFAA	Non-Federal Administrative Account
NJDEP	New Jersey Department of Environmental Protection
NJEIT	New Jersey Environmental Infrastructure Trust
NJWB	New Jersey Water Bank
NPDES	National Pollutant Discharge Elimination Systems
NSF	National Sanitation Foundation
O&M	Operations and Maintenance
OWMP	Onsite Wastewater Management Plan
OWTS	Onsite Wastewater Treatment System
PCS	Pollution Control Security
PSN3	Performance Standard Nitrogen Level 3
RICRMC	Rhode Island Coastal Resources Management Council
RIDEM	Rhode Island Department of Environmental Management
SCDH	Suffolk County Department of Health
SEFO	Septic System Extended Funding Option Program
SLOSH	Sea, Lake, and Overland Surge from Hurricanes
SRF	State Revolving Fund
SRLP	Septic Rehabilitation Loan Program
STILF	Sewer Tie-In Loan Fund
SWP	Revised Draft Subwatersheds Wastewater Plan
TMDL	Total Maximum Daily Load
TWA	Treatment Works Approval
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WIP	Watershed Implementation Plan
WQMP	Water Quality Management Plan

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Introduction

Nearly fifty-three million gallons of raw sewage enter Hawai'i's ground and surface waters every day, most of this pollution comes from roughly 88,000 cesspools across the state.[1] According to the Hawai'i State Department of Health (DOH), cesspools are a substandard method to dispose of human waste.[2] In 2017, the Hawai'i State Legislature passed Act 125, requiring the replacement of all cesspools by 2050. The Hawai'i Department of Health was tasked with investigating the number, scope, location, and priority of cesspools statewide.[1] In 2018, the Legislature established a Cesspool Conversion Working Group (CCWG) under Act 132 to create a long-range, comprehensive plan for cesspool conversion.[3]

This report was commissioned by the CCWG to evaluate and analyze cesspool and conventional on-site wastewater treatment system (OWTS) conversion methods in other states. States were chosen based upon proximity to a coastal environment, the number of cesspools, and recent legislation. Six states were evaluated based upon criteria approved by the Data and Prioritization Subgroup of the CCWG. This document is meant to briefly summarize other state efforts, policies, and procedures regarding OWTS upgrades and not meant to be an exhaustive report on state OWTS regulations. The document is organized by state and subdivided into eight categories: (1) regulation overview, (2) regulation enforcement and requirements, (3) methods to determine priority conversion areas, (4) methods to identify impaired waters, (5) nutrient reduction science, (6) conversion technologies/future approval, (7) conversion method and timelines, and (8) funding mechanisms. Embedded within the document are URL links directing the reader to sites with further information about specific policies. After each section, a bulleted summary outlines successful aspects of that state's program or potentially feasible methods that the State of Hawai'i may wish to evaluate when drafting its own cesspool and OWTS conversion program. Every effort has been made by the author to ensure that each state's policies and regulations are accurately represented in this report, however, some errors may still exist. When possible, chapters were edited and reviewed by counterparts within state departments handling OWTS and water pollution issues.

1. Rhode Island

Rhode Island is a state in southern New England bordered by Connecticut to the west, Massachusetts to the north and east, and the Atlantic Ocean to the south. The Narragansett Bay, New England's largest estuary, is the state's most distinctive feature and contributes significantly to Rhode Island's 400 miles of coastline.[4,5] The United States Census Bureau estimates the population to be 1,057,315 as of 2018. The population density is 1,018 people per square mile.[6] The total land area of the state covers 1,045 square miles.[7] Rhode Island has a humid continental climate, with warm summers and cold winters.

1.1 Regulation Overview

Estimates calculate that almost twenty-six percent of Rhode Island's population receives drinking water from a groundwater source. In order to better protect coastal water quality, groundwater, and improve substandard waste disposal methods, Rhode Island passed The Rhode Island Cesspool Act of 2007.[8,9] When the regulation was enacted, it was estimated that Rhode Island had about 25,000 cesspools.[10] The R.I. Cesspool Act was passed in 2007 with the requirement to replace cesspools within the 200 feet zones adjacent to tidal waters, drinking water reservoirs, and public wells. This was the end result of a political process that began with a proposal for a blanket removal of all cesspools statewide. The language of the 2007 Act has been interpreted to require connections to sewers only in the 200-foot zones or when a property is sold or transferred. In 2016, the state passed a blanket cesspool phaseout program requiring the identification and replacement of cesspools of all properties subject to sale or transfer.

Efforts to only replace cesspools within environmentally sensitive regions proved to be slow and labor-intensive. According to Jon Zwarg, Senior Environmental Scientist at the Office of Water Resources in the Rhode Island Department of Environmental Management (RIDEM) (personal communication, May 2, 2019), it took years to replace about 1,000 of the 1,400 cesspools originally identified in the two hundred foot environmentally sensitive regions. The State decided that a better mechanism was needed to trigger cesspool replacement and identified a successful method used in the neighboring State of Massachusetts, the point-of-sale model. Many cesspools were being converted prior to the 2016 blanket conversion program because of an update to the OWTS rules in 2009. Cesspools were classified as substandard waste disposal methods, and many mortgage companies began requiring updates before issuing loans.

1.2 Regulation Requirements/Enforcement

All OWTS are regulated and permitted by RIDEM through the implementation of "Rules Establishing Minimum Standards Relating to Location, Design, Construction and Maintenance of Onsite Wastewater Treatment Systems."[11] However, management and enforcement of OWTS, including maintenance requirements, are delegated through local municipalities. Under the original Cesspool Act of 2007, all cesspools within two hundred feet of the inland edge of a shoreline feature bordering a tidal water area, within two hundred feet of a public drinking water well, and within two hundred feet of a surface drinking water supply were to be inspected by a specific date (D. Chopy, personal communication, April 26, 2019; J. Zwarg, personal communication, May 2, 2019).[9] Homeowners could be subject to a fine of up to $2,500 for failing to comply with cesspool upgrades after inspection.[12] However, the RIDEM sought to work with property owners to

facilitate upgrades rather than take a heavy-handed regulatory approach (D. Chopy, personal communication, April 26, 2019).

OWTS Inspections are required and reported in accordance with procedures required by the RIDEM and local municipalities. Several municipalities require septic inspectors to register septic with The New England Onsite Wastewater Training Center and report inspections through an online database system at https://septicsearch.com. RIDEM does not require septic inspectors to register with the State; however, it does require OWTS designers and installers to be licensed. Cesspool inspections may be done by either a registered inspector or a licensed designer or installer. If property owners don't know if they have a cesspool, it is the homeowner's responsibility to hire a professional to identify the type of OWTS.[11] Rhode Island Class I, II, or III licensed septic system designers or Registered Septic System Inspectors are recommended by the state when homeowners are attempting to determine the type of OWTS.[13] More information on professional licensing requirements can be found on the RIDEM website.[13] Homeowners with permits for OWTS after 1990 can search and view the information in an online database that also allows towns to better manage OWTS data and inventory. The RIDEM Office of Water Resources maintains a website where homeowners can perform an OWTS permit search.[14] Permits issued prior to 1990 are also held by RIDEM but are more difficult to search online, sometimes requiring an in-person visit to RIDEM's offices (J. Zwarg, personal communication, May 2, 2019).

The Rhode Island Coastal Resources Management Council (RICRMC) has authority over construction proposed in certain coastal regions of the state.[15] The coastal region includes all coastal features and all land within two hundred feet of tidal waters, saltwater ponds, saltwater marshes, and saltwater wetlands. Cesspools within the RICRMC Special Area Management Plans for the Salt Ponds and Narrow River that must be replaced are required to upgrade to an innovative, advanced or experimental (I/A/E system) onsite wastewater treatment system that reduces nitrogen loading.[12,16]

The RIDEM has established minimum standards for OWTS throughout the state, including establishing standards related to their location, design, construction, and maintenance. RIDEM also encourages municipalities to establish local programs to meet the onsite wastewater needs of their community. Cities and towns have authority under state law to establish local management programs to encourage or require OWTS maintenance, which can help ensure systems are performing to their stated nutrient reduction expectations. These programs and requirements can be incorporated into zoning laws that allow for an additional layer of enforcement to ensure compliance by property owners (D. Chopy, personal communication, April 26, 2019). RIDEM has identified and suggested elements of a comprehensive municipal onsite wastewater program that can be found on the RIDEM website.[17] Suggested elements include a web-based tracking system, financial assistance and maintenance, and operations ordinances. Towns can require and determine

appropriate ongoing maintenance requirements and enforcement beyond state requirements. The state has discussed attempting to create operational permits based upon a properly functioning and maintained I/A/E system date (D. Chopy, personal communication, April 26, 2019; J. Zwarg, personal communication, May 2, 2019).

RIDEM enforcement of the Cesspool Act of 2007 is broken into two sections. Part one includes an expedited citation notice program for cesspools within specialized protection zones. The state identified all properties that could contain a cesspool within two hundred feet of the protection zones. From that list, properties were cross-checked with permits at RIDEM and properties that have documented sewer connections (D. Chopy, personal communication, April 26, 2019). Expedited notices were then mailed to the remaining identified properties. The expedited notice program allows the state to bypass traditional notices that can be challenged in court. The notice is good for sixty days, and if the homeowner remains non-compliant, the state could assess a penalty of up to $2500.[12]

The second type of enforcement is more nuanced and involves case-by-case investigations. This method is responsible for enforcing requirements for all properties not within the specialized protection zones. RIDEM has no mechanisms in place to identify when a property replaces a cesspool during a real estate transaction because documentation is not sent to the RIDEM enforcement office. Complaints or grievances may come in from the public about potential violations. However, due to limited staff, enforcement priorities are secondary (D. Chopy, personal communication, April 26, 2019).

Designers of OWTS must renew a state license every three years and obtain continuing education credits. Installers of OWTS are licensed, however, they are not required to obtain continuing education credits.[11]

1.3 Methods to Determine Priority Conversion Areas

The U.S. Environmental Protection Agency (EPA) awarded a $3 million State and Tribal Assistance Grant to certain Rhode Island towns to develop a blueprint for creating comprehensive wastewater management plans.[18] Under the grant program, the state began to perform an extensive inventory of OWTS, which later informed the state conversion methods. More information is available within the Block Island Green Hill Pond National Community Decentralized Wastewater Treatment Demonstration Project report.[18]

In its initial cesspool conversion attempt, Rhode Island primarily used existing setback regulations for wellhead and waterbody protections to establish its cesspool priority conversion areas. The state did not perform modeling or collect water quality data to determine the priority areas to be addressed in the phaseout process. Once most of the

cesspools were replaced in the established protection zones, the state shifted to a point-of-sale model for cesspool conversion. This model was borrowed from the Massachusetts Title 5 program (J. Zwarg, personal communication, May 2, 2019).

RIDEM and RICRMC used geographical information system (GIS) analysis tools, high-resolution aerial photography, and precise building location data to determine which properties were subject to the initial mandate of replacement with two-hundred feet of coastal, tidal waters, and public drinking water supplies.[19] The selection process began by mapping the inland edge of the coastal shoreline feature. Because coastal features are dynamic (beaches, bluffs, salt marsh, dunes, etc.), their boundaries sometimes shift. This requires onsite identification and verification of coastal features and distances by staff, which requires extensive resources.[19] RIDEM used photographic interpretation and approximation for the selection process. When required to convert their cesspool, homeowners were encouraged to enlist professional assistance in determining the relation to the coastal shoreline feature identified by RICRMC. More information on the selection process can be viewed on the RIDEM website archives.[19]

1.4 Methods to Identify Impaired Waters

There have been numerous studies evaluating nitrogen pollution in Rhode Island dating back to as early as the 1970s and 1980s (J. Zwarg, personal communication, May 2, 2019). EPA studies, as part of the Narragansett Bay Project, identified OWTS as a threat to the water quality of groundwater and coastal estuaries.[20] Many of these studies informed the need for the current OWTS upgrade program, however, they were not directly used to identify impaired waters for the updated OWTS regulations or Cesspool Act (J. Zwarg, personal communication, May 2, 2019).

RIDEM took a proactive approach to upgrade OWTS and converting cesspools and identified protection zones alongside the RICRMC that identified the two-hundred-foot requirements listed in the Regulation Enforcement/Requirements section.[11] RIDEM based its requirements to upgrade cesspools and mandating I/A/E systems in certain locations as a public health argument, as numerous studies identified nitrogen as a major source of pollution for coastal and groundwater sources (D. Chopy, personal communication, April 26, 2019).

1.5 Nutrient Reduction Science

RIDEM did not have the resources to develop models or perform specific research to evaluate what levels of nitrogen would be most beneficial to preserve environmental and human health in impaired areas. RIDEM monitored low dissolved oxygen levels and

documented eutrophication in coastal environments but did not have the data to determine if cesspool pollution was the culprit (J. Zwarg, personal communication, May 2, 2019). According to phone conversations with Jon Zwarg (personal communication, May 2, 2019), RIDEM began to frame the argument for cesspool conversion based upon best management practices to reduce risk to coastal ecosystems, drinking water supplies, and human health. Because Massachusetts had success with its Title 5 program since the mid-1990s, and it has similar geology and climate, Rhode Island borrowed similar aspects to create its updated OWTS program (J. Zwarg, personal communication, May 2, 2019). Total maximum nitrogen discharge concentrations for all I/A/E system effluent in Rhode Island were set at 19 mg/L.[11] This number was borrowed from the Massachusetts Title 5 program (J. Zwarg, personal communication, May 2, 2019). Achieving this concentration at the point where the system discharges to the soil absorption system assumes that approximately fifty percent of the total nitrogen is removed from the influent wastewater depending on the incoming nitrogen concentration, which may vary from site to site depending on water usage and other factors.[21] Research was done by the University of Rhode Island and RIDEM in tandem with in-ground monitoring at various I/A/E systems in Rhode Island to evaluate nitrogen removal effectiveness.[22]

1.6 Conversion Technologies/Future Technology Approval

As of January 2015, 20,827 systems with I/A/E technologies and drainfields have been installed in Rhode Island. Many of these 20,000 systems were replaced for reasons other than in direct response to the R.I. Cesspool Act. Most installations were done to replace failed systems or to expand or modernize homes. As a direct result of the R.I. Cesspool Act, 148 homes have connected to a sewer system, and 361 have been identified as “need to be replaced” (J. Zwarg, personal communication, September 6, 2019).[8] RIDEM decides which areas need I/A/E systems versus conventional OWTS based upon the designation and location of critical resource areas (CRAs).[23] If residential OWTS are not within a critical resource area, RIDEM may, on a case-by-case basis, mandate an I/A/E system requirement if it will protect sensitive habitat.[11] Communities who design an Onsite Wastewater Management Plan (OWMP) can require I/A/E systems beyond CRAs to protect water resources. RIDEM has the authority to reevaluate the nitrogen effluent levels of OWTS if further water testing shows coastal areas have high enterococci levels and/or other indicators such as algal blooms and low dissolved oxygen.[24] In 2010, RIDEM attempted to work with manufacturers and municipalities to streamline permitting of new I/A/E systems as an attempt to reduce costs, however, this effort was not successful (J. Zwarg, personal communication, May 2, 2019).

1.6.1 Conventional System Conversion Methods

Two convention cesspool conversion methods are approved in Rhode Island, including connecting to a municipal sewer system or installing a conventional OWTS. Homeowners can install a conventional OWTS if it meets local and state regulations. The required minimum liquid capacity of a septic tank, below the flow line, is based on the number of bedrooms in the dwelling. The bottom of the soil absorption system must be at least three feet above the seasonal high groundwater table. For three bedrooms or less, the minimum tank capacity is one thousand gallons. For each additional bedroom, two hundred fifty gallons of capacity must be added. A garbage grinder or a one hundred gallon or greater tub will each require the septic tank capacity to be increased by two hundred fifty gallons.[11] There are no nitrogen effluent concentration requirements for conventional OWTS.[11,12] Conventional OWTS do not require a maintenance and operations contract (D. Chopy, personal communication, April 26, 2019).

Property owners must connect to a sewer if there is reasonable access and service capability, as determined by the Director of the RIDEM.[11]

The New England Onsite Wastewater Training Program is actively researching small-scale decentralized wastewater treatment systems for use in New England to meet site constraints.[18]

1.6.2 Advanced Nitrogen Removal Methods

An I/A/E system is defined as an OWTS that does not meet the location, design, or construction requirements of a conventional OWTS and demonstrates through field testing, calculations, and other engineering evaluations the ability to provide the same level of environmental and public health protection as a conventional OWTS.[11] RIDEM will maintain a list of approved alternative technologies and charge for the cost of administering the approval procedures, reviewing, monitoring, and tracking of OWTS performance standards.[25]

System evaluation criteria can be found in the OWTS Rules (page 77).[11] I/A/E systems can be removed from approval lists if applicants fail to submit reports, data, or proper permits. Manufacturers seeking approval must have a minimum of three sites and no more than ten sites where the technology is being applied. Rhode Island has created two types of I/A/E system classification.[11]

To be approved I/A/E systems must meet the following criteria for Class 1[11]:

- The vendor provides at least four consecutive years of performance data per installation for no fewer than ten installations with data collected no less frequently than quarterly that demonstrates that department standards are met; and
- The vendor demonstrates that the technology has been approved and utilized successfully for at least four consecutive years in Rhode Island with no fewer than ten installations or at least four consecutive years in at least three other jurisdictions with no fewer than ten installations in each jurisdiction. Class 1 certifications do not require renewal.

I/A/E systems must meet the following criteria for Class 2 (A or B)[11]:

A. Any Technology:

- The vendor provides at least two consecutive years of performance data per installation for no fewer than ten installations with data collected no less frequently than quarterly, that documents that RIDEM standards are met;
- The vendor demonstrates a theory or applied research; and
- The vendor demonstrates that the technology has been approved and utilized successfully for at least two consecutive years in Rhode Island or at least two consecutive years in another jurisdiction with no fewer than ten installations in each jurisdiction.

B. Nitrogen Reducing Technology:

- The vendor provides certification that the technology meets National Sanitation Foundation (NSF)/American National Standards Institute (ANSI) "Standard 245- Wastewater Treatment Systems- Nitrogen Reduction" and the testing results show a preponderance of treated effluent nitrogen concentrations of 19 mg/L or less; or
- The vendor demonstrates approval for use in another jurisdiction in an area where the temperature conditions are similar to, or colder than those in Rhode Island and with technology review criteria substantially equivalent to Class One or Class Two. Substantially equivalent review in another jurisdiction shall be held to mean the other jurisdiction has a minimum nitrogen reduction standard of fifty percent reduction in total nitrogen concentration and a maximum effluent total nitrogen concentration of 19 mg/L and the other jurisdiction has a review process in which the vendor's data is evaluated considering a technology performance claim. Class 2 certifications require renewal every five years.

