A Model Program for Onsite Management in the Chesapeake Bay Watershed

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A MODEL PROGRAM FOR ONSITE SYSTEM MANAGEMENT IN THE CHESAPEAKE BAY WATERSHED

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Disclaimer

This model program document was developed to assist states in developing and implementing a model program for managing onsite systems with the goal of minimizing nitrogen impacts to the Chesapeake Bay. It was developed to assist states in the management of onsite wastewater systems to address nutrient pollution in surface waters when such systems are not otherwise regulated under the National Pollution Discharge Elimination System (NPDES) program, which regulates point source discharges to waters of the United States. This document does not address the management of onsite systems for the purpose of protecting underground sources of drinking water, which is the subject of the Safe Drinking Water Act's Underground Injection Control (UIC) program.

The model program reflects the U.S. Environmental Protection Agency's latest research and recommendations on the reduction of nitrogen pollution using different onsite system technologies. This document does not establish any binding requirements, nor does it change or substitute for any legal requirements under which states and municipalities regulate onsite systems. Whether and to what extent a state or local government chooses to implement the recommendations contained in this document is a decision that is ultimately left up to the state or local government.

This model program is not a rule, is not legally enforceable, and does not confer legal rights or impose legal obligations upon any member of the public, the U.S. Environmental Protection Agency (EPA), states, or any other agency. In the event of a conflict between the discussion in this document and any statute or regulation, this document would not be controlling. The word "should" as used in this document does not connote a requirement, but does indicate EPA's recommendations for establishing a model program to manage onsite systems.

EPA may decide to revise this document without public notice to reflect new data or advances in onsite technologies, to reflect changes in EPA's recommendations, or to clarify and update text. EPA is also interested in receiving comment or feedback on this document at any time, and will consider making revisions to reflect such comments or feedback.

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EXECUTIVE SUMMARY

The management of onsite systems plays an important role in the ongoing restoration of the Chesapeake Bay (the Bay). In support of the restoration efforts, the U.S. Environmental Protection Agency (EPA) has prepared this document to provide recommendations to states and local communities on how to develop and implement a model program for the management of onsite wastewater disposal systems to protect water quality in the Bay. The recommendations are based on existing EPA documents regarding onsite systems, as well as best practices currently used both by the Chesapeake Bay watershed states and other states across the country. These recommendations are designed to constitute a model program that can be adopted in whole, or in part, at the discretion of the states and local communities based on their nitrogen reduction strategies and funding priorities.

It is recognized that, while Bay restoration efforts have been ongoing for some time, water quality in parts of the Bay still does not meet applicable water quality standards. President Obama's Executive Order on *Chesapeake Bay Protection and Restoration,* issued on May 12, 2009, along with the Chesapeake Bay Total Maximum Daily Load (TMDL) issued by the EPA, is designed to accelerate the actions needed to limit pollution inputs and restore the Bay (EPA, 2010a). The TMDL is a historic and comprehensive "pollution diet" set at the level necessary to clean up the Chesapeake Bay and its tidal tributaries. The TMDL identifies a 25% reduction in nitrogen inputs to the Bay and a maximum nitrogen load to the Bay of 185.9 million pounds per year.

To support the development of the TMDL, states in the Bay watershed developed Watershed Implementation Plans (WIPs) detailing the actions they would take to reduce nitrogen, phosphorus, and sediment inputs to the Bay. The WIPs evaluate a range of opportunities to reduce nutrient inputs to the Bay, including reductions from agriculture sources, point source discharges (e.g., municipal wastewater treatment facilities), stormwater discharges, and onsite wastewater disposal systems, which are the focus of this document. EPA is committed to working with state and local partners to achieve the nitrogen reductions from onsite systems identified in the TMDL. Although the District of Columbia has also developed a WIP, it does not have any onsite systems, only municipal sewers.