The New England Onsite Wastewater Training Center at the University of Rhode, University of Rhode Island, and RIDEM created an I/A/E system demonstration project in association with Rhode Island Independent Contractors & Associates, an organization representing contractors in construction, excavation, and utilities.[26] About fifty-eight I/A/E systems were installed and evaluated over a ten-year period. Data was then made available for industry training, performance evaluations, and the development of informed decision-making processes for OWTS regulations.[27] Approved systems were able to enter a streamlined

approval process gaining provisional approval if seventy-five percent of the units installed have a combined total average effluent of 19 mg/L of nitrogen or less for at least six months of sampling.[27]

Rhode Island allows alternative toilets, including composting toilets, that comply with the requirements of the NSF Standard 41.[28] A separate OWTS for the treatment of any greywater must accompany an alternative toilet and designs on sixty percent of the normal daily design flow. Solids produced by alternative toilets may be buried on site unless the resident resides in an area designated as a CRA. Residuals shall not be applied to any food crops. Alternative toilets that generate excess liquids will be pumped to the greywater septic tank or to a separate holding tank. Liquids must be removed from this separate holding tank by a RIDEM permitted septage transporter. Owners of alternative toilets and I/A/E systems must have a valid maintenance contract with an entity or individual that is certified by the vendor. The minimum maintenance contract term is two years. RIDEM will issue a Certificate of Conformance after reviewing permits and maintenance contracts. Every two years, the I/A/E system owner must submit documents to the RIDEM showing the condition of the system and valid permits.[11]

According to Jon Zwarg (personal communication, May 2, 2019), RIDEM doesn't have adequate long-term data to determine I/A/E system nitrogen loading to ecosystems. Smaller residential OWTS aren't required to perform annual in-ground monitoring of nutrients. Nitrogen effluent estimations were calculated by technology vendors accompanied by sampling requirements for technological certification; however, long-term sampling isn't mandated for small-scale residential systems to validate claims. Therefore, the effects of lack of maintenance or climatic changes on specific I/A/E systems are unknown. RIDEM is currently in the process of evaluating if a monitoring program could be put into place to ensure systems are achieving maximal nitrogen removal. It has been best practice that vendors and maintenance providers submit maintenance contract paperwork to RIDEM to show systems are being maintained and functioning properly, however, this isn't a highly scrutinized process (D. Chopy, personal communication, April 26, 2019).

Many studies have been performed at the University of Rhode Island, including climate change impacts on the biogeochemistry of wastewater treatment in I/A/E systems.[29] Additional studies have included modeling of wastewater movement beneath OWTS soil treatment area, aerated drainfields to provide alternatives for areas prone to sea-level rise, and how removal nutrients and biochemical oxygen demand compare between conventional drainfields and shallow, narrow drainfields.[30] These types of studies can help managers approve I/A/E systems that are found to be resilient to rising water tables and changing climates. A list of approved alternative systems can be found on the RIDEM website.[30]

1.7 Conversion Method and Timeline

If a property is subject to sale or transfer after January 1, 2016, and a cesspool is found, it must be removed from service within one year of the closing date. Purchasers will have a ten-day period, unless the parties mutually agree upon a different period, to conduct an inspection of the property's OWTS.[9]

If a cesspool fails an inspection at any time, the cesspool must be replaced within one year of the failure, or less time if an imminent threat to public health is identified. A cesspool must be replaced with, at minimum, a conventional OWTS or a municipal sewer line if one is available. The upgrade requirement is triggered by the actual closing date of a property sale or transfer. If the property transaction closes prior to January 1, 2016, the upgrade requirement does not apply until the next time the property is transferred.[9,11]

Prior to the point-of-sale inspection trigger, cesspools were converted on geographical requirements (J. Zwarg, personal communication, May 2, 2019). If a cesspool is located within two hundred feet of the inland edge of all shoreline features bordering tidal water areas; two hundred feet of any public wells; or within two hundred feet of a water body with an intake for a drinking water supply, it is required to be replaced immediately.[9]

Rhode Island defines a failed cesspool as the following[9,11,31]:

- Liquid level in the cesspool is less than six inches from the bottom of the pipe that drains into it;
- Cesspool fails to accept sewage, as evidenced by sewage backing up onto the ground surface or into the building it serves;
- The cesspool must be pumped more than two times per year;
- The cesspool has been shown to have contaminated a drinking water well, stream, or wetland; or
- The bottom of the cesspool is below the groundwater table at any time of year, resulting in a direct connection between the waste in the cesspool and the groundwater.

Cesspool conversion within a year can be avoided if all criteria are met[9,11,31]:

- The cesspool has not failed,
- The property/neighborhood is to be connected to sewer by January 1, 2020,
- The property owner does not propose to increase the flow of wastewater to the cesspool (i.e., adding a bedroom to a home) prior to the installation of sewers,
- Your city or town obtains bonding authorization for expansion of sewers to the area of the building served by the cesspool, and
- You certify in writing that the building will be connected to the sewer system within six months of receipt of notification to connect to the sewer system.

A temporary hardship extension may be granted to eligible property owners and may delay the upgrade deadline as late as January 1, 2018. A temporary hardship extension expires with a property sale or transfer. To qualify for a temporary hardship extension, the property owner's income must be less than or equal to eighty percent of the area median, and the cesspool must not be classified as failed. Rhode Island allows some exceptions for the cesspool replacement requirement; including transfers between current spouses, between parents and their children, between full siblings, or where the grantor transfers the real property to be held in a revocable or irrevocable trust where at least one of the designated beneficiaries is of the first degree of relationship to the grantor.[31]

1.8 Funding Mechanisms

Towns are provided with funds (State Bond funds, Federal Nonpoint Source funds through Department of Environmental Management [DEM] grants, or EPA grants) to develop an OWMP to meet local OWTS and environmental needs. An example of an OWMP can be found on the Town Portsmouth website.[32] Program elements may include ordinances requiring system inspections, enhancing homeowner education, or specifying more stringent treatment requirements in environmentally sensitive areas. Afterward, the town is eligible to apply for the Community Septic System Loan Program (CSSLP). The Rhode Island Infrastructure Bank, RIDEM, and RIHousing launched the CSSLP in 1999.[33] Low-interest loans cover homeowner costs of conversions, repairs, and upgrades. CSSLP has been used to incentivize towns to develop an OWMP. Currently, 17 communities are participating.[33] Towns are responsible for ensuring funds are properly distributed.

CSSLP funds come from a State Revolving Fund and are administered by RIHousing.[33] RIHousing accepts applications from homeowners and coordinates payments to septic system installers. Additionally, the organization collects repayments from homeowners, adjusts repayments to local governments and makes monthly reports to both the Clean Water State Revolving Fund and the local government.

CCSLP Loan Terms[33]:

- No income limits for program participants.
- Can be used for residential properties with up to 4 units.
- One-time $300 origination fee to RIHousing and a one percent service fee on the outstanding loan balance that is split between RIHousing and the Rhode Island Infrastructure Bank for servicing the loan.
- Most programs cap loans at $25,000.
- The debt-to-income ratio cannot exceed forty-five percent.
- Non-owner occupants can participate.
- Funding covers engineering costs, as well as system replacement costs.

- Funding is released to the homeowner when RIHousing receives the DEM Certificate of Conformance.
- Work must be completed by a state-licensed installer.

The CSSLP program has distributed $12.4 million in loan funds to communities since 1999. Approximately 783 loans have been closed. The average CSSLP loan amount is $15,435, and the monthly payment for a $15,000 loan with a 10-year term would be $131.[34]

The Rhode Island Infrastructure Bank and RIHousing also oversee the Sewer Tie-In Loan Fund (STILF) to provide low-interest loans to homeowners to connect to local sewer systems and abandon their OWTS.[35] Five communities are currently participating. The Rhode Island Infrastructure Bank provides loans of up to $150,000 to the sewer system owner. The system owner then directs the STILF funds to individual homeowners through RIHousing.

STILF Loan Terms[35]:

- The maximum loan amount is $10,000, with a term of up to five years.
- Funding is released to the homeowner when RIHousing receives a Certificate of Compliance (COC) after the work is completed.
- Cost to properly abandon the existing septic system (pumping out its contents and filling it with sand) is eligible.

As of February 2018, the STILF program closed forty-two loans totaling $149,170. The average loan amount was $3,552, and the monthly payment for a $4,000 loan with a 5-year term would be $68.[35]

According to Laura Sullivan, Assistant Chief of the Rhode Island Office of Housing and Community Development (personal communication, May 1, 2019), municipalities may also apply for Community Development Block Grant funds (CDBG), allowing septic, cesspool, and sewer upgrades. Grants may be awarded to communities who design a housing rehabilitation program and then apply to the state Office of Housing and Community Development for funding. Cities and towns then provide a loan or grant to the household secured by deed restrictions.[36]

1.9 Final Analysis/Application

- Rhode Island originally adopted a cesspool conversion method by distance to important coastal and drinking water resources; however, it was changed to a point-of-sale mechanism to convert a larger number of cesspools.
- If a property is subject to sale or transfer after January 1, 2016, the cesspool must be removed from service within one year of the closing date.

- If a cesspool fails an inspection at any time, the cesspool must be replaced within one year of the failure, or less if an imminent threat to public health is identified.
- A cesspool must be replaced with a septic system or connected to a sewer system if one is available.
- OWTS permits and program functions are administered through RIDEM.
- Long-term nutrient monitoring of small-scale residential I/A/E systems is not mandated.
- Rhode Island requires total nitrogen discharge concentrations for all I/A/E system effluent not to exceed 19 mg/L. This number was derived from the Massachusetts Title 5 program.
- University and State partners created a demonstration project that would allow approved systems to enter a streamlined approval and permitting process if I/A/E systems could demonstrate reductions of nitrogen below 19/mg/L.
- Owners of I/A/E systems must have a valid maintenance contract with an entity or individual that is certified by the vendor. The minimum maintenance contract term is two years. Every two years the owner must submit documents to RIDEM showing the condition of the system and valid permits.
- A robust CSSLP enables low-interest financing of OWTS system upgrades.
- To access CSSLP funds, towns must develop an OWMP to meet local environmental needs. Program elements may include ordinances requiring system inspections, enhancing homeowner education, or specifying more stringent treatment requirements in environmentally sensitive areas.
- Only two towns will fine residents for not having a compliant maintenance contract for I/A/E systems.
- Minimal enforcement mechanisms exist at the State level. RIDEM is not required to be notified when a property replaces a cesspool during a real estate transaction. If OWTS regulations are incorporated into local zoning laws, local officials may have more options to enforce non-compliance.

2. Suffolk County, New York

Suffolk County is in the southeastern region of New York State and is bordered by Connecticut and Nassau County to the west, the Atlantic Ocean to the south and east, and the Long Island Sound and Connecticut to the north. Suffolk County has 980 miles of coastline.[37] The United States Census Bureau estimates the population to be 1,481,093 as of 2018.[38] The population density is 1,637 people per square mile, with the total land area covering 1,461 square miles.[38,39] Suffolk County is in a transition zone between a humid subtropical climate and a humid continental climate.[39]

2.1 Regulation Overview

Nearly seventy-five percent of Suffolk County does not have municipal sewer service.[40] County officials have estimated that about 252,000 cesspools and 108,000 conventional OWTS are currently in use.[41] Studies estimate that the average conventional OWTS in Suffolk County discharges nearly forty pounds of nitrogen per year into the ground.[42] Sixty-nine percent of the total nitrogen impacting ground and surface waters in Suffolk County is thought to originate from OWTS.[43] Because of the degraded water quality, the county has experienced beach closures, restrictions on shellfishing, toxic algae blooms, and massive fish kills. Like Hawai'i, Suffolk County relies on underground aquifers for its primary drinking water source.[44] A 1999 assessment found about seventy-percent of Suffolk County community drinking water supply wells were rated as high or very high susceptibility to nitrate contamination.[45] The loss of aquatic and coastal vegetation—which can reduce wave energy and prevent erosion—has become more evident in Suffolk County, especially in the aftermath of recent storms (e.g., Superstorm Sandy).[43a]

Suffolk County created the Reclaim Our Water Initiative in 2014 to make water quality a priority issue for the government. A central pillar of the initiative is to reduce nitrogen pollution from cesspools and outdated conventional OWTS by helping homeowners upgrade to I/A/E systems or connect to the municipal sewer.[42] Additionally, there have been updates to several articles in the County Sanitary Code, the creation of an updated Comprehensive Water Resources Management Plan, and the formation of a partnership with Stony Brook University to research new and emerging OWTS technology.[46] Finally, a temporary grant and loan mechanism was created to assist homeowners in converting outdated or substandard OWTS (C. Clapp, personal communication, June 28, 2019).

2.2 Regulation Requirements/Enforcement

Updates to Article 6 of the Suffolk County Sanitary Code include new sewage disposal requirements for new construction of a residence and the closure of a long-standing loophole that allowed an existing cesspool to be replaced with another cesspool, despite the construction of cesspools being banned since 1973.[47,48] The previous loop-hole did not require property owners to apply for a permit from the Suffolk County Department of Health (SCDH) to upgrade an OWTS when re-installing the system in-kind (C. Clapp, personal communication, June 28, 2019). The county had a previous upgrade requirement in place requiring property owners to upgrade an OWTS when additions to dwellings were proposed, however, this only captured about 242 upgrades of convention systems to I/A/E systems per year.[43]

Recent updates to County Sanitary Code outlines how I/A/E systems will be tested and certified while setting rules for the average amount of nitrogen (19 mg/L) new technology

can release.[48] Article 19 establishes the SCDH as the main management entity to evaluate, approve, register, oversee, and facilitate the use of I/A/E systems.[48] As of July 2018, additional regulations require wastewater haulers to provide data regarding system replacement and pumping activities to SCDH.[47] Permits will also be required to replace or retrofit an existing OWTS beginning July 2019.[49]

Though not specifically addressed in the current Reclaim Our Water program, Suffolk County has identified emerging contaminants of concern for future studies and consideration in Section 8 of the Comprehensive Water Resources Management Plan.[43]

Suffolk County has also updated its Liquid Waste License requirements. Previous regulations allowed maintenance to be done on OWTS by license holders but did not require training to obtain a license. New regulations added eleven endorsements for the Liquid Waste License and created training requirements for each endorsement. A specific amount of continuing education credits are required upon every two-year license renewal.[47]

The county requires residents to connect to community sewer when new construction is proposed in an area of an existing sewer district, if the subsoil or groundwater conditions are not conducive to nitrogen removal, the OWTS would be located in Groundwater Management Zones (GWMZ) III, V, or VI, and the parcel is less than 40,000 square feet in area.[43] Community sewer connection is also required if the property is located outside of GWMZ III, V, and VI, and the project parcels are less than 20,000 square feet in area. More information on GWMZs is outlined in Section 2.3 of this report. Exemptions for sewer connection requirements can be found in the Suffolk County Sanitary Code Article 6 (pages 6–12). A variance or waiver on an OWTS may be granted if the general purpose and intent of an action is to protect groundwater, drinking water supplies, surface water, and other natural resources, public health, safety, and welfare.[47]

The SCDH can use enforcement procedures established in Article 2 of the Suffolk County Sanitary Code. Property owners may face additional sampling, maintenance, inspections, and/or monitoring based on the previous inspection and/or performance monitoring results after being issued a notice and the opportunity for a hearing. Fine amounts and mechanisms will be recommended in the upcoming final Subwatersheds Wastewater Plan (C. Clapp, personal communication, June 28, 2019).

Previous OWTS density requirements existed within Suffolk County and are detailed in section 2.3 of this report.

Possible additional Sanitary Code changes/requirements may include:

- Requirement of I/A/E OWTS for new construction;
- Requiring replacement of failed conventional systems with I/A/E OWTS;

- Requiring I/A/E OWTS upon property transfer; and
- Amend current zoning standards to limit one OWTS unit for all Groundwater Management Zones.

2.3 Methods to Determine Priority Conversion Areas

Prior to the Reclaim Our Water Initiative, several methods were created to identify areas where water quality protection zones were needed. The Suffolk County Department of Economic Development and Planning identified approximately 209,000 homes with OWTS in areas considered to be high priority protection areas. High priority areas were defined as areas in the 0–50 year contributing zone to public drinking water wells fields; areas in the 0–25 year contributing zone to surface waters; unsewered parcels with densities greater than what is permitted in Article 6, or areas where groundwater is less than 10 feet below grade.[43]

SCDH began to study the effects of building density on groundwater quality in the 1970s. Because of the study, eight GWMZs with differing recharge characteristics were identified. The study showed that one-acre zoning kept groundwater impacts to a minimum and allowed for reasonable development.[43] Early versions of Article 6 (many residences of Suffolk County were built before Article 6) of the County Sanitary Code set property building restrictions on certain GWMZs.[43,47] Residential properties located within GWMZ III, V, and VI were required to have a minimum lot size of 40,000 square feet of land with the use of a conventional OWTS and public water or private wells. Residential properties located in the remaining zones are required to have a minimum of 20,000 square feet of land when utilizing conventional OWTS and public water, or 40,000 square feet with private wells.[43]

Nine special groundwater protection areas have also been designated in Suffolk County through the New York State Department of Environmental Conservation Article 55 Sole Source Aquifer Protection program.[50,51] Under this program, areas are protected and managed in a way to maintain or improve existing water quality with policies and procedures directed through the development of comprehensive management plans.[51] A map of special groundwater protection areas may be found on the Suffolk County website.[52]

The Suffolk County Comprehensive Water Resources Management Plan calls for the creation of a GIS-based maps defining required wastewater treatment options based on a future study that will establish nitrogen load targets (Table 1) for the area considering effluent nitrogen requirements, distance to existing sewer districts, depth to groundwater, soil conditions, distance to surface waters, Sea, Lake, and Overland Surge from Hurricanes (SLOSH) zones, and Federal Emergency Management Agency (FEMA) flood zones.[43]

Table 1. Example of wastewater treatment categories based on studies to establish nitrogen load targets.

Category	Minimum Wastewater Nitrogen Effluent Requirement	Minimum Wastewater Treatment Option
A1	>30 mg/l	Conventional onsite sewage disposal system
A2		Innovative/alternative onsite sewage disposal system
A3		Community sewage treatment (centralized or decentralized)
B1	<30 mg/l and >10 mg/l	Innovative/alternative onsite sewage disposal system
B2		Community sewage treatment (centralized or decentralized)
C	<10 mg/l	Community sewage treatment (centralized or decentralized)

Note: Reprinted with permission of the Suffolk County Department of Health Services.