Onsite wastewater systems (also called septic systems or decentralized systems) are not the largest source of nutrients to the Bay, but they do contribute approximately eight million pounds annually to the Bay. The Chesapeake Bay Program Watershed Model is dynamic and is continually refined and improved as data become available. Phase 5.3.2 of the Watershed Model indicates that, in 2012, the 8.3 million-pound nitrogen contribution from onsite systems represents approximately 3.4 percent of the overall load to the Bay (Chesapeake Bay Program 2012 Progress Run, personal communication).

While phosphorus reductions are also identified in the TMDL, the focus of this document is on technologies and practices for reducing nitrogen discharges from onsite systems because phosphorus does not move as readily as nitrogen in subsurface soils.

Nitrogen discharges from onsite systems can be mitigated through advanced technologies and improved design, installation, and management practices. Traditional septic systems discharge approximately 9 pounds (lb)/person/year (yr) or 4 kilograms (kg)/person/yr of nitrogen from the drainfield into groundwater which, over time, flows into Chesapeake Bay or one of its tributaries, following partial attenuation[1]. Alternative treatment components can be added to a traditional system, often between the septic tank and the drainfield, which can reduce this nitrogen load by 50%[2]. This provides a treated effluent with a total nitrogen concentration of approximately 20 mg/L. Using a combination of treatment components will further reduce nitrogen and can provide an effluent concentration of 10 mg/L, or even in some cases, 5 mg/L. A variety of technologies exist that provide this level of treatment, and the available technologies and their performance are expected to increase over time (EPA 2010a, Rich, 2005).

States looking to reduce the nitrogen impacts from onsite systems are encouraged to establish a performance-based approach involving use of these alternative treatment systems. The level of treatment specified should depend on the extent of nitrogen reduction that is needed to meet the goals within a state's WIP. To support the states' efforts, EPA provides the following recommended nitrogen treatment approach that could be adopted in whole or in part by each state. This suggested approach (see Table EX-1) recognizes the comparatively higher pollution risk posed by onsite systems that are closer to the Bay or its tributaries. Using this approach, a state could adopt higher levels of treatment in areas in close proximity to the Bay, including tidal portions of the tributaries to the Bay, with less treatment recommended in the rest of the watershed (Table EX-1).

Table EX-1: Summary of Recommended Onsite System Nitrogen Treatment Approach

Horizontal Distance from the Bay or a Tributary*	Recommended Nitrogen Treatment
0 - 100 feet	No discharge of onsite system effluent
100 – 1,000 feet	10 mg/L for total nitrogen
Beyond 1,000 feet	20 mg/for total nitrogen for: • New construction • System upgrades and replacements

**The horizontal distance, or setback, extends from the dispersal system to the ordinary high water mark of the Chesapeake Bay, or the tidal portion of any tributary to the Bay.*

The approach is designed to apply to all existing onsite systems within 1,000 feet from the Bay or a tributary, and to all future onsite systems in the watershed, with higher levels of nitrogen removal recommended for areas located close to the Bay and its tidal tributaries. For the existing systems, an inspection and upgrade program should be implemented within 1,000 feet from the Bay and its tributaries to identify and document the extent of upgrade necessary for each onsite system, as conventional systems are not capable of meeting the recommended level of treatment.

[1] Partial attenuation occurs through denitrification in a number of environments, including anaerobic saturated soils, at the groundwater surface water interface, through plant uptake, or in streams and other surface waters.

[2] Effluent concentrations from septic tanks can vary depending on homeowner practices, temperatures, and other factors (e.g., seasonal vs. year-round use of homes). The Chesapeake Bay Program Watershed Model assumes a total nitrogen concentration of 39 mg/L at the edge of the drainfield for a conventional onsite system (i.e., once the effluent has traveled through the drainfield and as it reaches groundwater). A 20 mg/L total nitrogen concentration would therefore represent approximately a 50% reduction in the nitrogen load to the Bay.

This inspection process will also identify and facilitate the upgrade of currently malfunctioning systems that are releasing untreated effluent to the ground surface or directly into the Bay. States will want to consider the timing for upgrading existing systems to make them consistent with these recommendations and to support the nitrogen reduction goals in their WIP.

To properly manage nitrogen treatment systems, state and local authorities should implement specific requirements guiding their siting, design, construction, and operation and maintenance (O&M) oversight. The strategies and recommendations provided here recognize the increased complexities associated with managing nitrogen treatment systems, and could be used to update regulatory and management requirements at the state and local levels to achieve the needed nitrogen reductions set forth in each state's WIP.

EPA previously developed five onsite system management models in the publication titled *Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems* (EPA, 2003a). These templates, or models, were designed for use by state and local officials to provide the appropriate local level of oversight via different ownership or O&M methods. They range in complexity from homeowner management of onsite systems, to ownership of onsite systems on private property by a Responsible Management Entity (RME) that assumes the operation, maintenance, and replacement of the systems as necessary.

In order to properly function and achieve their designed nitrogen reduction, advanced onsite treatment systems need regular maintenance. Therefore, Model 3 from the *Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems* (EPA, 2003a) discussed above is the recommended minimum level of management for advanced onsite treatment systems. If a state adopts the Model 3 approach, a property owner would be issued an operating permit for the onsite system that details the level of performance required, and includes a provision that the system be maintained by a qualified service provider. The operating permits issued under the Model 3 approach should require regular monitoring and provide the level of oversight needed to ensure that nitrogen reductions are achieved. This model provides greater accountability compared to traditional regulatory approaches that only oversee the construction of onsite systems and can be useful in demonstrating that TMDL reduction goals are being met.

Management Model 4 is recommended by EPA in the *Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems* (EPA, 2003a) as the minimum level of management for clustered systems with multiple owners and in situations where advanced technology is needed to achieve significant nitrogen reductions such as meeting a 10 mg/L effluent concentration. This model provides for frequent and highly reliable O&M through an operating permit issued to an RME, a designated legal entity that has the technical, managerial, and financial capacity to ensure viable, long-term O&M of all systems within its jurisdiction (EPA, 2003a). In this model, property owners retain ownership of their systems, while the RME coordinates system inspections, performs required maintenance, and ensures the effective operation of their systems. An RME management approach might be appropriate for economically disadvantaged communities where funding could be acquired to support nitrogen reduction systems for property owners who may not be able to obtain this service on their own.

The choice of a management approach depends on the goals a state or local agency sets for nitrogen reduction balanced against the associated O&M and record keeping needed to meet these goals. While each model can stand on its own, state and local agencies can also use more than one management model within a jurisdiction or use elements of individual models as appropriate for their circumstances.

This document also provides information on additional model program components relating to the inspection and upgrade process, site evaluation and design protocols, system O&M and many of the programmatic elements needed to support a successful onsite system management program. It also provides recommendations for the approval and verification of advanced treatment systems and suggested programmatic elements to support the management of onsite systems designed to treat for nitrogen.

A series of reference materials and tools are included as attachments to the document and were prepared in support of the model program components discussed in the document. The key attachments include:

- Model regulatory language for key components of the model program components, providing materials that could be used to update current state or local regulations;
- A draft reciprocity agreement that could be used by watershed states to more efficiently verify and approve new wastewater treatment technologies that could provide nitrogen treatment; and
- A checklist of the recommended components of a model onsite program, keyed to this document, to allow users to identify where specific issues in the document are discussed.

The states and communities within the Chesapeake Bay Watershed face significant challenges in restoring water quality within the Bay. They should consider the nutrient impacts from municipal and industrial dischargers, agriculture, onsite systems and stormwater inputs among others. The goal of this model program document is to support ongoing efforts to improve the management of onsite wastewater disposal systems in a way that minimizes nitrogen impacts to the Bay in as efficient and effective a manner as possible.

1.0 OVERVIEW OF THE MODEL PROGRAM

1.1. Introduction

President Obama's Executive Order on *Chesapeake Bay Protection and Restoration*, issued on May 12, 2009, declares that the "Chesapeake Bay is a national treasure constituting the largest estuary in the United States and one of the most biologically productive estuaries in the world." The Bay's 64,000-square-mile watershed spans parts of six states and the District of Columbia and is home to approximately 17 million people. There are over 100,000 miles of creeks, streams, and rivers which run through the watershed and ultimately flow into the Bay. The Bay's watershed is 14 times the area of the Bay, a ratio much higher than any other comparable watershed in the world, making the Bay highly susceptible to impacts from nutrient (including nitrogen and phosphorus) and sediment inputs associated with agriculture, development, transportation, and wastewater.