Suffolk County has also evaluated priority areas that may be impacted by sea-level rise in its Comprehensive Water Resources Management Plan. Four general recommendations were provided in the 2015 Plan. The first was the establishment of nitrogen loads for watersheds. The second relayed the need for the improvement of onsite sewage disposal technologies. The third called for expansion and/or creation of new Suffolk County operated OWTS entities and, finally, the creation of privately run centralized sewer districts. It is estimated that 80,000 of the existing 360,000 unsewered parcels within the County are currently located in areas where groundwater is less than ten feet deep.[43] Leach fields inundated by ground or floodwaters can compromise system performance and creates a conduit for nutrients to reach ground and surface water supplies. The report also recommended these areas be prioritized for evaluation of appropriate OWTS alternatives (C. Clapp, personal communication, June 28, 2019).[43]

Suffolk County completed the revised draft Subwatersheds Wastewater Plan (SWP) in mid-2019, which is a science-based report designed to bridge OWTS policy with recent groundwater studies and provide a roadmap for a wastewater management plan (J. Jobin, personal communication, July 5, 2019).[43a] This plan sets priority areas, performs models, and develops nitrogen load reduction goals. Three approaches have been identified and implemented for the establishment of load reduction goals within the revised draft SWP, including[43a]:

- Reference water body approach – this approach assumes that nitrogen loading to the priority subwatersheds should be reduced to the level of existing loading to subwatersheds with observed good water quality within Suffolk County.
- Development of stress-response relationships between nitrogen loads and desired water quality can be identified based on existing data, and that these relationships

can be used to identify the nitrogen load reductions required to achieve the desired water quality outcomes.

- Use of published guidance values – this approach was to be used if the reference water body approach and the stress-response relationships were not successful in the identification of nitrogen load reduction goals. In addition, they provide a frame of reference against which to access the results of the first two approaches.

The revised draft SWP will help Suffolk County continue to identify data gaps and use adaptive management methods to respond to future conditions, changing technology, and new data while building upon previous and existing models and studies of nutrient pollution. Overall, the revised draft SWP recommendations support the overarching goal of halting and reversing increasing nitrogen concentrations and degradation to ecosystems. Nitrogen's impact on water resources within Suffolk County is clearly detailed within the revised draft SWP, along with case studies of other geographic areas in the United States to realize benefits (social, economic, ecological) achieved by reducing nitrogen pollution.[43a]

Finally, Suffolk County created Priority Critical Areas to determine Septic Improvement Program Grant eligibility.[42] Areas are scored using three levels of Priority Critical Areas are listed below, with the first being the highest priority.

1. High and medium density residential parcels less than one acre located within the 0–2 year groundwater travel time to surface waters, or high or medium density residential parcels within 1,000 feet of enclosed water bodies.
2. High and medium density residential parcels less than one acre located within the 2–25 year groundwater travel time to surface waters.
3. A qualifying Residential Parcel located outside of a Priority Critical Area or outside of a Critical Area

A map of the priority areas can be accessed on the Reclaim Our Water website.[53]

2.4 Methods to Identify Impaired Waters

Through existing surface water quality data and by calculating nitrogen loads and hydraulic residence times, Suffolk County has concluded that lower nitrogen loads and well-flushed waters have higher water quality, as defined by dissolved oxygen content, chlorophyll-*a*, water clarity, and a reduction in harmful algal blooms. Suffolk County used several models (coastal, ground, and surface water) to show how upgrading outdated OWTS to sewer, clustered, or I/A/E systems and reducing nitrogen loading would improve water quality by improving dissolved oxygen, chlorophyll-*a*, water clarity, and reducing the number of harmful algal blooms. [43a]

Numerous historical studies from both governmental and non-governmental organizations such as the 1978 Long Island Comprehensive Treatment Management Plan, the 1987 Suffolk

County Comprehensive Waste Treatment Management Plan, and the 2015 Comprehensive Water Resources Management Plan have evaluated and documented the effects of nitrogen pollution from wastewater and other sources. A consensus of these reports concluded that a majority of the nitrogen pollution is caused by poorly performing OWTS.[43a]

The U.S. Geological Survey (USGS) operates a groundwater-monitoring network on Long Island that provides long-term hydrologic data that can be used for scientific evaluation and management of the region's resources. The current monitoring network has approximately 550 wells. More information can be found on the Long Island Groundwater Network website.[54] Previous research by the USGS was conducted from 1985 to 1996 in an attempt to estimate nitrogen sources and loads entering the Long Island Sound from groundwater and streams on Long Island. Results from the report located are available on the USGS website.[55] Additional studies sought to comprehensively document the delineations of the recharge areas and calculate travel times for groundwater discharge to Long Island streams and estuarine environments.[55]

An assessment was done in 1999 by the Suffolk County Water Authority to evaluate drinking water quality and hazards. Nearly seventy percent of the community drinking water supply wells were rated as highly, or very highly susceptible to nitrate contamination. Community water supplies are treated and blended to meet federal water quality standards, which reduces concern.[45] However, about 50,000 citizens receive water from private wells, the same aquifer as the community water supply, and without proper and consistent testing, it may be difficult to determine potential susceptible to higher nitrate levels.[45]

2.5 Nutrient Reduction Science

Nitrogen discharge concentrations from OWTS are regulated by density and lot size through the Suffolk County Sanitary Code Article 6. Based on differences in regional hydrogeology and groundwater quality conditions, the county delineated the boundaries of eight GWMZ for the protection of groundwater quality. The goal of creating the GWMZ was to limit groundwater nitrogen to 4 mg/L in GWMZ III, V, and VI and to 6 mg/L in the remaining zones.[43]

Suffolk County set minimum standards for I/A/E system nitrogen discharge concentrations of 19 mg/L borrowed from the Massachusetts Title 5 program and best available science. An annual review by the SCDH is required to evaluate I/A/E system effluent reduction standards, and nitrogen concentration requirements may be adjusted as technology improves (J. Jobin, personal communication, July 5, 2019).[47]

In cooperation with the New York Department of Environmental Conservation, Suffolk County began a multiyear initiative to develop the Long Island Nitrogen Action Plan (LINAP).[56] LINAP is a partnership with various stakeholders to determine the best methods to reduce nitrogen pollution to ground and surface waters through technical, management, and regulatory/policy actions. More information about the LINAP can be found on the New York State Department of Environmental Conservation website.[57]

Previous management efforts have been undertaken to protect drinking water supplies, however, many studies document that surface waters are able to sustain far lower nitrogen concentrations than drinking water sources. Recommended surface water nitrogen concentrations by the USEPA ranged from 0.45 mg/L for the protection of dissolved oxygen, to 0.34 mg/L for the protection of eelgrass.[57]

In order to understand how many properties may be impacted by OWTS property transfer conversion mechanisms, Suffolk County created estimates within its Comprehensive Wastewater Resources Management Plan. The number of estimated cesspool conversions that may occur through the property transfer mechanism and the amount of nitrogen load reduced within priority areas are shown in Table 2.[43]

Table 2. Predicted SCDHS I/A OWTS applications for existing dwellings at the time of property transfer.

Example of Number of Onsite Sewage Disposal System in Suffolk County That May Be Required to be Upgraded Per Year in Priority Areas at Property Transfer				
SC Home Sales (non-Condo)	**2011**	**2012**	**2013**	**Notes:** Estimated % Priority Systems [209000/360000]- = 0.58 or 58% Estimated % Sub-Standard Systems (from Fig. x) [252530/360000] =0.70 or 70% Estimated % Unsewered = 74% SCDHS Final 3 Year Avg. (1397 + 1200 + 1328)/3 = 1308 (Includes Condo's and therefore 1308 is an overestimate)
	9,460	10,735	9431	
Average Home Sales for 3 Year period	9875			
Average SCDHS Residential Construction Permits Issued Final During the same 3-year period	1308			
Number of Homes In Priority Areas Requiring Sanitary System Upgrade At the Time of Transfer Per Year		**2573** (See Below)		
Assumes 74% parcels unsewered, 58% systems priority systems, 70% systems are sub-standard – See Notes				
[9875-1308] x .74 x .58 x .70 = 2537 upgrades per year				
Housing data from www.tax.ny.gov				

Note: Reprinted with permission of the Suffolk County Department of Health Services.

2.6 Conversion Technologies/Future Technology Approval

Suffolk County realized that many properties would have to remain on OWTS and that properly installed OWTS are a viable alternative to a community sewer. According to the EPA, OWTS are more affordable than centralized sewage treatment plants and can be designed to perform under a variety of specific site conditions.[58] With that in mind, the county created Article 19 with a focus on promoting the use of I/A/E systems to protect the underground aquifer and county surface water quality. Suffolk County Sanitary Code Article 19 facilitates the development and use of I/A/E systems as an environmental conservation and public health protection measure that designates SCDH as the responsible management entity. SCDH is charged with ensuring that all I/A OWTS are properly managed and maintained. Regardless of which type of OWTS technology is used for a property, conventional or innovative and advanced, Suffolk County limits the amount of sewage that can be discharged on a parcel of land based on lot area, soil type, and hydrological conditions. According to county documents, using I/A/E systems in tandem with the density requirements allows more pollution control and greater water resource protection.[59]

2.6.1 Conventional System Conversion Methods

Suffolk County has evaluated priority areas for new sewer systems, with assessment criteria that focuses on high-density communities within a 25-year groundwater-to surface water travel time (50-year travel time to a water supply well), communities that contribute nitrogen to an impaired surface water, and areas that have a depth-to-groundwater of fewer than ten feet.[60] Recommendations to install sewer systems were made in the four priority areas of Mastic (Forge River), North Babylon and West Babylon (Carlls River), Great River (Connetquot River), and Patchogue (Patchogue River).[60] The four areas are characterized by the number of substandard septic systems and cesspools, small lot sizes with dense populations, a short depth to groundwater, and short travel times for nitrogen-enriched groundwater to enter surface waters.[60]

The minimum separation distance from the bottom of a leaching pool system to the highest groundwater elevation is nine feet to ensure adequate treatment in the unsaturated zone prior to discharge to groundwater. In some instances, the minimum separation distance may be reduced for alternative treatment systems, as approved by SCDHS.[47]

2.6.2 Advanced Nitrogen Removal Methods

To incorporate and certify I/A/E systems for use in Suffolk County, intragovernmental and external systems were evaluated to ensure information was available to installers, regulations were updated, and funding mechanisms were available for implementation (J.

Jobin, personal communication, July 5, 2019). Figure 1 details the process to incorporate I/A/E systems into county regulations.

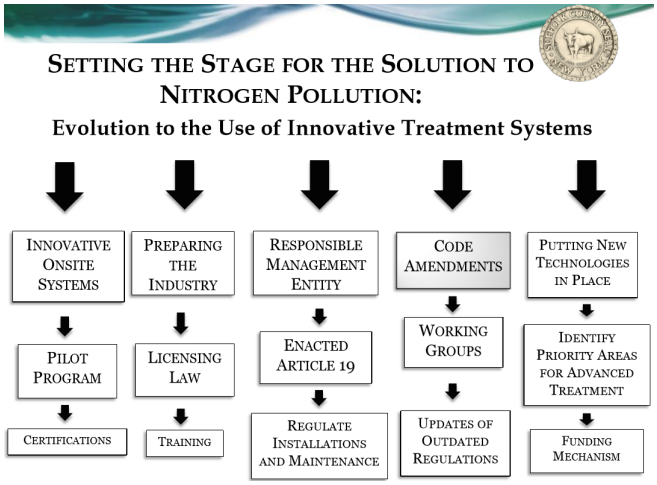

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Figure 1. Evolution process incorporating I/A/E systems.

Suffolk County defines I/A/E systems as onsite decentralized wastewater treatment systems that are designed to reduce total nitrogen in treated effluent to 19 mg/L. I/A/E systems must also achieve greater reductions in biological oxygen demand and total suspended solids than that of a conventional OWTS. An I/A/E system can serve more than one parcel but cannot be considered a community sewerage system.[47,48]

In 2014 and 2016, Suffolk launched in-field demonstration projects for I/A/E systems to evaluate design, operation, maintenance, installation, and overall ability to remove nitrogen in Suffolk County climate and geology. Manufacturers pay to install their systems for evaluation and educational purposes.[61]

Homeowners could participate in the pilot program to test I/A/E systems by entering a lottery system to select sites. As of January 2018, a total of fourteen different technologies have been installed at thirty-nine homes.[62] If seventy-five percent of the demonstration systems maintain nitrogen effluent levels of 19 mg/L or better for a minimum of six months, they are granted Provisional Use Approval through a fast-track approval process (Table 3).[61] When evaluating the nitrogen removal capacity of I/A/E systems, Suffolk County mandates that systems have a minimum of twelve samples from twenty systems of a specific I/A technology, this method was adopted from the Barnstable County (Massachusetts) I/A/E system program (J. Jobin, personal communication, July 5, 2019).[61] Suffolk County adopted these approval values and methods based upon Barnstable County's statistical analysis of monitoring data and Maryland's methods (J. Jobin, personal communication, July 5, 2019).[61]

Table 3. Summary approval chart for residential systems.

Approval Phase	No. of Systems	Sampling Frequency	Performance Requirement
Experimental	3 – 5 Year-Round	Monthly Sampling 12 months rolling average	The total dataset of 75% of the systems must have a combined average of 19 mg/L or less TN
Piloting*	8 – 12 Year-Round	Monthly Sampling 12 months rolling average	The total dataset of 75% of the systems must have a combined average of 19 mg/L or less TN
Septic Demonstration Systems*	1 – 5 Year-round	Monthly Composite Samples 6 month rolling average for streamlined approval.	The dataset of 75% of the systems must maintain a combined average of 19 mg/L or less TN
Provisional 1	First 20 Year-Round	Bi-Monthly Sampling fo 24 months rolling average	The dataset of all the 20 systems must have a combined average of 19 mg/L or less TN
Provisional 2	All Other installations during Provisional Use Approval	Every 12 months, unless seasonal then every month of operation.	The annual dataset must maintain a combined average of 19 mg/L or less TN in order to remain in the Provisional phase ***
General Use		Every 36 Months	The dataset must maintain an average of 19 mg/L or less in order to remain in General Use phase **

Note: The number of required systems is a cumulative number. For example, the minimum of 20 systems for Provisional Use includes the number of systems installed as part of Experimental and Piloting phases.

**Suffolk County Sponsored I/A OWTS Demonstration Program may permit a streamlined Pilot approval phase.*

***The combined average of the dataset in Experimental, Piloting and Provisional 1 is the requirement to achieve successful completion of that phase.*

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Outside the demonstration or experimental category, manufacturers must submit acceptable design specifications, and sampling data to SCDH to receive a pilot system permit. During the pilot system phase, a minimum of five pilot systems would be installed and sampled bi-monthly for eighteen-months. A maximum of fifteen systems may be installed during the pilot phase. Pilot systems will be granted provisional approval if they meet a minimum of seventy-five percent of the total nitrogen removal targets for twelve months. Provisional approval mandates that fifty systems must be installed and sampled for a minimum of thirty-six months. If the sample results and operational performance for the systems achieve a ninety percent success rate, the system would be granted general use approval. Systems that have a general use approval are certified for advanced nitrogen removal and can maintain the approval as long as there are no significant environmental or public health concerns.[61]

New York State-funded and established the New York State Center for Clean Water Technology (CCWT) at Stony Brook University.[63] CCWT is focused on developing efficient and cost-effective I/A/E systems to reduce the impacts of nitrogen and other contaminants to ground and surface waters caused by cesspools and conventional OWTS. CCWT adopted three core objectives regarding I/A/E systems, known as the 10-10-30 strategy. The systems must produce a total nitrogen concentration of at least 10 mg/L; cost to construct a system is approximately $10,000; the system must last thirty years. The center is also focused on creating an outreach and business development plan to create businesses revolving around clean water technology to create jobs in the community and advance technology. Additionally, CCWT is highly focused on industry training to ensure I/A/E systems are maintained properly, ultimately ensuring that systems remove nitrogen as claimed. CCWT is

also studying emerging technologies such as constructed wetlands or Nitrogen Removing Biofilters as additional methods to remove nitrogen from wastewater effluent.[64,65,66]

Experimental I/A technologies must undergo additional testing and meet requirements, protocols, procedures, and standards established by the SCDH to become eligible. The SCDH has established a set of standards and methods for evaluating the performance of I/A/E systems to meet the effluent standard at each stage of the approval process based upon research from several other state's I/A/E programs.[61]

An annual review by the SCDH and CCWT of new I/A technologies occurs to ensure performance verification standards represent the best available technologies. The SCDH will maintain a Management Information System, which tracks the approval and registration information, inspection, sampling, and operations and maintenance (O&M) of all approved I/A OWTS. Maintenance providers can face enforcement if they fail to comply with any reporting or record-keeping requirements.[61]

The property owner is responsible for all necessary repairs, annual maintenance, and access after installing an I/A/E system. Every property owner must have an active O&M contract with a company that has a current Suffolk County Liquid Waste License and Innovative and Alternative Treatment System Service Provider Endorsement.[48] Property owners must notify the SCDH in writing within thirty days in the event there is a change in the maintenance provider. Maintenance providers must notify the SCDH when an O&M contract is not renewed or is canceled. Maintenance providers are also required to report all O&M and emergency I/A/E system service to the County. Maintenance providers must maintain inspection records for at least five years. The SCDH may inspect I/A/E systems and sample discharges as often as deemed necessary to determine compliance, upon reasonable notice to the property owner.[48]

Suffolk County has also considered joining a regional data-sharing program for I/A/E systems.[43] A similar program exists within the Chesapeake Bay area and allows states to approve new I/A technologies in their home state by using data from another (J. Jobin, personal communication, July 5, 2019).

2.7 Conversion Method and Timeline

Suffolk County is in the process of developing and implementing timelines and methods that require cesspool conversions and upgrades to outdated and substandard OWTS. Suffolk County is also in the process of identifying long-term dedicating funding to support OWTS conversions (C. Clapp, personal communication, August 1, 2019). The 2019 revised draft SWP identified a phased approach to convert OWTS by evaluating eight plans as a recommended roadmap for the OWTS upgrade program. Each of the eight programs

consisted of the same four-phased structure listed below. “Alternative 4” was chosen as the recommended roadmap and is detailed after the phase details listed below[43a]:

Phase I: A five-year phase with the primary objective(s) of:

- Requiring I/A OWTS for all new construction;
- Establishment of a stable and recurring revenue source;
- Establishment of a Countywide wastewater management district; and,
- Continuation of the existing voluntary upgrade program(s) and Town/Village mandates.

Phase II: The timeframe of the phase varies based upon the I/A OWTS upgrade triggers selected. The kick-off for this phase is the collection of revenue from the stable recurring revenue source. This phase has the following primary objective(s):

- Continuation of existing voluntary upgrade program(s) and Town/Village mandates;
- Implementation of wastewater upgrades within the 0- to 2-year groundwater contributing area for all surface water Priority Rank 1 areas, and within all groundwater/drinking water Priority Rank 1 areas (e.g., areas within existing or predicted total nitrogen of greater than 10 mg/L).