Despite several decades of significant efforts to improve water quality, parts of the Bay still do not meet their applicable water quality standards. The President's Executive Order, along with the Chesapeake Bay Total Maximum Daily Load (TMDL), issued by the U.S. Environmental Protection Agency (EPA) on December 29, 2010, are designed to accelerate the actions needed to limit pollution inputs and restore the Bay (EPA, 2010a). The TMDL is a historic and comprehensive "pollution diet" set at the level necessary to clean up the Chesapeake Bay and its tidal tributaries. The TMDL identifies a 25% reduction in nitrogen inputs to the Bay and a maximum nitrogen load to the Bay of 185.9 million pounds per year (see Attachment A for further detail).

To support the development of the TMDL, states in the Bay Watershed developed Watershed Implementation Plans (WIPs) detailing the actions they would take to reduce nitrogen, phosphorus, and sediment inputs to the Bay. The WIPs evaluate a range of opportunities to reduce nutrient inputs to the Bay, including reductions from agriculture sources, point source discharges (e.g., municipal wastewater treatment facilities), stormwater discharges, and onsite wastewater disposal systems, which are the focus of this model program document.

Onsite wastewater disposal systems (also called septic systems or decentralized systems) are not the largest source of nutrients to the Bay. Phase 5.3.2 of the Watershed Model developed by the Chesapeake Bay Program indicates that, in 2012, onsite systems contributed 8.3 million pounds of nitrogen to the Bay, representing approximately 3.4 percent of the overall load to the Bay (Chesapeake Bay Program 2012 Progress Run). The Watershed Model is dynamic and is continually refined and improved as data become available.

While they are not the largest source of nutrients to the Bay, reducing the load from onsite systems is an important part of the effort to improve Bay water quality. EPA developed this model program to provide state-of-the-art treatment, management, and operational recommendations that states and local communities can use if they are interested in reducing onsite system nitrogen impacts As the states implement the TDML, the model program provides technology and management recommendations that states can consider.

It is understood that full application of the recommendations in the model program represents a significant investment for a state or local program. The degree to which each state adopts these recommendations will depend on its individual plan for onsite system management relative to its plans for nitrogen reductions associated with wastewater treatment plants, stormwater runoff, and agricultural practices. By providing this model program, EPA is working to fulfill its responsibilities under Section 202(a) of the President's Executive Order by defining "the next generation of tools and actions to restore water quality in the Chesapeake Bay."

1.2. Onsite System Nutrient Management

NITROGEN

Approximately 1.7 million onsite systems were in operation in the Chesapeake Bay Watershed in 2012, and this number is expected to increase 13.5% to 1.9 million by 2015 (Chesapeake Bay Program Phase V Watershed Model). The Chesapeake Bay Program (CBP) has modeled the impacts of these onsite systems to the Chesapeake Bay over time.

To understand the effectiveness of advanced nitrogen treatment systems, it is useful to discuss the movement of nitrogen through a conventional septic system. A conventional system includes a septic tank that collects the effluent from a home or business and a drainfield that disperses the effluent to the subsurface (Figure 1).

Septic systems receive effluent from a variety of sources including toilet flushing, sink and shower drains, and washing machines. According to the Water Environment Research Foundation, nitrogen concentration in the influent entering the onsite system will vary, but typically averages about 60 mg/L (Lowe et al., 2009). The CBP Watershed Model documentation (EPA, 2010a), also recognizes that the septic tank influent concentration can vary and states that the nitrogen loading rate is typically between 11 and 13 pounds (lb) of nitrogen (N)/person/year (yr) or five to six kilograms (kg) N/person/yr.

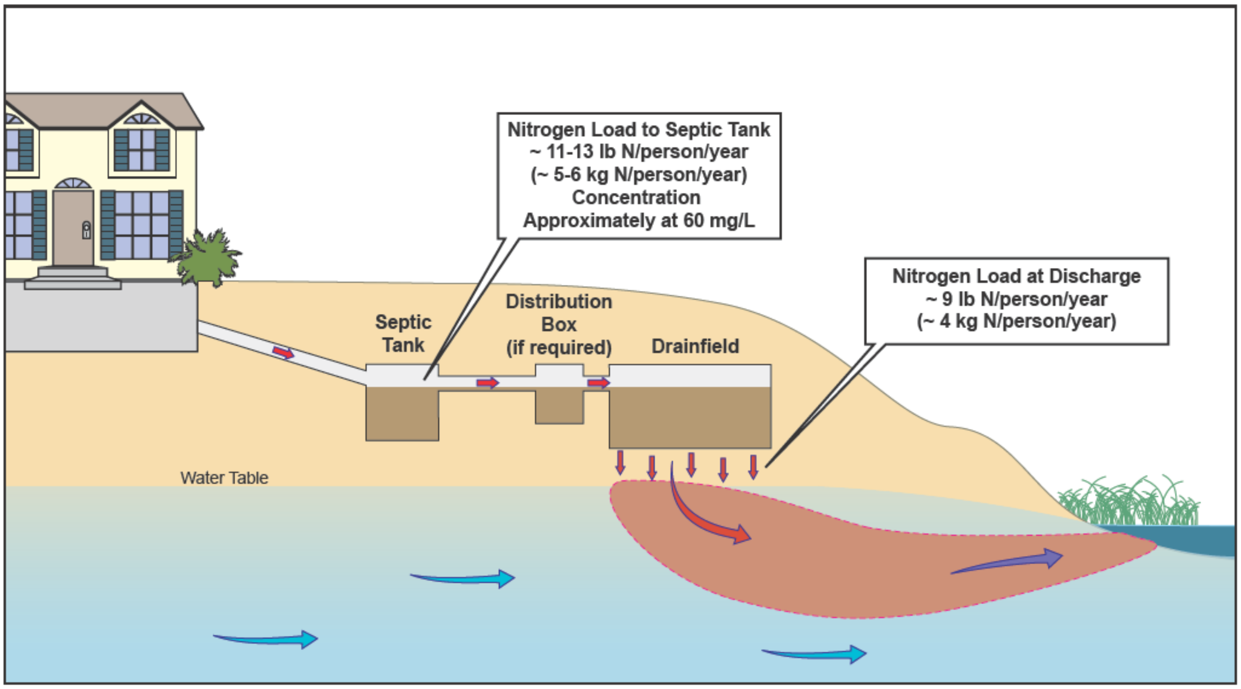

Figure 1. Traditional Onsite System

The CBP Watershed Model also assumes that the load of nitrogen leaving the septic system drainfield averages approximately 9 lb N/person/yr (4 kg N/person/yr) for conventional onsite systems. This is based on a water use of 75 gallons/person/day, and a nitrogen concentration of 39 mg/L in the effluent leaving the drainfield, prior to any dilution from precipitation recharge or dilution in the underlying groundwater (EPA, 2010a). The reduction between the septic tank and the edge of the drainfield is attributed to ammonia volatilization and settling of nitrogen solids in the septic tank, followed by soil denitrification and plant uptake. The Watershed Model then assumes, for most states, that 40% of this load actually reaches the Bay through groundwater transport, with the rest lost to attenuation through denitrification in anaerobic saturated soils, at the groundwater surface water interface, through plant uptake, or in the lower-order streams before the simulated river reach (EPA, 2010a).