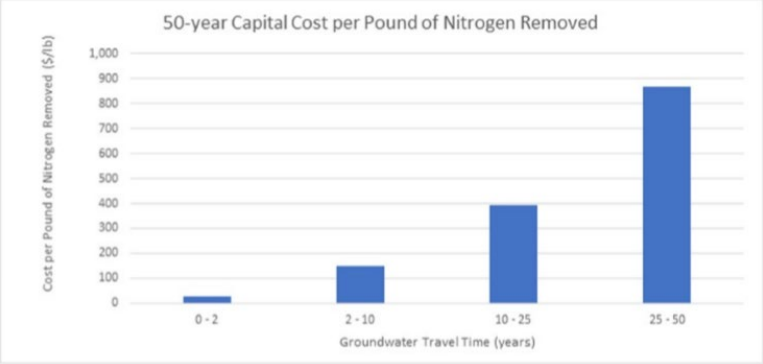
Phase III: The timeframe of the phase varies based upon the I/A OWTS upgrade triggers selected. The kick-off for this phase is the completion of upgrades within all Phase II priority areas. This phase has the following primary objective(s):

- Continuation of existing voluntary upgrade program(s) and Town/Village mandates;
- Implementation of wastewater upgrades within the 2- to 25/50-year groundwater contributing area for all surface water bodies and within all groundwater/drinking water Priority Rank 2 areas (e.g., areas with predicted total nitrogen of between 6 mg/L and 10 mg/L).

Phase IV: The timeframe of this phase is not included within the SWP and shall be determined based on future analysis during subsequent program evaluations. The kick-off of this phase is the completion of upgrades within all Phase III priority areas. The primary objective of this phase to upgrade all remaining parcels in Suffolk County that were not addressed in the first three phases.

“Alternative 4” includes the four-phase program described above and adds upgrade requirements for existing properties at property transfer, existing OSDS failure, and the construction of a building addition. Ramp-up sub-phases are added during Phase II to accommodate program needs. To accommodate OWTS technology developments, Phase II has several sub-phases that are geographically separated when new triggers or priority areas are implemented. The goal is to complete all upgrades within Phase II in 30 years and 45 years for upgrades within all Phase III areas.[43a]

The most cost-effective solution to reduce annual nitrogen loading to surface waters as calculated by nutrient modeling and estimations of cost per pound of nitrogen removed is achieved by focusing on coastal areas within the 0–2-year groundwater travel time.[43a]



Note: Reprinted with permission of the Suffolk County Department of Health Services.

Figure 2. 50-year capital cost per pound of nitrogen removed by I/A/E OWTS implementation in groundwater travel time intervals.

According to the revised draft SWP, Alternative 4 financially supports homeowners who voluntary update their OWTS, or upgrade after OWTS failure with one hundred percent funding through the identified stable recurring revenue source. Homeowners who construct a new building addition can obtain fifty percent funding toward an OWTS upgrade. Alternative 4 does not currently allow OWTS upgrades at property transfer to qualify for funding support. The cost to fund the upgrades is within the range of potential funding evaluated under the various stable and reoccurring revenue source models. The maximum incremental step increase in annual installs is within the range that is forecast to be acceptable for accommodating industry and RME ramp up.[43a]

A failed cesspool means any cesspool or OWTS that does not adequately treat and/or disperse wastewater so as to create a public or private nuisance or threat to public health or environmental quality, as evidenced by and including, but not limited to, one or more of the following conditions[47]:

- Continued failure to accept wastewater into the building sewer;
- Continued discharge of wastewater to a basement, subsurface drain, stormwater collection, conveyance or treatment device, or watercourse unless expressly permitted by SCDH;
- Wastewater rising to the surface of the ground over or near any part of an OWTS or seeping from the Absorption Area at any change in grade, bank or road cut;
- Where pumping of the Cesspool, septic tank, I/A OWTS, or Leaching Structure is required four or more times per year due to the infiltration of groundwater into the system, a collapsed Leaching Structure, or clogged Absorption Area which does not allow effluent to infiltrate the surrounding soils. This condition excludes grease trap

maintenance or commercially reasonable, regular/scheduled preventative maintenance of a Cesspool, septic tank, I/A OWTS, or Leaching Structure. The Department may promulgate Standards pursuant to this Article defining commercially reasonable, regular/scheduled preventative maintenance;

- Where groundwater seeps into a septic tank, Cesspool, pump tank/basin, distribution box/utility hole, or Leaching Structure after it is pumped;
- Any structural damage or deterioration that has caused structural damage to the Individual Sewerage System, as determined by a New York State (NYS) Licensed Design Professional or a contractor/Developer holding an active Liquid Waste License through the Suffolk County Department of Labor, Licensing and Consumer Affairs. A determination of structural damage or deterioration that causes structural damage by an NYS Licensed Design Professional (registered architect or licensed professional engineer) shall supersede a Liquid Waste License holder's determination.

2.8 Funding Mechanisms

Suffolk County created a Septic Improvement Grant and Loan Program, where homeowners who decide to replace their cesspool or conventional OWTS in the near term may be eligible for a grant of up to $30,000 with funds from Suffolk County and New York State.[42] The county has enough funding to issue approximately 185 to 200 grants per year (J. Jobin, personal communication, July 5, 2019). Suffolk County has also increased staffing for SCDHS to administer the expanded grant program. Grant awards are expected to increase from 200 per year to 1,000 per year as more funding is developed. In addition to the grant, those who qualify can receive additional funding to finance any remaining costs over fifteen years at a three percent fixed interest rate. The loan program will be administered by the Community Development Corporation of Long Island Funding Corp, with financial support from Bridgehampton National Bank, in the amount of $1 million and financial commitments from several philanthropic foundations.[42]

Grant applicants must meet the following criteria[42]:

- The residence must be served by a conventional OWTS or cesspool and not located within a proposed sewer district.
- New construction on vacant lots is not eligible.
- The property does not have any outstanding or open real property tax liens.
- There must be a valid certificate of occupancy (CO) or equivalent issued by the applicable town or village.
- Income verification

New York State created a pilot Septic System Replacement Program Fund as part of its Clean Water Infrastructure Act of 2017.[67] In 2018, New York State announced that Suffolk County

would be awarded over $10 million. The fund provides funding for the replacement of cesspools and conventional OWTS to reduce the environmental and public health impacts associated with the discharge of wastewater effluent. The State Department of Environmental Conservation and SCDH will determine priority areas to provide grant funding. Priority areas are based on a location's vulnerability to contamination. Areas are evaluated on factors such as the presence of a sole-source aquifer or known contamination or impairment, population density, soils, hydrogeology, and climate. Counties in priority areas can obtain funding to provide grants to property owners for up to fifty percent of the eligible costs (maximum of $10,000) of their eligible OWTS project.[67]

Clean Water State Revolving Fund (CWSRF) can assist property owners to upgrade their OWTS by providing low-interest loans, but a countywide wastewater management district must exist for funds to become available. Under the CWSRF, Suffolk County can receive funds for nonpoint source pollution projects, including decentralized wastewater treatment systems to replace outdated or failing OWTS, in addition to I/A projects that demonstrate new approaches to delivering services or managing water resources.[43]

Though grant and loan programs exist for Suffolk County, these programs have been created from pilot funds, which may not provide a steady, sustainable source of funding for future OWTS conversion. The county is exploring options such as increased water delivery and disposal fees, or through property tax mechanisms (C. Clapp, personal communication, June 28, 2019). Some towns within Suffolk County, such as East Hampton and South Hampton, have passed an expansion of existing local Community Preservation Funds to incentivize the voluntary upgrade of outdated OWTS to I/A/E systems.[68] A two percent tax is added to real estate transfers after a certain monetary value, which provides funding to upgrade OWTS or cesspools to those who qualify. According to town documents, approximately $4,600,000 will be available annually for water quality improvement projects. Many towns are creating their own programs because local economies are closely linked to tourism, fishing, and real estate.[68]

2.9 Final Analysis/Application

- Created the Reclaim Our Water Initiative effectively making a public brand to promote the new OWTS regulations and rally homeowners to protect Long Island's water quality.
- Developed easy online grant and loan applications to encourage participation in financial programs.
- Extensive outreach on OWTS performed by the County and CCWT directed towards the public, manufacturers, and businesses.
- Suffolk County has specific density requirements for OWTS.

- Towns can create more stringent OWTS regulations to protect public health, safety, welfare, and the environment.
- Created demonstration programs that have allowed the evaluation of system design, O&M, installation issues, and analysis of nitrogen reduction objectives. A lottery scheme was developed to provide homeowners with free systems in exchange for the testing of I/A technologies that may eventually gain general use approval under a fast track process.
- Suffolk County uses key financial incentives, including grants and low-interest loans, to promote conversion to I/A technology.
- Suffolk County and New York State partnered with Stony Brook University, creating the Center for Clean Water Technology to create a bridge between research institutions, regulatory agencies, and private sector resources in hopes of overcoming knowledge and technology gaps in regional water quality restoration solutions.
- The County has estimated the number of parcels at risk for climate change impacts, including those impacted by sea-level rise and groundwater inundation.
- New York State created a $75 million Septic System Replacement Fund.
- For I/A/E system approval, Suffolk County is using data from a minimum of twelve samples from twenty systems of a specific technology to make a determination on the level of nitrogen removal. According to documents, Suffolk County is the first jurisdiction to adopt an approval process based on the Barnstable County statistical analysis.

3. Delaware

Delaware is a state in the Mid-Atlantic region bordered by Maryland to the west and south, Pennsylvania to the north, and the Delaware Bay, Atlantic Ocean, and New Jersey to the east. Delaware has 381 miles of coastline.[69] The United States Census Bureau estimates the population to be 967,171 as of 2018.[70] The population density is 460 people per square mile, with the total land area covering 1,954 square miles.[71,72] Delaware has a humid subtropical climate, with hot and humid summers and cool to mild winters.

3.1 Regulation Overview

Statewide regulations in Delaware regarding the installation and operation of OWTS have existed since 1968. However, according to the state, years of inappropriate installations, poor operation, and maintenance practices have contaminated groundwater and threatened public health.[73] To better protect public health and the environment, the Delaware Department of Natural Resources and Environmental Control's (DNREC) updated regulations in 2014 regarding site evaluation, siting density, installation, operation and

maintenance of OWTS. This updated regulation entitled 7 Delaware Code Chapter 60 can be viewed on the DNRC website.[74]

Currently, almost all of Delaware's rivers and streams are listed as impaired due to excess nutrients and bacteria. DNREC's Division of Water estimates that approximately eighteen percent of the state's 70,000 OWTS may be malfunctioning. The regulatory changes for OWTS represent five-plus years of work by DNREC and included thirteen workshops and three public hearings.[75]

In 2014, Delaware began requiring inspections of all OWTS prior to property transfer. New inspection protocols for OWTS contractors and inspectors were also created. Additionally, a novel program that allowed homeowners to maintain their own I/A/E system, once certified through a homeowner-training program was implemented. In 2015, all cesspools were prohibited and when discovered and must be replaced within one year. The state also required upgrades to all new and replacement systems within 1,000 feet of tidal portions of the Nanticoke River and Broad Creek, assisting Delaware in meeting federal targets to clean up the Chesapeake Bay Watershed. Additional measures taken by Delaware include establishing statewide performance standards for all I/A/E systems and requiring waste haulers to report septic tank pump-outs mandated at every three years for conventional systems, and greater frequencies for I/A/E systems.[74,75]

3.2 Regulation Requirements/Enforcement

All OWTS are regulated and permitted through the DNREC. DNREC requires inspection of all OWTS by a Class H system inspector prior to property transfers.[76] A Class H inspection is a comprehensive and mandatory inspection of the OWTS to check its functionality.[75] A cesspool or seepage pit must be replaced within one year of identification. There are extensions for sheriff sales, auctions, short sales, and cash sales for up to ninety calendar days from the date settlement date. Inspection reports are submitted to DNREC within seventy-two hours of an inspection. Three situations exist where a Class H inspection is not required[74]:

- The certificate of completion for transfers of new property was issued within the past twenty-four months;
- An inspection has occurred within the previous thirty-six months and the property owner can provide proof of pump-out;
- The owner of an I/A/E system provides proof of a licensed operator or has a service contract with a certified service provider.

In the 2014 updated regulations, Delaware incorporated FEMA guidelines when siting OWTS in flood-prone areas. Certification by a registered professional engineer (Class C) is required for all new and replacement OWTS. OWTS must be located and designed to minimize or

eliminate flood damage, infiltration of floodwaters, and discharges from the system into floodwaters. Rules also stipulate that new and replacement OWTS must also be located to minimize alterations to any sand dunes.[74]

When DNREC determines that construction of OWTS should be limited or prohibited in an area, it can issue an order limiting or prohibiting construction; these areas are called Moratorium Areas. The order will contain a specific description of the Moratorium Area and be limited to the area immediately threatened with groundwater or surface water contamination. Currently, there is only one proposed moratorium area identified by the state.[74,77]

For residential dwellings, the maximum OWTS siting density is one dwelling unit per one-half acre. For multiple-family dwellings, or where more than one dwelling is to be served by an OWTS, the maximum siting density is based on the net pervious area (e.g., unpaved, without structures) available for groundwater recharge after total project completion.[74]

DNREC administers a program for the licensing of many types of wastewater professionals. All applicants will be required to pass an examination prepared and administered by DNREC to test competency and knowledge. Depending on the Class of licensing, additional qualifications and professional certifications may be required and can be reviewed on page 35 of 7 Delaware Code Chapter 60.[74]

Wastewater Professional Classifications[74]:

Class A—Percolation Tester
Class B—Conventional System Designer
Class C—Innovative/Alternative Designer
Class D—Soil Scientist/Site Evaluator
Class E—System Contractor
Class F—Liquid Waste Hauler
Class H—System Inspector
Class I—Construction Inspector

OWTS owners are responsible for operating and maintaining their systems. Each conventional OWTS should be pumped by a licensed Class F liquid waste hauler once every three years, however, this is not mandatory. I/A/E systems must be pumped according to manufacturer recommendations unless determined that the tank is less than one-third full of solids. A pumping schedule is prescribed in accordance with current DNREC guidelines based on the size of the treatment unit and an anticipated number of residents. The owner of the conventional OWTS should maintain a record indicating when the system has been pumped.[74]

All I/A/E systems have strict operation and maintenance requirements. For new construction, and prior to DNREC granting a COC, the owner must enter into a service contract with a certified service provider, for a minimum of two years when the OWTS becomes functional (unless certified by the homeowner training program). For replacement systems, this service contract must be submitted with the permit application. An online reporting system was created to report when a system is pumped. This system records the pumper's license number, the address of the system pumped, and how many gallons were pumped. Under the new regulations, the waste hauler is now responsible for reporting to DNREC how much they pump quarterly.[74]

Inspection programs for I/A/E systems include a schedule indicating inspection frequency, inspection objectives, inspection details, necessary operation and maintenance activities, additional sampling if required, and recordkeeping requirements. A service contract must outline that the certified service provider is to inspect the system once every six months or otherwise as approved by the DNREC. A certified service provider must document all inspections. Reports document the date and time of the inspection, sampling and laboratory analysis results, operation and maintenance performed, repairs, an assessment indicating the current performance status of the entire treatment and disposal system, and any corrective actions that must be taken prior to the next inspection.[74]

Delaware has a unique program entitled the Homeowner Training Program (HTP). HTP allows homeowners to maintain their own I/A/E system, once certified. In order to become certified, a service provider is required to meet with the homeowner during the first sixth-month inspection to educate the homeowner on the components of the system and on the proper O&M requirements. The certified service provider must also provide the homeowner with an operation and maintenance manual.[74]

Following the initial two-year service contract period, the owner is required to maintain a service contract for the system by renewing the existing contract annually, at a minimum, contracting with another certified service provider or being certified by the homeowner training program. DNREC reserves the right to collect and analyze samples of I/A/E systems to ensure proper treatment levels and system performance.[74]

Waivers in cases of extreme and unusual hardship may be granted to OWTS owners. The DNREC may consider the following factors in reviewing an application for a waiver based on hardship including data from DNREC; Division of Water or Groundwater Discharges Section; advanced age or bad health of the applicant; need of applicant to care for aged, incapacitated, or disabled relatives; relative insignificance of the environmental impact of granting a waiver.[74] Owners of OWTS may be investigated by DNREC's Enforcement section under 7 Delaware Code §6019, and fines may be issued accordingly. However, 7 Delaware Code Chapter 60, does not specifically list fine amounts or procedures, other than DNREC will initially attempt to gain voluntary compliance.[74]

3.3 Methods to Determine Priority Conversion Areas

The Delaware OWTS regulations do not specify methods for testing, evaluation, or determination of priority areas for cesspool or conventional OWTS replacement on a state level (J. Baumgartner, personal communication, July 5, 2019). The main mechanism for converting cesspools or outdated and failing OWTS is through the real estate inspection program. A map of proposed areas for I/A/E systems within Chesapeake and Inland Bays watersheds can be viewed on the DNRC website.[78] The state has a goal of eliminating a minimum of 6,074 conventional OWTS by 2025.[79]

3.4 Methods to Identify Impaired Waters

Specific provisions about the state identifying impaired waters from cesspool or septic system pollution were not included in the updated OWTS regulations. All new and replacement OWTS permitted within 1,000 feet of the Chesapeake Bay tidal waters must meet the performance standards for nitrogen and phosphorus set forth in 7 Delaware Code Chapter 60. Delaware's Chesapeake Bay WIP and the Inland Bays Pollution Control Strategy (PCS) does seek to address loading issues from OWTS; however, it does not appear that the state underwent any additional methods to scientifically identify impaired waters in the updated OWTS regulations.[80,81]

3.5 Nutrient Reduction Science

Delaware did not develop models or perform specific scientific research to evaluate what levels of nitrogen would be most beneficial to preserve environmental and human health (J. Baumgartner, personal communication, July 1, 2019).[74] The updated OWTS regulations list specific nitrogen requirements for I/A/E systems. However, small-scale I/A/E systems (<2,500 gallons per day [gpd]), do not require in-ground testing to confirm nitrogen reduction prior to certification, or in-ground monitoring post-installation to confirm manufacturer performance metrics. There are no long-term programs within the 7 Delaware Code Chapter 60 that track reductions in nitrogen pollution from cesspools or septic tanks and ecosystem changes (J. Baumgartner, personal communication, July 1, 2019).[74] Additional state programs or projects to evaluate nutrient levels related to wastewater discharge was not discovered while researching the state of Delaware.

3.6 Conversion Technologies/Future Technology Approval

The DNREC encourages the development of new I/A/E systems, processes, and techniques for eliminating, reusing, or recovering resources from wastewater. This includes eliminating, reusing, or recovering resources from wastewater via greywater collection and use, nutrient recovery, and source reduction of wastewater.[74] All innovative technologies are subject to

review and approval by DNREC. All new and replacement systems permitted within 1,000 feet of the Chesapeake Bay tidal waters must meet the performance standards for nitrogen and phosphorus set forth in the 7 Delaware Code Chapter 60. Small I/A/E systems must meet specific nitrogen performance specifications (see below), and requirements become effective one year from the update of 7 Delaware Code Chapter 60. As of 2019, around 2,000 permitted I/A/E systems exist in Delaware, according to Jason Baumgartner, Environmental Scientist with the DNREC Groundwater Discharges Section (personal communication, July 1, 2019).

3.6.1 Conventional System Conversion Methods

When a central wastewater system is deemed both physically and legally available, the connection must occur within a timeframe as set forth by the wastewater system owner and the existing OWTS must be abandoned. A central wastewater system is deemed physically available if its nearest connection point from the property line or boundary to be served is within two hundred feet for all single-family dwellings.[74]

Conventional OWTS are permitted under Delaware law if an I/A/E system is not required. DNREC has recognized that many home lots are small and have incorporated some exemptions to ease siting problems. These can include waiving isolation distances or downsizing a system. The very last resort for small lots is the pumping and hauling of a holding tank when it is three-fourths full. The required minimum liquid capacity of a septic tank for flows less than or equal to 500 gpd is one thousand gallons. For each additional bedroom, add two hundred fifty gallons must be added to capacity. If large flow surges are anticipated, the septic tank size must be increased to accommodate surges without causing sludge or scum to be discharged from the tank. There are no nitrogen effluent concentration requirements for conventional OWTS.[74]

3.6.2 Advanced Nitrogen Removal Methods

Composting toilets are permissible under Delaware law. Homeowners would still need to process greywater, including wastewater from bathtubs, showers, bathroom washbasins, clothes washing machines, laundry tubs, and other wastewater that do not present a threat from contamination by unhealthy processing or operating wastes. Wastewater from kitchen sinks or dishwashers is considered blackwater and requires separate treatment from greywater.[74] According to Jason Baumgartner, only a handful of permits exist for composting toilets across the state (personal communication, July 1, 2019).

I/A/E systems provide advanced treatment for the reduction of nitrogen and are part of the Chesapeake Bay WIP and PCS for the Inland Bays. I/A/E systems less than 2500gpd are not required to be field-tested prior to certification for use. Manufacturers submit third-party

testing results based upon the NSF protocols and apply for approval with the state. All new and replacement systems requiring advanced treatment units must adhere to the performance standard nitrogen level 3 (PSN3).[74]

PSN3 total nitrogen levels achieve either[74]:

- An average annual concentration of 20 mg/L (ppm) total nitrogen in effluent sampled at the end-of-pipe of the advanced treatment unit; or
- A fifty percent reduction in effluent total nitrogen concentration when compared to the influent total nitrogen concentration at the end-of-pipe of the advanced treatment unit; or
- A fifty percent reduction in effluent total nitrogen concentration when compared to the influent total nitrogen concentration beneath any permitted on-site wastewater treatment and disposal system as verified by in-field monitoring or third-party test results.

I/A/E systems may be appropriate for areas where site constraints limit the suitability for conventional OWTS. DNREC considers applications for I/A/E system use in the state on a case-by-case basis from manufacturers. Applications for I/A/E systems must provide documentation of the capabilities of the proposed system; this can include long-term usage data or short-term documentation from controlled projects from reliable sources such as Universities or the National Sanitation Foundation International. Alternative treatment units with flows <2,500 gpd must meet treatment levels prescribed for PSN3.[74]

Sites may be considered for I/A/E system permits where soils, climate, groundwater, or topographical conditions are indicating the seasonal high-water table, or a limiting condition encountered deeper than ten inches below the soil surface or observation well data determines the seasonal high-water table is deeper than ten inches.[74]

There are no long-term or post-installation monitoring requirements by DNREC to ensure I/A OWTS effluent is meeting nitrogen standards. When performance standards have not been achieved on an annual average basis after the appropriate system start-up period, as defined in the regulations and/or applicable on-site system permit, those persons may qualify to participate in a nutrient offset program subject to review and approval by the Department on a site-specific basis (J. Baumgartner, personal communication, July 5, 2019). A list of approved alternative systems can be found on the DNRC website.[82]

3.7 Conversion Method and Timeline

A cesspool or seepage pit must be replaced within one year of identification through a real estate inspection or investigation by DNREC. A failed cesspool is defined as the existence of cesspool or seepage pit. Delaware does not evaluate the condition or assess whether a

system is functioned to determine if a cesspool or seepage pit classifies as failing (J. Baumgartner, personal communication, July 5, 2019). There are no other defined timelines regarding the replace of cesspools or outdated OWTS.[74]

3.8 Funding Mechanisms

A Community Septic System Outreach Program was developed as a partnership between the Community Action Agency and the Delaware Environmental Finance Office.[83] It exists to identify low- and moderate-income homeowners in the Chesapeake and Inland Bay Watersheds that may need financial assistance to replace failed and/or failing OWTS.

Two main financial mechanisms exist for individual homeowners. The first is the Septic Rehabilitation Loan Program (SRLP) to replace failing OWTS or cesspools with new OWTS or help with sewer hookups.[84] Financing is available at interest rates of three or six percent, depending on income.[85] A loan of $1,000 (minimum) to $35,000 (maximum) for individual systems and $250,000 (maximum for community or mobile home park systems) can be repaid over 20 years with no prepayment penalty. There is a non-refundable fee of $11 for individual and $15 for a joint credit history report. Loans are secured by a mortgage lien on the rehabilitated property. The SRLP is managed by Environmental Finance with technical assistance from the Ground Water Discharges Branch. Eligible costs for OWTS include site evaluation, septic system design, permits, construction costs, and closing and recording charges. Eligible costs for central sewer projects include impact fees, connection fees, permit costs, electrical, and abandonment of septic systems.[83,84]

The second program uses a Non-Federal Administrative Account (NFAA), which funds the Septic System Extended Funding Option Program (SEFO). Loans under the SEFO program become due and payable upon property transfer. Applicants must first be denied for an SRLP loan (due to insufficient income, credit problems, liens and/or judgments, etc.) before being considered for an SEFO loan.[83]

Elderly deferral or tax betterment mechanisms were not discovered while researching financial programs for OWTS upgrades within the state of Delaware.

3.9 Final Analysis/Application

- In 2014, Delaware began requiring inspections of all OWTS prior to property transfer. New inspection protocols for OWTS contractors and inspectors were also created.
- In 2015, all cesspools were prohibited and when discovered and must be replaced within one year. The state also required upgrades to all new and replacement systems within 1,000 feet of tidal portions of the Nanticoke River and Broad Creek,

assisting Delaware in meeting federal targets to clean up the Chesapeake Bay Watershed.

- Delaware established statewide performance standards for all I/A/E systems and requiring waste haulers to report septic tank pump-outs mandated at every three years for conventional systems, and greater frequencies for I/A/E systems.
- Delaware created a program for the licensing of many types of wastewater professionals. All applicants are required to pass an examination prepared and administered by DNREC to test competency and knowledge.
- All I/A/E systems have strict operation and maintenance requirements. For new construction, and prior to DNREC granting a COC, the owner must enter into a service contract with a certified service provider, for a minimum of two years when the OWTS becomes functional (unless certified by the homeowner training program).
- Delaware created the HTP, which allows homeowners to maintain their own I/A/E system, once certified. To become certified, a service provider is required to meet with the homeowner during the first sixth-month inspection to educate the homeowner on the components of the system and the proper operation and maintenance requirements.
- Connection to a central wastewater system is required when available, and the existing OWTS must be abandoned.
- All new and replacement systems permitted within 1,000 feet of the Chesapeake Bay tidal waters must meet the performance standards for nitrogen and phosphorus.
- There are no long-term or post-installation monitoring requirements by DNREC to ensure I/A OWTS effluent is meeting nitrogen standards.
- Two main financial mechanisms exist for individual homeowners. The first is the SRLP to replace failing OWTS or cesspools with new OWTS or help with sewer hookup. Financing is available at interest rates of three or six percent depending on income.

4. Massachusetts

Massachusetts is a state in New England bordered by New York to the west, Connecticut, Rhode Island, and the Atlantic Ocean to the south, Vermont and New Hampshire to the north, and the Atlantic Ocean to the east. Massachusetts has 1,519 miles of coastline.[69] The United States Census Bureau estimates the population to be 6,902,149 as of 2018.[86] The 2017 population density is 871 people per square mile, with the total land area covering 7,840 square miles.[87,88] Massachusetts has a typically humid continental climate, with warm summers and cold, snowy winters. Some eastern parts of the state have a humid subtropical climate, characterized by hot and humid summers and cool to mild winters.

4.1 Regulation Overview

Title 5 is the state's main mechanism governing OWTS and was created in 1995 to provide protection of public health, safety, welfare, and the environment by regulating the proper siting, construction, and maintenance of OWTS.[89] Title 5 requires inspections of OWTS prior to property transfer or dwelling enlargement. If an OWTS fails an inspection, they must be repaired or replaced within two years. In 1996, the law also required a soil evaluation test to be performed by a Massachusetts Department of Environmental Protection (MassDEP) approved soil evaluator. Title 5 is the minimum code, and a Local Board of Health (LBH) may create more stringent and optimal ordinances concerning OWTS in their area and environmental needs.[90] Additional information about Title 5 policies and guidance can be found on the MassDEP website.[89,91]

4.2 Regulation Requirements/Enforcement

Title 5 is implemented and enforced by an LBH with oversight and assistance by the MassDEP. The approval of any OWTS, including the issuance of permits, approvals, and COC, will be handled by the LBH. An LBH may enforce Title 5 in the same way local health rules and regulations are enforced. More stringent regulations can be added by an LBH or county to protect public health, safety, welfare, and the environment (B. Dudley, personal communication, April 12, 2019).[89] If an LBH fails to enforce Title 5 regulations within a reasonable time, MassDEP may act to bring the LBH into compliance. The MassDEP will be the responsible agent charged with approval and enforcement systems owned or operated by an agency of the Commonwealth or of the federal government.[89,91]

Each OWTS system will obtain a COC. Before a COC is issued, system designers file an electronic registration for the system. The OWTS installer and the designer will certify that the system has been constructed in compliance with Title 5. The LBH may inspect the OWTS to determine that the work has been completed in compliance with the requirements of Title 5.[89]

Massachusetts implemented a new professional position and permit when updating Title 5. The soil evaluator position was created to enhance the review and approval of proposed systems by ensuring that appropriate expertise in soil identification, groundwater hydrology, and topography was involved in the OWTS process. The Disposal Systems Installer Permit was created to ensure installers demonstrate knowledge of and experience with the proper construction and installation of systems in accordance with Title 5 (B. Dudley, personal communication, April 12, 2019).[89]

Fines and penalties may be issued to those who fail to comply with orders issued by MassDEP or an LBH regarding Title 5 regulations. Enforcement actions may consist of non-

compliance letters, non-compliance orders, or an imminent threat order. When a homeowner is issued a non-compliance letter, a request is made for the owner to take corrective actions necessary to come into compliance with Title 5. The letter is not an order and is not appealable. When a homeowner is issued a non-compliance order**,** the owner of an OWTS, inspector, system installer, designers, or soil evaluator is required to come into compliance with the provisions of Title 5, or to take any other action necessary to protect public health, safety, welfare or the environment. If an order is issued by a local authority, the order may be appealed in court. If issued by MassDEP, an adjudicatory hearing would be afforded. An imminent threat order may be issued in the case of an imminent threat to public health, safety, welfare or the environment exists, the local Board of Health or MassDEP may issue an emergency, requiring that corrective action be taken as necessary.[89]

Title 5 has certain requirements for system inspections. The overall goal of system inspection is to provide enough information to decide as to whether the system is adequate to protect public health and the environment (B. Dudley, personal communication, April 12, 2019). Inspections are performed by Massachusetts Registered Professional Engineers, Massachusetts Registered Sanitarians, Massachusetts Certified Health Officers, individuals certified as on-site inspectors by the NSF, or other approved certifying organizations. OWTS failing to protect public health or the environment must be repaired, replaced, or upgraded. An inspection document whether the system has been continually operated as approved, if the system consists of a greywater filter, whether it is operating properly, and whether compost and blackwater are disposed of off-site in accordance with all applicable laws and regulations. MassDEP or other state agencies do not regulate OWTS inspection fees.[89]

If an OWTS passes inspection, documents are submitted to the LBH within 30 days, and the homeowner must provide a copy to the buyer if a real estate transfer is taking place. Lending institutions may also require a copy of the inspection. If an OWTS fails inspection, documents are submitted to the LBH within 30 days and the system must be repaired or upgraded within two years, regardless if the property is sold. The LBH maintains records for each OWTS within its jurisdiction.[89]

Title 5 requires that all OWTS must be inspected at or within two years prior to the time of transfer of title, Title 5 requires all advanced OWTS (or those with increased flow rates) be inspected on an annual basis. An inspection conducted up to three years before the time of transfer may be used if the inspection report is accompanied by system pumping records demonstrating that the system has been pumped at least once a year during that time. For full inspection requirements, see page 65 of Title 5.[89]

Inspections are not required when an LBH has issued a COC within two years before the time of transfer of title or when the community has adopted a comprehensive plan approved by MassDEP requiring periodic inspections. Inspections are also exempt when the

homeowner has entered into an enforceable agreement, binding on subsequent buyers, or when an LBH requires a connection to the municipal sewer system within two years of transfer or sale. Additional Title 5 inspection exemptions were passed in 2004 and are not required if the transfer is of residential property and is between current spouses; parents and their children; between full siblings; and where the grantor transfers the real property to be held in a revocable or irrevocable trust, where at least one of the designated beneficiaries is of the first degree of relationship to the grantor.[89,92]

Title 5 provides guidance for OWTS pumping and maintenance. Every conventional OWTS or cesspool is recommended to be pumped whenever necessary to ensure the proper functioning of the system. At a minimum, conventional OWTS are recommended to be pumped every three years. Pumping is required whenever the top of the sludge or solids layer is within twelve inches of the bottom of the outlet tee, or the top of the scum layer is within two inches of the top of the outlet tee, or the bottom of the scum layer is within two inches of the bottom of the outlet tee. I/A/E system pumping and maintenance requirements are discussed in Section 4.6.2.[89] MassDEP, in collaboration with other institutions, has produced educational materials to the public describing the importance of proper maintenance and operation of OWTS and the impact of systems on public health and the environment (B. Dudley, personal communication, April 12, 2019).[89,93]

4.3 Methods to Determine Priority Conversion Areas

Massachusetts did not research specific science-based methods to determine what cesspools or conventional OWTS would be prioritized for upgrade. When the state originally developed the real estate transfer inspections, the method was controversial, with some concessions made to ensure statewide passage (B. Dudley, personal communication, April 12, 2019). Many communities in environmentally sensitive areas, however, did institute more stringent local standards (including setbacks) that targeted cesspools and OWTS nitrogen pollution. Massachusetts has a strong tradition of local control, and Title 5 allows for the adoption of more stringent local standards as needed (B. Dudley, personal communication, April 12, 2019).

Nitrogen loading limitations were part of Title 5 regulations. New construction of OWTS in nitrogen sensitive areas must be designed to discharge no more than 440 gallons of design flow per day per acre unless the system can meet effluent standards of 10 mg/L of nitrogen. Systems using recirculating sand filters must not discharge more than 25 mg/L of nitrogen in wastewater effluent (B. Dudley, personal communication, April 12, 2019).[89]

In areas where the use of both OWTS and private drinking water supply well is proposed, systems must be designed to receive no more than 440 gallons of design flow per day per acre from residential uses unless property owners are participating in the Aggregate Flows

Rule or Enhanced Nitrogen Removal method, which are discussed later in this chapter. Owners of OWTS must also ascertain whether the system to be constructed will be within a nitrogen sensitive area (definition below). MassDEP will publish locations of nitrogen sensitive areas accessible to the public via maps (B. Dudley, personal communication, April 12, 2019).[89]

MassDEP has determined specific geographic areas listed below to be particularly sensitive to the discharge of pollutants from OWTS. These areas will be required to have increased treatment of pollutants and reduction in effluent nutrients discharged from OWTS to protect water resources. OWTS in Zone I of a public water supply well are prohibited.[89]

- Interim Wellhead Protection Areas and Department approved Zone IIs of public water supplies;
- Nitrogen sensitive embayments or other areas that are designated as nitrogen sensitive. These areas will be mapped based on scientific evaluations of the affected water body and adopted through parallel public processes in relation to Title 5 and the Massachusetts Water Quality Standards.

4.4 Methods to Identify Impaired Waters

Title 5 applies to all OWTS statewide and did not include specific methods to identify impaired waters in conjunction with the OWTS regulations. However, there are other programs within the MassDEP that do identify impaired waters (B. Dudley, personal communication, April 12, 2019). Development of the Integrated List of Impaired Waters under Section 303d of the Federal Clean Water Act (CWA) is the state's primary mechanism.[94] In southeastern Massachusetts, the state has also developed the Massachusetts Estuaries Project to evaluate the level of impairment in coastal ecosystems.[95]

4.5 Nutrient Reduction Science

Combined efforts by local communities, county, state, and the Massachusetts Estuaries Project have identified many of the causes of nitrogen pollution and the degree of impairment in coastal water bodies and groundwater (B. Dudley, personal communication, April 12, 2019).[95]

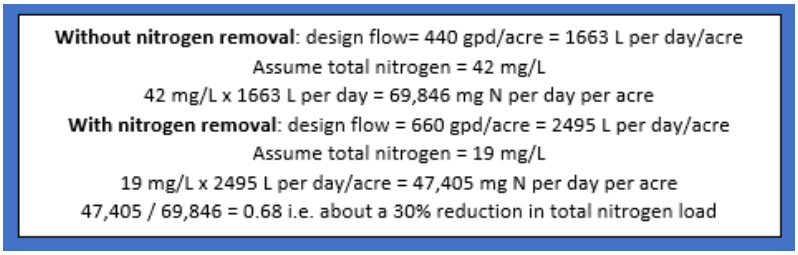
An update to the original 1978 Water Quality Management Plan for Cape Cod was made in 2015 to develop an integrated water and wastewater management to remediate groundwater and surface water impairments.[96] This plan reevaluates sources of nutrient pollution, regulations, models used to evaluate nitrogen, impacts to waterbodies, and solutions needed. The updated plan recommends actions to streamline the regulatory

process, provide transparent processes for citizens, reduce community costs to waters already impacted by nitrogen, increase financial support mechanisms, and provide more support to local water quality efforts.[96]

Massachusetts' regulations and calculations for total nitrogen discharge concentrations of all I/A/E system effluent were created not to exceed 19 mg/L. Achieving this concentration, at the point where the system discharges to the soil absorption system, assumes that approximately fifty percent of the total nitrogen is removed from the influent wastewater of I/A/E systems compared to conventional OWTS nitrogen concentrations estimated at 38 mg/L. This performance level was based upon the best available technology (BAT) at the time the Title 5 OWTS rules were being created (B. Dudley, personal communication, April 12, 2019).[89] It should be noted that new technologies can achieve seventy-five percent or more nitrogen concertation reductions.[97] Performance evaluations were performed, and results were outlined in a report on I/A/E systems and web-based reporting in Barnstable County between 1999–2007. It found that systems that were properly maintained removed nitrogen at rates closer to the manufacturer specifications.[98]

Title 5 set new OWTS standard flow rates of 440 gpd per acre (40,000 sq. ft); this roughly translates to 110 gpd for each bedroom. The state used a rudimentary mass balance equation considering nitrogen concentrations of conventional septic effluent of roughly 35 mg/L and applied a groundwater recharge rate of 18 inches per year. The result equates to about 10 mg/L of nitrogen at the property line with adequate mixing assumed in the aquifer (B. Dudley, personal communication, April 12, 2019).[89]

Enhanced treatment allows an increase in acceptable flow rates, increasing the effluent flow rate to 550 gpd per acre. This would allow a homeowner to place a dwelling with more bedrooms on a smaller property footprint. Additionally, a homeowner may participate in the Aggregate Determinations of Flows Program if they own land to offset nitrogen loadings (detailed in Section 4.6) (B. Dudley, personal communication, April 12, 2019).[89]
Figure 3 shows an example of mass nitrogen loading (mg/acre/day) for a system with and without a nitrogen removal system capable of fifty-five percent nitrogen reduction.[99]



Note: Reprinted with permission from Barnstable County Health Department.