Alternative treatment components can be added to a traditional system, often between the septic tank and the drainfield, to provide advanced treatment of nitrogen (Figure 2). Most of these systems can reduce nitrogen effluent concentrations and associated loads from conventional systems by approximately 50%[3] relative to the 9 lbs N/person/yr (4 kg N/person/yr) loading rate currently used in the CBP Watershed Model. Many alternative systems provide a treated effluent with a total nitrogen concentration of approximately 20 mg/L or a load reduction of 4 lbs N/person/yr (2 kg N/person/yr). Some systems have a combination of treatment components that can treat to a final concentration of 10 mg/L, or even in some cases 5 mg/L (EPA, 2010b; Rich, 2005) resulting in even greater load reductions (Table 1).

[3] This reduction is based on a comparison of effluent concentrations at the leaching field between a conventional system (i.e., approximately 39 mg/L according to the CBP Watershed Model), and an advanced treatment system that treats the effluent to a concentration of approximately 20 mg/L.

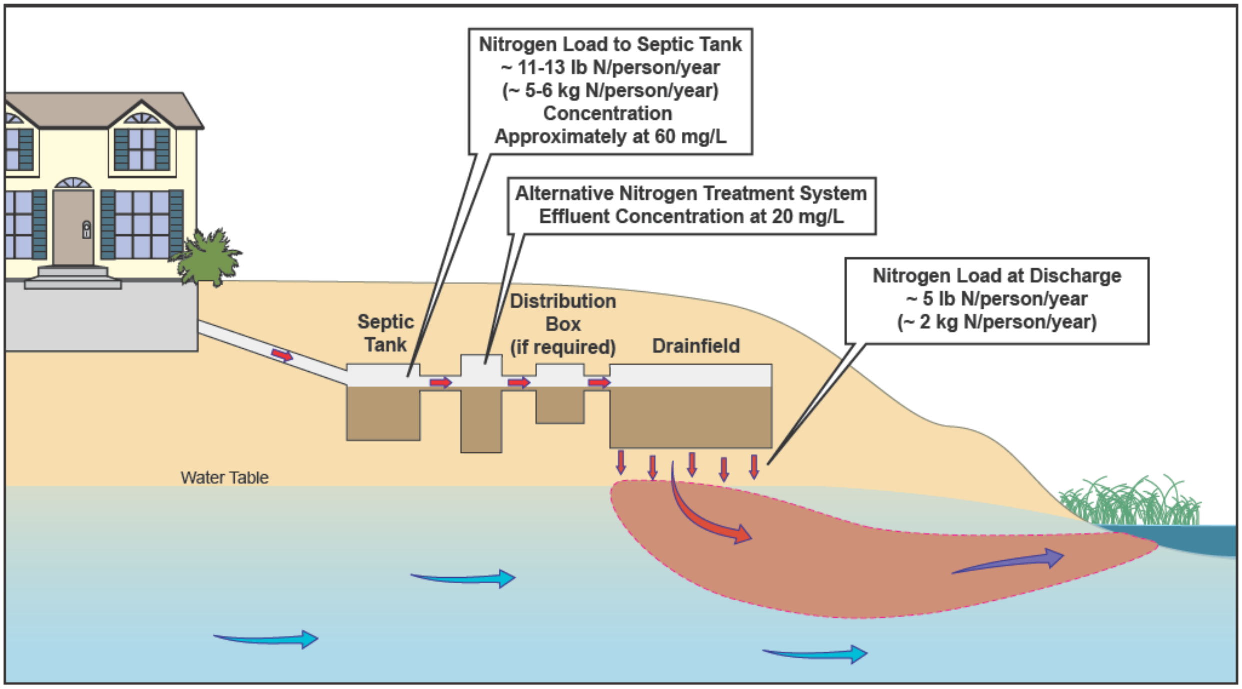

Figure 2. Onsite System with Nitrogen Treatment

Alternative systems reduce total nitrogen through a process of nitrification followed by denitrification. Nitrification uses oxygen to transform the organic nitrogen from the septic tank into nitrate-nitrogen (nitrate) in an oxygen-rich environment. Denitrification of the nitrate then occurs in an anoxic environment (i.e., in the absence of oxygen) either in the septic tank after recirculation, or in a separate denitrification system. Sampling to confirm that these systems function properly can only be conducted where access is available, which is usually prior to the effluent reaching the drainfield. The drainfield may provide further nitrogen attenuation.