Figure 3. Example of mass nitrogen loading calculation.

4.6 Conversion Technologies/Future Technology Approval

Every OWTS must be designed by a Massachusetts Registered Professional Engineer or a Massachusetts Registered Sanitarian. Any other agent of the owner may prepare plans for the repair of one or more components, excluding the soil absorption system, of an OWTS designed to discharge less than 2,000 gpd provided the repair plans are reviewed and stamped by a Massachusetts Registered Sanitarian or Massachusetts Registered Professional Engineer and approved by the LBH.[89]

If an OWTS cannot meet the 440 gpd per acre nitrogen loading limitation and the landowner is not using an I/A/E system, a landowner can meet the correct loadings by using eligible Nitrogen Credit Land. This program is listed within Title 5 under Aggregate Determinations of Flows and Nitrogen Loadings.[100] Essentially, if a property owner has a lot that cannot meet OWTS nitrogen effluent requirements, the owner may use other property to achieve the gap. OWTS must be located within a community or region covered by an approved Community Aggregation Plan (CAP) that is approved by MassDEP. Other applicants, not in a CAP, seeking an aggregate determination of flows and nitrogen loading must prepare a Facility Aggregation Plan to be eligible.[89,100]

To qualify as Nitrogen Credit Land under Title 5, the land must be within the same Nitrogen Sensitive Area as the system. Credit land may not have any human-made sources of nitrogen, including, but not limited to wastewater discharges and nitrogen-based fertilizer. Land cannot be used for raising, breeding, or keeping of animals. Land must be pervious and be outside of Zone A's, Velocity Zones, and Regulatory Floodways. Land cannot be covered by any surface water body; including a river, stream, lake, pond, or ocean. Land located within a Zone I of a public water supply well may be used as Nitrogen Credit Land unless the well is determined to be at risk in accordance with the MassDEP guidelines or the proposed design flow is 2,000 gpd or greater.[89,100]

A CAP allows a city or town to seek approval for aggregate determination of flows and nitrogen loading across a region-wide area, including a Zone II of a public water supply well. Site-specific facility aggregation plans may exist within an approved CAP.[89,100]

The following conditions must be met for a CAP to be approved by MassDEP[89]:

- The plan contains a mechanism to protect surface and groundwater supplies within the community or region from pollutant and nitrogen loading and a proposed mechanism for implementing the Plan;
- The plan meets the criteria in MassDEP's Guidelines for Title 5 Aggregation of Flows and Nitrogen Loading;
- For areas that include a Zone II, the plan includes a nitrate loading analysis and nitrate management plan; and

- Any other conditions that MassDEP deems appropriate.

4.6.1 Conventional System Conversion Methods

If a community sewer is available, an OWTS must be abandoned, except in certain circumstances and when promoting recharge of stressed basins, improving low streamflow, or addressing other local water resource needs. An owner is not required to connect to a sewer if an OWTS is an I/A/E system, and the LBH has determined I/A/E systems do not need to connect to community sewer or a variance from the requirement is obtained from an LBH. More information can be found in the MassDEP Title 5 of the State Environmental Code (section 15.004: Applicability) regulations.[89]

Conventional OWTS are allowed under Title 5 regulations unless an I/A/E system is required in Interim Wellhead Protection Areas, Zone II of public water supplies, or nitrogen sensitive embayments. Title 5 allows for the use of shared systems for new construction and existing systems with increases in flows for both conventional and I/A/E systems. New construction that exceeds the 10,000 gpd flow limit exceeds Title 5 regulations and would require a groundwater discharge permit and appropriate treatment plant (B. Dudley, personal communication, April 12, 2019).[89]

Septic tanks for a single-family dwelling must have a design flow of fewer than 1,000 gpd and a minimum effective liquid capacity of two-hundred percent of the design flow or a minimum hydraulic detention flow of 48 hours, whichever is greater. If the septic tank will serve facilities other than a single-family dwelling unit or the calculated design flow is 1,000 gpd or greater, a two-compartment tank or two tanks in series are required. If a garbage grinder is installed, the minimum liquid capacity of the septic tank must be two hundred percent of the design flow with a minimum tank size of 1,500 gallons. Garbage grinders are prohibited in facilities that include an elevated septic tank. Minimum depth above the high groundwater tables for conventional OWTS is four feet in soils with a percolation rate of more than two minutes per inch and five feet in soils with a percolation rate of two minutes or less per inch.[89]

4.6.2 Advanced Nitrogen Removal Methods

I/A/E systems under Massachusetts law may include humus or other composting toilets; mounded systems designed to overcome limiting site conditions; any system designed to chemically or mechanically aerate, filter, separate or pump the liquid, semi-solid or solid constituents in the system; or any system designed specifically to reduce, convert, or remove nitrogenous compounds, phosphorus, or pathogenic organisms (including bacteria and viruses) by biological, chemical, or physical means. I/A/E systems may include substitutes or alternatives for one or more components of a conventional system or may be

fundamentally different approaches intended to eliminate the need for a conventional system.[89]

Humus and composting toilets are approved for general use, assuming there is no liquid waste discharge from the toilet. If the toilet produces a liquid by-product that is not recycled through the toilet, the liquid by-product must be either discharged through a greywater system on the facility that includes a septic tank and leaching system or removed by a licensed septage hauler. Any other disposal of a liquid by-product requires specific approval by the MassDEP. More information on alternative disposal methods can be found within the text of Title 5, page 58.[89]

MassDEP or an LBH may issue a Remedial Use Permit for the rapid approval of an alternative system that is likely to improve existing conditions at a facility or facilities currently served by a failed, failing, or nonconforming system.[89]

Massachusetts has a well-developed system to evaluate and approve new I/A OWTS technologies that appear technically capable of providing levels of protection at least equivalent to those of conventional OWTS. These approvals will be used to determine whether, under field conditions in Massachusetts, the general use of the alternative system will provide environmental protection; and to determine whether any additional conditions addressing long-term operation, maintenance, and monitoring considerations are necessary.[89]

I/A/E systems have different requirements for the provisional standards. General use approval is granted after completing the pilot and provisional stages. The specific stages are detailed below[89]:

- Pilot stage: Intended to provide a field-testing and technical demonstration to determine if the technology can or cannot function effectively. Can install up to fifteen systems and meet required monitoring for eighteen months, with twelve months of results where seventy percent of systems meet your stated nitrogen criteria.
- Provisional use: Approval is intended for the evaluation of alternative systems that appear technically capable of providing levels of protection at least equivalent to those of a standard on-site disposal system. Allows the installation of up to fifty systems (35 more from the 15 in the pilot stage). Monitoring must continue for an additional three years, and if ninety percent meet standards manufacturer is awarded a General use permit.
- General use: Systems will provide a level of environmental protection at least equivalent to that of a conventional on-site system designed in accordance with Title 5 and requires service contract and monitoring to be paid by the owner.

- Remedial use: Systems to improve existing conditions at a facility served by a failed, failing, or nonconforming system.

The Massachusetts Alternative Septic System Test Center (MASSTC) was developed to address impacts to coastal environments from nitrogen.[101] Barnstable County Department of Health and Environment, in conjunction with the Massachusetts Coastal Zone Management through the Buzzards Bay Project, created MASSTC. In 1999, the center began testing I/A technologies. Working with the EPA and NSF of Ann Arbor (Michigan), MASSTC conducted a refined nutrient testing protocol in 2002, referred to as the Environmental Technology Verification (ETV). Further refinement of the nutrient standards was completed in 2007 by the NSF and resulted in the NSF 245 Standard.[101]

Barnstable County leads the state in innovative technologies and policies regarding I/A/E system data management (E.-M. Olmstead, personal communication, July 3, 2019). The county requires that homeowners with I/A/E systems monitor nitrogen concentrations (through self-reporting by O&M personnel) to ensure systems are performing to their stated capabilities by manufactures and legal requirements. This standard goes beyond simply requiring systems to be pumped and allows for more robust maintenance with timely tweaks and updates to ensure systems are performing appropriately, fix problems earlier, and track the amount of nitrogen that I/A/E systems are releasing. Regulatory and enforcement authority over OWTS remains at the local level (typically the board of health).[102]

The Barnstable County OWTS Tracking program provides system compliance monitoring services to fourteen towns in the County via an online database.[102] The program was originally funded with a 604b grant to assist with water quality assessment and management planning.[103] The I/A/E system database allows system operators (state-licensed wastewater treatment operators who are contracted by homeowners for system maintenance) to submit maintenance and sampling reports online. Many parameters of an I/A/E system performance can be tracked through the system. Data points range from parameters such as total nitrogen in the effluent to influent biochemical oxygen demand and water meter readings (E.-M. Olmstead, personal communication, July 3, 2019).[102] Using a large collection of data from its tracking system, Barnstable County was able to establish the optimum number of I/A/E systems and the number of samples needed from each system to provide enough data to evaluate the performance of new nitrogen-reducing technology. Suffolk County (New York) subsequently adopted these rules for their program (C. Clapp, personal communication, June 27, 2019). I/A/E system owners in towns that participate are billed a user fee to fund administrative costs; this fee is collected by operations and maintenance company contracts. Conventional OWTS are not required to monitor nitrogen effluent. Since the results are self-reported, there are challenges to

ensuring validation and timeliness of test results (E.-M. Olmstead, personal communication, July 3, 2019).[102]

A list of approved I/A/E systems, as of May 14, 2019, can be found on the MassDEP website.[104]

A website tutorial and self-paced learning module, maintained by Barnstable County, was created to assist LBH members with their understanding of Title 5. The module was developed under a grant from the Federal 319(b) Program, administered by the MassDEP.[99]

4.7 Conversion Method and Timeline

Title 5 mandates that a failing OWTS or cesspool must be upgraded within two years of discovery unless a shorter period is set by the LBH or the MassDEP determines the existence of an imminent health hazard. Continued use of the OWTS is permitted by the LBH with proper approvals. OWTS may be used if future proposals to connect to a sanitary sewer or shared system are in place with a financial commitment to a sewer plan or shared system plan, proposing connection or replacement of the failing system within five years, and an enforceable commitment by the owner to perform interim measures (for example, regular pumping) for approval.[89]

A failed cesspool definition falls under two categories[89]:

- A cesspool or privy is located within one-hundred feet of a surface water supply or tributary to a surface water supply, within a Zone I of a public well, within fifty feet of a private water supply wells, and less than one-hundred feet but fifty feet or more from a private water supply well. (Unless a well water analysis indicates an absence of fecal coliform bacteria and the presence of ammonia nitrogen and nitrate nitrogen is equal to or less than 5 ppm).
- A cesspool or privy is within fifty feet of surface waters or within fifty feet of a bordering vegetated wetland or a salt marsh and the LBH, in its professional judgment, determines the system is not functioning in a manner to protect the public health and safety, welfare and the environment.

In determining a failing system, the LBH will consider[89]:

- the condition, design, and treatment provided by the existing system;
- the vertical separation of the existing soil absorption system from groundwater;
- the horizontal separation of the existing soil absorption system from the water body;
- the soil characteristics of the site; and

- the condition of the water body or wetland, including any sensitive use areas such as beaches or shellfish beds.

Failing conditions applicable to all OWTS[89]:

- there is a backup of sewage into the facility served by the system or any component of the system due to overloaded and/or clogged soil absorption system or cesspool;
- discharge of effluent directly or indirectly to the surface of the ground through ponding, surface breakout or damp soils above the disposal area, or to surface water;
- the static liquid level in the distribution box is above the level of the outlet invert;
- the liquid depth in a cesspool is less than six inches from the inlet pipe invert or the remaining available volume within a cesspool above the liquid depth is less than half of one day's design flow;
- the septic tank or cesspool requires pumping more than four times a year;
- the septic tank and/or the tight tank is made of metal, or the septic tank and/or the tight tank is cracked or is otherwise structurally unsound, indicating that substantial infiltration or exfiltration is occurring or is imminent; or
- a cesspool, privy, or any portion of the soil absorption system extends below the high groundwater elevation.

4.8 Funding Mechanisms

The Massachusetts legislature passed a Title 5 tax credit that provides eligible homeowners with a tax credit equal to forty percent of the design and construction costs incurred to upgrade or repair a septic system (B. Dudley, Personal Communication, April 12, 2019). The tax credit relief measure provides credits against personal income tax imposed up to $1,500 per year for qualified homeowners with a maximum credit of $6,000 over four years. This tax credit is available for all septic system and cesspool upgrade and repairs that occurred on or after January 1, 1997. More information about Personal Income Tax Credit for Failed Cesspool or Septic System Title 5 Expenditures can be found on the MassDEP website.[105]

Additional financial assistance is available in the form of low-interest loans through the Massachusetts Housing Finance Agency (MHFA) and the Rural Economic Development Service Loan program. The MassDEP allocated $13 million for financing septic loan repairs. MassDEP has contracted with MHFA to implement and administer the Home Septic Repair Loan Program (HSRLP).[106] The HSRLP is available to owners of owner-occupied 1–4 family properties and condominium associations with failed septic or cesspool systems. To encourage lender participation, the Commonwealth will provide a $500 per-loan origination fee to lenders. Loans are backed by mortgage security.[107]

Loan size may range from $1,000 to $25,000 (Table 4). The minimum monthly payment must equal $27. Loans are fully amortizing at an interest rate of zero, three, or five percent depending on household income. All loans are due in full upon sale, transfer, or refinancing of the first mortgage. Refinancing of the first mortgage will require payoff of the Septic Repair Loan.[108]

In addition, eligible municipalities can make low-interest 20-year loans to low-to-moderate income homeowners, repaid by adding an annual betterment to their tax bill, called the Betterment Fund Program.[109] Betterment Loans can only be made after a community has adopted an inspection or management plan and been awarded monies from the state. A Betterment Agreement between the community and a homeowner may be used for all costs necessary to repair or replace a failed septic system, including renovating the existing system, hooking-up to existing sewer lines, or replacing traditional septic systems with an approved Title 5 alternative system.[109]

Table 4. Maximum loan terms for septic system and cesspool upgrade and repairs.

Years	Range ($)
3	1,000 – 3,000
5	3,001 – 5,000
10	5,001 – 10,000
15	10,001 – 15,000
20	15,001 – 25,000

Note: Reprinted with permission from MassDEP. Loans to borrowers qualified for 0% interest with debt-to-income ratios greater than 50% will be eligible for a 0% non-amortizing loan. These loans are due in full upon sale, transfer, or refinancing of the first mortgage. Very low-income households with considerable equity may also qualify for a deferred loan on a case-by-case basis.

The Community Septic Management Program (CSMP) offers loans to communities to develop OWTS management plans.[110] The CSMP was developed in collaboration with the MassDEP, the Executive Office of Administration and Finance, the Office of the State Treasurer, and the Department of Revenue.[111] Initial funding was provided by the 1996 Open Space Bond Bill that authorized MassDEP to spend $30 million dollars on funding loans. The CSMP provides funding of up to $200,000 in the form of low-cost loans to allow communities to devise a Community Inspection Plan (CIP) or a Local Septic Management Plan (LSMP). Each plan must include provisions for financial assistance to homeowners using Betterment Agreements.[110,111]

A CIP is designed to protect environmentally sensitive areas from contamination from OWTS. Inspections are performed every seven years. CIPs relieve property owners covered

under the plan from their obligation to have their OWTS inspected upon ownership transfer. More details about CIPs can be found on the MassDEP website.[110]

An LSMP identifies, monitors, and addresses proper operation, maintenance, and upgrade of OWTS in a comprehensive manner. Plans must include identification and prioritization of areas containing systems that warrant more regular monitoring and maintenance and/or upgrade. LSMPs also include the development of a database system for tracking the inspection of OWTS. The database must also track whether failed systems are being upgraded in accordance with timelines outlined in Title 5. Finally, LSMPs require a schedule for periodic pumping and other routine maintenance of systems covered by the program.[110]

Some towns have developed additional financial programs. Gloucester (Massachusetts) developed an Elderly Deferral Program.[112] Loan payments may be able to be deferred if applicants are over age 65, have a gross income in the previous year that did not exceed $30,000, have lived in Massachusetts for the past ten years, and the applicant has owned and occupied the home for the last five years. A new deferral agreement must be filed each year with the LBH. The entire amount of the deferral, plus interest of eight percent, and recording fees is due and payable upon death, sale, or transfer of title.[112]

4.9 Final Analysis/Application

- Title 5 requires inspections of OWTS prior to property transfer or dwelling enlargement.
- Title 5 mandates that a failing OWTS or cesspool must be upgraded within two years of discovery unless the LBH sets a shorter period or the MassDEP determines the existence of an imminent health hazard.
- Title 5 set new OWTS standard flow rates of 440 gpd per acre (40,000 sq. ft), roughly translating to 110 gpd for each bedroom.
- Massachusetts regulations and calculations for total nitrogen discharge concentrations of all I/A/E system effluent was created not to exceed 19 mg/L. This performance level was based upon the BAT at the time the Title 5 OWTS rules were being created.
- Towns can create more stringent OWTS regulations to protect public health, safety, welfare, and the environment.
- An I/A/E system is required in an Interim Wellhead Protection Areas, Zone II of public water supplies, or nitrogen sensitive embayments.
- If an OWTS cannot meet the 440 gpd per acre nitrogen loading limitation and the landowner is not using an I/A/E system, a landowner can meet the correct loadings by using eligible Nitrogen Credit Land.