For purposes of this document, an advanced treatment system is defined as a system that includes a septic tank, an aeration system (i.e., oxygen is added to the effluent), and a recirculation system, or equivalent. The recirculation system recirculates the effluent from the aeration system back into the septic tank where anoxic conditions transform the nitrate into nitrogen gas. Advanced treatment systems can achieve a total nitrogen concentration of approximately 20 mg/L.

An advanced treatment system with denitrification is defined as an advanced system in which the denitrification process occurs in an anoxic environment separate from the septic tank. It includes a separate anoxic system. Some advanced treatment systems with denitrification have been shown to achieve a total nitrogen concentration of approximately 10 mg/L.

Table 1. Examples of Nitrogen Load Reductions Achievable Through Advanced Treatment

Type of System	Nitrogen Discharge[1] Concentration (mg/L)	Load Reduction Provided	Loading (per person/yr)		Nitrogen Reduction (per person/yr)		Treatment Cost for Upgrading System
			kg	Lb	kg	Lb	
Conventional System	39	0%	4	9	0	0	N/A[2]
Advanced Treatment[3]	20	49%	2	5	2	4	$4,000-$10,000[4]
Advanced Treatment with Denitrification[5]	10	74%	1	2	3	7	$10,000-$15,000

[1] *This is the concentration of wastewater effluent as it enters the drainfield.*
[2] *The average capital cost per household for a conventional onsite system is $5,000 to $6,000.*
[3] *"Advanced treatment system" refers to a system that includes a septic tank, an aeration system, and a recirculation system into the septic tank, or equivalent.*
[4] *(EPA, 2010b)*
[5] *"Advanced treatment system with denitrification" refers to a septic tank, an aeration system, and an anoxic environment separate from the septic tank, or equivalent.*

A literature review and summary of the performance of many available treatment technologies was developed as part of the *Guidance for Federal Land Management in the Chesapeake Bay Watershed* prepared by EPA in response to the President's Executive Order (EPA, 2010b).

Many states looking to reduce the nitrogen impacts from onsite systems are proposing the use of alternative treatment systems. The level of treatment recommended by each state depends on the extent of reduction that is needed to meet the goals within their WIP. To support the states' efforts, the model program provides a recommended approach for nitrogen treatment that could be adopted in whole or in part by each state. As described in Section 2, the approach includes advanced nitrogen treatment systems for all onsite systems within the Bay watershed, with higher levels of nitrogen removal recommended for areas in close proximity to the Bay and its tidal tributaries.

Nitrogen treatment systems involve additional equipment and added operation and maintenance (O&M) oversight, adding to the complexity of operation for the owner and to the level of oversight needed from the regulatory authority. The strategies and recommendations in this document recognize these increased operation, maintenance, and oversight needs and could be used to update regulatory and management rules for onsite systems at the state and local levels to achieve the nitrogen reductions set forth in the TMDL and discussed in each state's WIP.

Phosphorus

In addition to nitrogen, onsite systems also produce phosphorus. However, compared to nitrogen, phosphorus does not move as readily in subsurface soils or groundwater. The phosphorus loadings to the Bay from municipal and industrial dischargers or agricultural sources are therefore much more significant than those from onsite systems.

Phosphorus discharged from a properly functioning onsite system will attach to the subsurface soils below a drainfield and will not migrate far into the underlying groundwater system. Soils can become saturated with phosphorus, including soils near drainfields and soils underlying former agricultural fields, which results in phosphorus migration. Phosphorus migration occurs at a slower pace than that of nitrogen; and phosphorus will continue to adsorb to downgradient unsaturated soils as it migrates.

The model program includes recommended management approaches to prevent system failure which would also result in additional phosphorous reaching the Bay. Implementing these recommended management approaches can help states to also limit loads of phosphorus from failing systems. As such, the focus of this document is on nitrogen, which moves easily through the subsurface and can travel significant distances to the Chesapeake Bay or one of its tributaries even from systems that are functioning properly.