- Massachusetts has a well-developed system to evaluate and approve new I/A OWTS technologies. Approvals will be used to determine whether, under field conditions in Massachusetts, the general use of the alternative system will provide environmental protection, and to determine whether any additional conditions addressing long-term operation, maintenance and monitoring considerations are necessary.
- The MASSTC was developed to address impacts to coastal environments from nitrogen by testing new and innovative OWTS technologies.
- Barnstable County created an I/A OWTS database that allows system operators (state-licensed wastewater treatment operators who are contracted by homeowners for system maintenance) to submit maintenance and sampling reports online.
- Massachusetts passed a Title 5 tax credit that provides eligible homeowners with tax relief. The tax credit relief measure provides credits against personal income tax imposed up to $1,500 per year for qualified homeowners with a maximum credit of $6,000 over four years.
- In addition, eligible municipalities can make low-interest 20-year loans to low-to-moderate income homeowners, repaid by adding an annual betterment to their tax bill, called the Betterment Fund Program.
- The MassDEP allocated $13 million for financing septic loan repairs. MassDEP has contracted with MHFA to implement and administer the HSRLP.
- Some towns have developed additional financial programs. Gloucester, Massachusetts developed an Elderly Deferral Program.

5. Maryland

Maryland is a state in the Mid-Atlantic region bordered by West Virginia to the west, Virginia to the south, Pennsylvania to the north, and Delaware to the east. Maryland has 3,190 miles of coastline.[69] The United States Census Bureau estimates the population to be 6,042,718 as of 2018.[113] The population density is 594 people per square mile, with the total land area covering 7,141 square miles.[114,115] Maryland has a range of climates from humid subtropical to humid continental.

This chapter will briefly cover Maryland's OWTS regulations and programs with a specific focus on the Chesapeake Bay Restoration Fund (CBRF), the Chesapeake Bay Critical Areas, and Maryland's requirements for BAT (also known as I/A/E systems). An extensive review of the state's onsite wastewater program was deemed to be unfitting due to an insufficient number of cesspools within the state.

5.1 Regulation Overview

The Chesapeake Bay has experienced a decline in water quality over many years due to the over-enrichment of nutrients, including nitrogen. In 2004, Maryland Senate Bill 320 was passed to create the Bay Restoration Fund (BRF) as a method to fund and upgrade OWTS and wastewater treatment plants to remove nitrogen in wastewater effluent.[116,117] There are approximately 420,000 OWTS in Maryland.[118] According to state documents, Maryland has a goal of reducing nitrogen loading in the Chesapeake Bay by over 7.5 million pounds of nitrogen per year.[119] The BRF included the creation of an Advisory Committee with many duties, including the analysis of nutrient removal from wastewater facilities, advising on outreach and education, and providing recommendations to improve the efficiency of programs.[120] In 2012, Maryland's House Bill 446 passed, effectively increasing the BRF fees, in addition to creating a financial hardship fee waiver.[121] The Maryland Department of the Environment updated Title 26 in 2013, its OWTS requirements, by requiring the installation of BAT in certain areas.[122] In 2017, The Clean Water Commerce Act (CWCA) passed, made up of Senate Bill 314 and House Bill 417, which allows the use of BRF by the state to include costs associated with the purchase of nitrogen loading reductions if they are determined to be cost-effective.[123,116,124] Essentially, this program allows the state to fund the outcomes of nutrient reduction projects rather than the project itself.

5.2 Regulation Requirements/Enforcement

Maryland's OWTS are regulated through 26.04.02 of Title 26 with permits administered by an LBH.[125] A list of LBH jurisdictions can be found on the Maryland Department of the Environment Onsite Systems website.[126]

I/A/E systems may be required by an LBH due to site or limiting conditions, even if outside a critical resource area (CRA) (T. Sterner, personal communication, June 14, 2019).[125]

Violations of Title 26.04.02 can result in a misdemeanor charge and fines of not less than $50 and not more than $100 for each offense.[125] Each day's failure to comply with any provision of these regulations is considered a separate violation. A court order to enforce regulations may be taken against those who violate the regulations.[125]

5.3 Methods to Determine Priority Conversion Areas

About six percent of Maryland's total nitrogen load to the Chesapeake Bay is from OWTS.[127] OWTS are projected to have a small increase in pollution loads on the Chesapeake Bay over time, reaching about seven percent by the year 2025, largely because a number of systems installed in the state exceed the number of existing OWTS upgraded.[127]

To prioritize areas to convert OWTS, Maryland has identified CRAs using geographic boundaries.[128] CRAs are classified as land within 1,000 feet of tidal waters and wetlands. It also includes the waters of the Chesapeake Bay, the Atlantic Coastal Bays, their tidal tributaries, and the lands underneath these tidal areas. It is estimated that 52,000 OWTS are located within CRAs.[118] These areas are priority areas to implement I/A technologies and assist with the Chesapeake Bay TMDL.[118]

In addition to CRAs, The BRF uses a priority list to address specific OWTS for conversion. The following list is arranged in order of importance, with the first being the most prioritized for upgrade and funding[118]:

- Failing OWTS in the Critical Areas
- Failing OWTS outside the Critical Areas
- Non-conforming OWTS in the Critical Areas
- Non-conforming OWTS outside the Critical Areas
- Other OWTS in the Critical Areas, including new construction
- Other OWTS outside the Critical Areas, including new construction

Maryland currently has no statutory definition for a failing OWTS.[129] Systems that are classified as failing can be subject to enforcement. A bill is currently being introduced in the state to address this issue (T. Sterner, personal communication, June 14, 2019).

5.4 Methods to Identify Impaired Waters

The Chesapeake Bay is the largest estuary in the United States.[130] In the late 1970s, Congress funded a five-year study to analyze the bay's rapid loss of wildlife and aquatic life (T. Sterner, personal communication, June 14, 2019).[131] The study identified excess nutrient pollution as the main source of degradation. The study led to the Chesapeake Bay Program as a method to restore the bay. Maryland, along with other Atlantic states, has implemented various programs attempting to address pollution in the Chesapeake Bay[131]. In spite of these efforts and due to a lack of results, the EPA in 2010 established the Chesapeake Bay Total Maximum Daily Load program.[132] Maryland is part of the Chesapeake Bay Program and has developed WIP that spells out detailed, specific steps to meet pollution reductions by 2025.[127]

According to Greg Bush of the Maryland Department of the Environment (personal communication, June 13, 2019), addressing nitrogen pollution from OWTS and implementing their conversion has been a challenge. If OWTS are only evaluated through the lens of nitrogen reduction, the cost-benefit of replacing OWTS is low (T. Sterner, personal communication, June 14, 2019). Other difficulties of replacing OWTS include the distribution of systems over large areas, private property interests, longer implementation horizons, and required engineering plans and approvals. Maryland is currently looking at

other metrics, such as groundwater protection and public health, to include in cost-benefit analyses of replacing OWTS in hopes of boosting the focus on replacing OWTS (T. Sterner, personal communication, June 14, 2019).

5.5 Nutrient Reduction Science

According to conversations with Travis Sterner of the Maryland Department of the Environment (personal communication, July 22, 2019), nutrient reduction science was based upon the ability of I/A/E systems to reduce the total nitrogen concentrations a minimum of fifty percent versus conventional OWTS. For a technology to be considered I/A, systems must reduce nitrogen concentrations to 30 mg/L or less. Many systems were able to achieve less than 30 mg/L of nitrogen concentrations based upon site conditions and soil abortion systems.[133] A fifty percent reduction assumes a total Kjeldahl Nitrogen amount of 60 mg/L, depending on the adsorption area behind the BAT more reduction of nitrogen may occur (T. Sterner, personal communication, July 22, 2019).

5.6 Conversion Technologies/Future Technology Approval

There are no specific requirements in the state regulations for OWTS owners to convert to sewer systems within connection boundaries (T. Sterner, personal communication, July 22, 2019). However, a county can expand a community sewer system requiring owners of OWTS within the connection zone to connect to the community sewer. From 2013 to 2017, all-new construction across the state required homeowners to install I/A/E systems. In 2017 the governor eliminated this requirement, currently only new construction within a CRA requires an I/A/E system be installed (T. Sterner, personal communication, July 22, 2019).

Maryland refers to I/A/E systems as BAT. The Maryland I/A/E system approval process has five different classifications.[134] An I/A/E system verification program approval flowchart, outlining BAT Class II technologies, was created in 2015 and is available on the Maryland Department of the Environment website.[135] Class I BAT systems are units that are approved under protocols identified by the State of Maryland and capable of reducing total nitrogen concentrations by fifty percent to 30 mg/L or less.[122] This standard is the least stringent of all states reviewed. I/A units currently on the approved list have successfully completed field verification testing. A list of approved I/A/E systems can be found on the Maryland Department of the Environment website.[136] The most efficient approved I/A/E system, reduced mean nitrogen concentrations of seventy-six percent over conventional OWTS. Units that are still under field verification are listed as BAT Class II and upon successful completion of the field, verification will become BAT Class I (T. Sterner, personal communication, July 22, 2019).

An OWTS owner must maintain and operate all new and existing I/A/E systems for the life of the system. The I/A/E system must be operated and maintained by an approved management entity, a certified service provider, or covered by a renewable operating permit. An I/A/E system must be inspected and have the necessary operation and maintenance performed at a minimum of once per year. Maryland also requires I/A/E systems to include a two-year operation and maintenance contract and a two-year warranty offered by the manufacturer. Prior to 2017, Class I BAT systems were required to have a five-year warranty and operations and maintenance contract. Because inspections must be performed by the system distributor's trained inspector, OWTS owners have limited choices to who performs the annual inspections (T. Sterner, personal communication, July 22, 2019).[122]

As of 2015, Delaware, Maryland, Pennsylvania, Virginia, and West Virginia have a Memorandum of Cooperation to share data developed to document the performance of I/A/E systems and nitrogen reduction methods.[118] It is the hope that the Memorandum of Cooperation aides in the simplification and time reduction of the OWTS approval processes, as well as reduce costs to residents and manufacturers.[118]

5.7 Conversion Method and Timeline

Research did not indicate that cesspools were a major issue in Maryland. However, the state did identify outdated and poorly functioning conventional OWTS as a contributor to pollution in the Chesapeake Bay. No specific timeline or number of required OWTS upgrades was listed in updated legislation on the issue (T. Sterner, personal communication, July 22, 2019). The replacement process is driven by available funds in the BRF and Watershed Implementation Plans for each county. The goal is to incentivize people to convert early and take advantage of the funds before they are exhausted. The Maryland Department of the Environment has upgraded over 12,000 conventional OWTS by either connecting them to a public sewer installing an I/A/E system through the Bay Restoration Fund.[118] On average, approximately 1,200 OWTS annually are upgraded to I/A/E systems.[127] I/A/E systems are not required outside the Chesapeake Bay or Atlantic Coastal Bays Critical Areas; however, local regulations may require I/A/E systems to protect public health or water quality.[137] New construction or replacement OWTS within CRAs are required to use an I/A/E system.[137]

5.8 Funding Mechanisms

Maryland has established two novel funds to assist with covering OWTS and municipal wastewater treatment plant upgrades. As of 2012, all municipal sewer customers are charged a $5.00 monthly fee. The fee is deposited into an interest-earning fund, which municipal wastewater facilities discharging to the Chesapeake Bay who meets the criteria

specified by the BRF, have priority to available funding to upgrade treatment plants to tertiary levels (less than 4 mg/L of nitrogen) (T. Sterner, personal communication, July 22, 2019).[116] BRF funds can also be used to connect existing dwellings (served by OWTS) to sewer, where public sewer is available. Grants are limited to $20,000 per household and can be applied toward the capital facility, user connection, and master plumber's charges. Priority to grant funds will be given to properties located in CRAs, priority funding areas and those within existing or planned areas. The property owner is responsible for any costs more than the grant amount (T. Sterner, personal communication, July 22, 2019).[116]

The OWTS BRF charges a $60 annual fee collected from each user served by an OWTS. Sixty percent of these funds are used for septic system upgrades, and the remaining forty percent is used to support farmers planting cover crops. OWTS BRF funds can be used statewide, however, CRA areas have priority. OWTS BRF funds can only be used to purchase a Class I BAT unit, an effluent disposal system (low-income households only), or a holding tank if a proper onsite system cannot be installed. Money from the BRF cannot be used to install a conventional OWTS (T. Sterner, personal communication, July 22, 2019).[118]

The estimated annual program income from the OWTS fee is about $27 million.[118] Between 2016–2018, Maryland spent roughly $10.1 million annually for installing roughly 1,000 I/A/E systems.[127] Priority for OWTS BRF funds is given to failing OWTS in critical areas (T. Sterner, personal communication, July 22, 2019). Funds can cover upgrades to BAT for nitrogen removal or for the marginal cost of using the best BAT, instead of conventional technology. If an owner receives funding to upgrade to an I/A/E system, the state of Maryland obtains an easement to access the I/A/E system for testing and maintenance. Grant money can be used toward the cost of the upgrade, which includes five years of O&M. The amount of assistance (up to a hundred percent in some cases) is determined based on income guidelines (T. Sterner, personal communication, July 22, 2019).

Maryland also has a Water Quality Trading Program, which creates a public market for nutrient reductions, including nitrogen.[138] The program promotes OWTS upgrades as a mechanism for generating a credit to meet National Pollutant Discharge Elimination System permit requirements. This program is voluntary and was created to assist the state restore and protect the Chesapeake Bay by promoting nutrient removal technology and cost reductions. Because the program is relatively new, not all elements of this program have been implemented (T. Sterner, personal communication, July 22, 2019).[138] Each county has a specific total maximum daily load (TMDL) goals and can reach these goals by upgrading OWTS to BAT or expanding municipal sewer systems. If counties connect OWTS to sewer or expand sewer capacity, they can receive additional nitrogen credits on top of the TMDL reduction.[138]

Maryland has a Linked Deposit Program, which is designed to provide a source of low-interest financing for private landowners or water system owners to make improvements that will reduce nutrients to the Chesapeake Bay.[139] A Linked Deposit program describes the relationship between the below-market rate of an interest investment agreement provided to a lender by the Maryland Department of the Environment Water Quality Financing Administration and the below-market rate of interest loan that is passed on to the borrower to fund OWTS upgrades. The below-market interest rate loan provided to a borrower is "linked" to the below-market rate of interest investment WQFA makes with a participating lender.[139]

Any financial institution that meets the following lender qualifications is eligible to participate in the program[139]:

- Eligible to make commercial loans
- Public depositor of state funds
- Agrees to receive linked deposits
- Insured by the Federal Deposit Insurance Corporation

5.9 Final Analysis/Application

- BRF charges fees to owners of OWTS and those connected to municipal sewer systems. Funds are used to help upgrade OWTS and wastewater treatment plants to reduce nitrogen, phosphorus, and sediment inputs to the Bay.
- When BRS is used to replace an OWTS with an I/A/E system, an easement to the OWTS is obtained by the state, ensuring that maintenance and monitoring can be performed.
- Maryland created CRAs using a geographic boundary. CRAs are classified as land within 1,000 feet of tidal waters and wetlands. OWTS within these areas are prioritized for an upgrade to I/A/E systems. Owners are incentivized by available funds from the BRF, sometimes covering all the costs of an upgrade depending on income level and the type of system.
- The Water Quality Trading Program, a voluntary program, promotes OWTS upgrades as a mechanism for generating a credit to meet NPDES permit requirements.
- A Memorandum of Cooperation to share data developed to document the performance of I/A/E systems and nitrogen reduction methods was implemented with states that are in the Chesapeake Bay Watershed. It is the hope that the Memorandum of Cooperation aids in the simplification and time reduction of the OWTS approval processes, as well as reduce costs to residents and manufacturers.
- The Clean Water Commerce Act of 2017 creates a market to purchase successful outcomes of nutrient reduction programs rather than funding projects by using high-

resolution land-cover data from the Chesapeake Conservancy's Conservation Innovation Center.

- Utilizes the combined average of an I/A technology's total nitrogen results in order to represent the overall ability of a technology.

6. New Jersey

New Jersey is a state in the Mid-Atlantic region of the United States bordered by Pennsylvania and Delaware to the west, Delaware and the Atlantic Ocean to the south, New York and Pennsylvania to the north and the Atlantic Ocean to the east. New Jersey has 1,792 miles of coastline.[69] The United States Census Bureau estimates the population to be 8,908,520 as of 2018.[140] The population density is 1,196 people per square mile, with the total land area covering 7,417 square miles.[141,142] New Jersey has a humid subtropical climate, characterized by hot and humid summers and cool to mild winters.

6.1 Regulation Overview

In 1978 New Jersey banned the use of cesspools in new construction, however many cesspools were still in use across the state.[143] In 2012, the state amended the rules that govern OWTS by imposing state-wide minimum standards for inspections of existing systems during a real estate transaction. The updated regulations, entitled N.J.A.C 7:9A, also required cesspools to be upgraded regardless of their "working" condition.[144] The rules do not mandate OWTS inspections to be done. However, it is State Standard and a best practice to perform an OWTS inspection. Inspections are typically required by mortgage lenders, banks, or home buyers and are conducted by private entities who must report results to the local approving authority (typically the Local Health Department), making it part of the property record.[145] Inspection protocol can be found in the Technical Guidance for Inspections of Onsite Wastewater Treatment and Disposal Systems report.[146] The new regulations do not specify who is responsible for the necessary upgrades during a real property transfer (seller or buyer). An upgrade must be completed before a unit can be occupied.[144] N.J.A.C 7:9A also allows for more stringent local ordinances regarding OWTS.[144] One such example is the Township of Jefferson, New Jersey. Jefferson Township developed stricter OWTS requirements titled Chapter 436, outlining requirements for OWTS operating permits, fines, enforcement, and educational programs.[147]

Management programs with advanced maintenance and record-keeping activities for traditional OWTS with design flows of less than 2,000 gpd exist in eight municipalities, located in Morris, Somerset, and Sussex counties.[148] These programs generally require licenses for the operation of each system. When OWTS owners apply for a license, they

must show that the conditions of renewal have been met. Standards may include pumping of tanks, inspections, and owners must attest that the system is functioning properly.[148]

Under the previous rules, and until April 2012, a property owner with an existing cesspool could (with a permit from the LBH) add a septic tank in front of the cesspool, creating a seepage pit system. Under the new provisions, the addition of a septic tank in front of the cesspool will no longer be allowed.[144]

An updated 2013 law (not part of N.J.A.C 7:9A) NJ Rev Stat 58:11-24.1 states that the New Jersey Department of Environmental Protection (NJDEP) will establish a septic system density standard to prevent degradation of water quality, or to restore water quality pursuant to the state's Water Pollution Control Act or Water Quality Planning Act.[149]

6.2 Regulation Requirements/Enforcement

All types of OWTS are regulated by the state and through local or county health departments. The updated OWTS standards passed in 2012 allowed I/A/E systems to be installed without a special Treatment Works Approval (TWA) permit from NJDEP.[144,150]

Existing OWTS that are not cesspools, privies, outhouses, latrines, or pit toilets that serve existing structures, may continue to be used without change provided that these systems are compliant with the conditions upon which they were approved, are not malfunctioning, and there is no expansion or change in use of the existing structure that increases the estimated volume of sanitary sewage from the structure or changes the type of waste generated.[144]

Non-compliant systems are defined as an OWTS that do not perform as approved, or that malfunction include, but are not limited to the following[144]:

- Contamination of nearby wells or surface water bodies by sewage or effluent as indicated by the presence of fecal bacteria where the ratio of fecal coliform to fecal streptococci is four or greater;
- Ponding or breakout of sewage or effluent onto the surface of the ground;
- Seepage of sanitary sewage or effluent into portions of buildings below ground;
- Back-up of sanitary sewage into the building served, which is not caused by a physical blockage of the internal plumbing;
- Any leakage from or into septic tanks, connecting pipes, distribution boxes and other components that are not designed to discharge sanitary sewage or effluent; or
- Any discharge of sanitary sewage without a zone of treatment.

A homeowner or an agent of a homeowner must notify the LBH upon detection of a non-compliant system, non-compliance may include a failing system or an I/A/E system without

a valid service contract . The LBH will typically perform an investigation whenever they have knowledge through a report or direct observation of the existence of a non-compliant system. If an LBH is notified of the existence of a potentially non-compliant system, the LBH will respond to the notification and provide its findings to the system owner within ten business days. If immediate action is necessary to abate potential public health or environmental impact, the LBH may respond according to its outlined procedures.[144]

Beginning in 2013, New Jersey began requiring authorized installers must be a New Jersey licensed professional engineer and have a valid Certified Installer of Onsite Wastewater Treatment Systems (CIOWTS) Advanced Level certification from the National Environmental Health Association (NEHA) or hold an S2 or higher public wastewater treatment system operator license from the NJDEP.[144,151]

Since 1990 municipalities are required to educate owners of OWTS on proper operation and maintenance. The education/notice must occur at the time of permit approval and at least every three years thereafter. According to New Jersey regulations, a mass mailing to owners of OWTS will satisfy this obligation.[144,152]

6.3 Methods to Determine Priority Conversion Areas

No specific provisions were written into N.J.A.C. 7:9A about the state determining priority replacement areas of cesspools or outdated OWTS.

6.4 Methods to Identify Impaired Waters

No specific provisions were written into N.J.A.C. 7:9A about the state identifying impaired waters from a cesspool or OWTS pollution. However, the state does have several other programs (listed below) and permitting procedures that limit impacts to environmentally sensitive areas.

Subchapter 9 of the Coastal Zone Management rules in N.J.A.C. 7:7 outlines “special areas” found in the coastal zone that are regulated by NJDEP. A list of sites can be found on the NJEDP Division of Land Use Regulation website.[153] Some special area sites may contain a variety of regulatory requirements for construction activities. Septic system installation, repair, and/or replacement may result in impacts to “special areas” and multiple permits from the Division of Land Use Regulation may be required prior to site preparation or construction.[153] An online mapping program of the state’s “special areas” may be found on the NJDEP Bureau of GIS website.[154]

The state also has specific areas with Water Quality Management Plans (WQMP). These plans do not directly address the management of individual OWTS. Some WQMPs do

mention OWTS as a non-point source of pollution and provide information on managing these systems.[155]

6.5 Nutrient Reduction Science

No specific provisions were written into N.J.A.C. 7:9A about the level of nitrogen in wastewater effluent that must be achieved for OWTS. The Pinelands Commission has created methods to track nitrogen effluent from I/A/E systems.[156]

6.6 Conversion Technologies/Future Technology Approval

A COC is required to build an OWTS. The LBH will inspect the OWTS during construction, installation, or alteration to ensure compliance with the requirements and approved engineering design. A COC may also be issued if a licensed professional engineer submits a statement in writing, signed, and sealed that states the OWTS has been located, constructed, installed, or altered in compliance with the proper requirements, standards, and the approved engineering design.[144]

There are four major types of OWTS approvals in New Jersey prior to constructing a system. The standards for OWTS require that septic permits be obtained before locating, designing, constructing, installing, altering, and operating a septic system are listed below[144,157]:

- Local Health Department Approval
- Alternative Design Treatment Works Approval
- Certification of 50 or more Realty Improvement Developments
- New Jersey Pollution Discharge Elimination System (NJPDES) Approval (required for systems above 2,000 gpd)

The Pinelands area of New Jersey has special considerations for OWTS, and the LBH must have a Pinelands Commission issued Notice of Filing, COC, Certificate of Filing, development approval, or a written statement that no approval from the Pinelands Commission for an OWTS to be constructed.[158] The Pinelands Commission is an independent state agency administering a comprehensive plan guiding land use, development, and natural resource protection in the 938,000-acre Pinelands Area of southern New Jersey.[159] The Pinelands Commission allows the use of conventional septic systems when they are installed at development densities that are consistent with the environment's carrying capacity. The carrying capacity is determined in the Pinelands by using a mass balance Pinelands Septic Dilution Model and requires a minimum of 3.2 acres for a conventional OWTS.[158]

6.6.1 Conventional System Conversion Methods

New Jersey has a state requirement that residents connect to a municipal sewer line if available within 150 feet of a dwelling. Townships, counties, or special designation areas such as those within the Pinelands district can restrict sewer development outside designated growth areas to protect habitat and aesthetics (E. Wengrowski, personal communication, July 12, 2019). Smaller community wastewater treatment systems are permissible under New Jersey regulations.[144] However, according to Edward Wengrowski, Environmental Technologies Coordinator with the New Jersey Pinelands Commission (personal communication, July 12, 2019), there are few examples of decentralized community systems. If a decentralized community system exceeds the 2,000 gpd threshold, the decentralized plant must meet NJDEP nitrogen standard, have a licensed operator, perform monitoring, and acquire discharge permits (E. Wengrowski, personal communication, July 12, 2019).

Conventional OWTS are permitted as a conversion method for cesspools.[144] Each component of the individual subsurface sewage disposal system must be designed and constructed to adequately treat and dispose of the expected volume of sanitary sewage to be discharged from the premises to be served. The expected volume of sanitary sewage from single residential occupancy activities will be determined by the number of bedrooms. Daily OWTS volume requirements for the first bedroom are 200 gpd. For each additional bedroom, the system must add 150 gpd capacity.[144]

A reduction of the daily design volume for a one-bedroom age-restricted unit or one-bedroom mobile home dwelling units less than 500 square feet may be approved to 200 gpd. A single-family unit must have a septic tank with a minimum capacity of 250 gpd per bedroom. A septic tank capacity cannot be less than 1,000 gallons. When domestic garbage grinder units or sanitary sewage ejector pumps are installed or proposed, a multiple compartment septic tank is required, and the liquid capacity of the septic tank(s) must be at least fifty percent greater than the minimum 1,000-gallon capacity.[144] Conventional OWTS in the Pinelands designated area must have systems inspected, cleaned, and certified once every three years.[160] The county and municipal governments are tasked with enforcement of OWTS regulations; the Pinelands Commission does not have enforcement capability. According to Edward Wengrowski (personal communication, July 12, 2019), many of the Counties in the state do not have adequate resources for enforcement capacity in terms of funding or personnel.

6.6.2 Advanced Nitrogen Removal Methods

The New Jersey definition of an I/A/E system is an NSF International Standard 40 or Standard 245 certified technology that is designed, installed, operated, monitored, and

maintained in accordance with that certification and N.J.A.C 7:9A regulations.[144] NJDEP encourages the development and use of new technologies that may improve the treatment of sanitary sewage prior to discharge or allow environmentally safe disposal of sanitary sewage in areas where standard sewage disposal systems might not function adequately (E. Wengrowski, personal communication, July 12, 2019). I/A/E systems may reduce the size and height of disposal fields because of a 2.5-foot reduction in the minimum vertical separation to the seasonal high-water table.[161] However, strict operation and maintenance must be conducted on I/A/E systems to ensure proper treatment and environmental protection.[161]

An acceptable alternative waste treatment system is identified as one that has been approved for use by NJDEP and is properly operated and maintained so as not to cause a health hazard or nuisance. Acceptable treatments may include an organic waste treatment system or compost toilet operating on the principle of decomposition of heterogeneous organic materials by aerobic and facultatively anaerobic organisms and utilizes an effective aerobic composting process, which produces a stabilized humus. An acceptable alternative waste treatment system does not include a septic tank—drain field system or another system that results in a discharge to the ground or surface water of this state.[144]

Composting toilets are not specifically addressed in N.J.A.C. 7:9A. A waiver from the plumbing code is needed for a property owner to install a composting toilet, but they are acceptable. In these cases, the design flow is calculated as prescribed in N.J.A.C. 7:9A – 7.4. Greywater is considered sanitary waste and will still need a treatment system (S. Kumpf, personal communication, June 3, 2019).

Since advanced OWTS options are highly case-specific, the NJDEP encourages people to speak with technology vendors and manufacturers and their local health departments; the state only provides minimal guidance on I/A/E systems (S. Kumpf, personal communication, June 3, 2019).[144] Guidance documents for three types of advanced treatment (Aerobic Treatment Systems, Peat Biofilters, and Drip Dispersal Systems) can be found on the NJDEP Bureau of Nonpoint Pollution Control website.[162] NJDEP maintains a list of I/A approved devices. Evaluation criteria can be found on page 77 of the OWTS Rules.[144]

For individual systems with expected volumes of sanitary sewage less than or equal to 1,500 gpd, I/A/E systems must have obtained an NSF Standard 40 and/or Standard 245 certification. I/A/E systems must also have service contracts throughout the life of the system with an authorized service provider. To obtain a COC, occupancy permit, or any sign off by the local administrative authority required for the issuance of any construction application, a service contract must be in place.[144]

I/A/E system minimum maintenance and inspection schedules include requirements for an initial inspection within thirty days following system startup; twice per year for the first two years of system operation, once per year thereafter; at the time of transfer of the property with the new system owner; and inspections shall be conducted on a more frequent basis if required by the manufacturer or system integrator, as applicable.[144] Inspection results are recorded and stored at the LBH. The forms must be signed by the authorized service provider and shall be submitted to the administrative authority within thirty days after the inspection. Online access or electronic submission of the data may be substituted for the physical form, at the administrative authority's discretion.[144] A list of I/A/E systems can be found NJDEP Bureau of Nonpoint Pollution Control website.[162]

A comprehensive I/A program is in place in the Pinelands region of New Jersey, which was designed to meet the needs of the Pinelands Comprehensive Management Plan.[156,163] In 2000 an OWTS committee to research I/A/E systems was formed.[156] Based on the results of the research, five I/A/E systems were identified to meet water quality standards for the Pinelands region. In 2002 an I/A/E system pilot program was established to evaluate the effectiveness of I/A/E systems in real-world conditions. As of 2018, a total of 320 pilot program I/A/E systems have been installed in the Pinelands Area (E. Wengrowski, personal communication, July 12, 2019].[156,164] All pilot program systems must be covered under five-year parts and labor warranty without additional cost to homeowners.[164] Annual reports are presented to the commission on the pilot program results, the most recent report is available for 2018 on the New Jersey Pinelands Commission website.[161] Over the sixteen years the pilot program has been operational, three I/A/E systems have been identified as meeting the water quality standard of 2 mg/L of nitrogen when placed on appropriately sized residential parcels (E. Wengrowski, personal communication, July 12, 2019). Based upon reported nitrogen removal efficiencies and the Pinelands Septic Dilution Model, four approved I/A/E systems could be installed on lots with a minimum size of one acre, and one I/A/E system requires a minimum of one and a half acres.[156,161]

All Pinelands I/A/E systems must be equipped with alarm dialing capability with a service contract for the life of the system. OWTS vendors must ensure that samples of treated wastewater are collected and analyzed during the initial three years of system operation to determine each system's nitrogen removal efficiency. Testing is performed by NJDEP certified laboratories and lab results are provided to the Pinelands Commission. Testing or sampling is not required after approval is granted upon completion of the pilot stage.[164]

Recent Water Quality Management Planning Rules (N.J.A.C. 7:15) amended in 2016 dictate that counties served by OWTS are subject to a mandatory maintenance program, including the creation of local ordinances to ensure OWTS are inspected periodically to determine functionality.[158] Failure to have a valid service contract for I/A OWTS constitutes a violation of the Water Pollution Control Act, and a noncompliance violation of N.J.A.C. 7:9A. Each day

the property owner fails to have in place a valid service contract shall constitute a separate and distinct violation. If a property owner fails to renew the service contract, the authorized service provider will provide written notification of the service contract expiration within thirty days after the expiration to the administrative authority.[158]

6.7 Conversion Method and Timeline

Effective June 2, 2012, all cesspools, privies, outhouses, latrines, and pit toilets that are part of a real property transfer shall be abandoned and replaced at the time of property transfer. Properties that are not being sold or transferred may continue to use their cesspool. The state does not have a failed system definition. However, New Jersey has deemed that cesspools, privies, outhouses, latrines, pit toilets, or similar sanitary sewage disposal units are not OWTS. When an administrative authority discovers one of these units or any cesspool that serves a structure and that needs repair or alteration, an order will be issued to abandon the unit and install a conforming system.[144]

Some exceptions exist with N.J.A.C. 7:9A. A cesspool that is not malfunctioning may continue to serve the structure after a real property transfer only in the following circumstances[144]:

- A conveyance for a consideration of less than $100.00;
- A conveyance by or to the United States of America, the State of New Jersey, or any instrumentality, agency or subdivision thereof;
- A conveyance encumbering realty, or providing for the modification, release or discharge of a debt, obligation or encumbrance, or the foreclosure of a mortgage or lien, or sheriff and execution sales;
- A deed which confirms or corrects a deed previously recorded;
- A sale for delinquent taxes or assessments and the foreclosure of same;
- Judicial proceedings affecting interests in real estate, and documents filed in connection thereto;
- A conveyance by a receiver, trustee in bankruptcy or liquidation, or assignee for the benefit of creditors;
- A deed eligible to be recorded as an “ancient deed” pursuant to N.J.S.A. 46:16-7;
- A deed or map that memorializes subdivisions of land, or which creates or affects easements or restrictions or other burdens upon title;
- A conveyance between family members or former spouses;
- Execution of a lease or license;
- In specific performance of final judgment;
- A deed releasing a right of reversion;
- A deed by an executor or administrator of a decedent to a devisee or heir to effect the distribution of the decedent’s property in accordance with the provisions of the

decedent's will or the intestacy laws of New Jersey, or the passage of title by intestacy or descent; or
- A deed to effectuate a boundary line agreement.

6.8 Funding Mechanisms

The New Jersey Water Bank (NJWB), formerly known as the Environmental Infrastructure Financing Program, is run in conjunction with NJDEP and the New Jersey Environmental Infrastructure Trust (NJEIT) to provide low-cost financing for the design, construction, and implementation of projects that help protect and improve water quality.[165] More information on the types of projects and programs funded can be found in a 2017 report from the NJDEP and New Jersey Infrastructure Trust.[166]

The NJWB finances projects by utilizing two funding sources. The NJEIT issues revenue bonds that are used in combination with zero percent interest funds to provide very low-interest loans for water infrastructure improvements and the NJDEP administers a combination of federal-state revolving fund capitalization grants, as well as the state's matching funds, loan repayments, state appropriations and interest earned on such funds.[165]

To receive funds through the NJWB, a public sponsor such as a community, must come forward and develop a septic management district with a set of policies and procedures governing system maintenance, repairs, and management.[165] According to Charles Jenkins of the NJDEP Municipal Finance and Construction Element (personal communication June 20, 2019), no public entities have utilized this funding mechanism, and the program has existed for nearly twenty years.

The state is in development of a program to invest unexpended capital funds from CWSRF and funnel the monies to individual homeowners through a Link Deposit Program.[167] A state CWSRF program purchases a reduced-rate certificate of deposit from a private financial institution. The financial institution then loans out the deposited funds (at a slightly lower interest rate) to individuals for smaller-scale water quality projects (i.e., allow individuals to replace cesspools).[167]

Because the law requires cesspools be upgraded during a real estate transaction, the state has recognized that funds or financing mechanisms may be available through New Jersey Department of Community Affairs (DCA) community development block grants or U.S. Department of Agriculture (USDA) rural development housing grants (C. Jenkins, personal communication, June 20, 2019).

6.9 Final Analysis/Application

- Effective June 2, 2012, all cesspools, privies, outhouses, latrines, and pit toilets that are part of a real property transfer shall be abandoned and replaced at the time of property transfer.
- In 2012, the state amended the rules that govern OWTS by imposing statewide minimum standards for inspections of existing systems during a real estate transaction. The updated regulations also required cesspools to be upgraded regardless of their "working" condition.
- The rules do not mandate inspections to be done. However, it is a state standard and best practice to perform an OWTS inspection.
- No specific provisions were written into law about the level of nitrogen in wastewater effluent that must be achieved for OWTS. Some environmentally sensitive areas like the Pinelands have created methods to track nitrogen effluent from I/A/E systems.
- Some areas like the Pinelands have specific density requirements.
- The 2012 law also allows for more stringent local ordinances regarding OWTS—more information is available on examples of ordinances that provide more strict pollution control.
- Management programs with advanced maintenance and record-keeping activities for traditional OWTS exist in eight municipalities. These programs generally require licenses for the operation of each system. Standards for licensing may include pumping of tanks, inspections, and owners must attest that the system is functioning properly.
- Beginning in 2013, New Jersey began requiring authorized installers must be a New Jersey licensed professional engineer and have a valid CIOWTS advanced level certification.
- Since 1990 municipalities are required to educate owners of OWTS on proper operation and maintenance. The education/notice must occur at the time of permit approval and at least every three years after that.
- I/A/E systems must have obtained an NSF Standard 40 and/or Standard 245 certification.
- I/A/E systems must also have service contracts throughout the life of the system with an authorized service provider.
- Pinelands I/A/E systems must be equipped with alarm dialing capability.
- The Pinelands Commission allows the use of conventional septic systems when they are installed at development densities that are consistent with the environment's carrying capacity. The carrying capacity is determined in the Pinelands by using a mass balance Pinelands Septic Dilution Model and requires a minimum of 3.2 acres for a conventional OWTS.

- New Jersey Water Bank has funds available. However, a public sponsor such as a community, must come forward and develop a septic management district with a set of policies and procedures governing system maintenance and repairs.
- The state is in development of a program to invest unexpended capital funds from CWSRF and funnel the monies to individual homeowners through a "Link Deposit Program."

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