1.3. How to Use the Model Program

The Model Program focuses on the Chesapeake Bay Watershed states and the optimization of their existing onsite system management programs to promote nitrogen removal and therefore protect the Bay. However, the recommended nitrogen treatment approach and design and management components described here may also be of use to states and other watersheds that face similar nitrogen management issues. If used elsewhere, consideration should be given to local factors that influence nitrogen transport and attenuation in groundwater, including soil type and permeability, depth to groundwater and the presence or absence of anoxic zones in groundwater that may increase nitrogen attenuation.

The model program is presented in a modular fashion so users can select specific performance recommendations or design and management components and incorporate them into existing programs. Sections 2-4 of the document describe a series of model program components for consideration by states. In Section 2, recommended nitrogen treatment for the watershed is described with varying levels of suggested treatment based on the proximity of an onsite system to the Bay. Section 3 discusses the selection of an appropriate management system to ensure proper operation of onsite systems that provide nitrogen treatment, as well as documentation of nitrogen reductions produced by onsite system upgrades. Section 4 provides information on additional components associated with the inspection and upgrade process, site evaluation and design protocols, system O&M, and many of the programmatic components that can support a successful onsite system management program.

EPA recognizes that states are using different strategies depending on their proximity and estimated impact to the Bay. States and jurisdictions adjacent to the tidal waters associated with the Chesapeake Bay include Delaware, Maryland, Virginia, and the District of Columbia. Other states in the Bay's watershed located in non-tidal areas include New York, Pennsylvania, and West Virginia. These states contain numerous miles of headwater streams and rivers that flow into the Bay. They acknowledge the need to reduce nutrient inputs to the Bay from onsite systems and other sources, but are not planning to achieve the same level of nitrogen reduction to the Bay from improvements to onsite systems as those states directly bordering the Bay.

The nitrogen treatment approach recommended in Section 2 could pose a financial burden for some communities and individual residents, particularly for those in historically underserved or economically disadvantaged communities. EPA encourages regulatory authorities and community governments to consider various opportunities of funding assistance for such residents to lessen the costs associated with upgrading and maintaining onsite systems. These opportunities may include allocating nitrogen credits achieved in other programs (Section 4.11) to economically disadvantaged communities to minimize the number of onsite system upgrades required from these communities. In addition, regulatory authorities and community governments may wish to target their outreach efforts and prioritize funding for historically underserved or economically disadvantaged communities. Information on funding opportunities is provided in Section 4.13.

References to EPA documents and programs for onsite system management are provided throughout the document. In addition, a series of reference materials and tools to help states implement the recommendations within this document have been developed. These include the following attachments:

- **Attachment A:** The regulatory and scientific framework for onsite system management in the Chesapeake Bay Watershed;
- **Attachment B:** An annotated bibliography to assist users in finding references and weblinks relevant to their needs;
- **Attachment C:** A checklist or map to this document designed to allow the user to compare their regulatory program to the recommendations in this document;
- **Attachment D:** Model regulatory language to implement the key recommendations in the document;
- **Attachment E:** A model state reciprocity agreement to support the adoption of alternative technologies already verified in other states; and
- **Attachment F:** Case studies showing successful implementation of key components of a model program.

2.0 RECOMMENDED NITROGEN TREATMENT APPROACH FOR ONSITE SYSTEMS

EPA recommends the following nitrogen treatment approach for onsite systems for use in the Chesapeake Bay watershed. The approach provides for a tiered, risk-based approach for nitrogen management similar to the Agency's approach in the *Guidance for Federal Land Management in the Chesapeake Bay Watershed* (EPA, 2010b) for the management of federal lands and federally-owned onsite systems within the watershed. Specific nitrogen reduction goals are recommended based on the proximity of a site to the Bay (or a tributary), recognizing that there is a greater potential for attenuation of nitrogen for onsite systems located farther from the Bay. The approach of suggesting additional nitrogen management closer to the Bay is also consistent with the system used by the Maryland Critical Areas Commission, which increases management of areas within 1,000 feet of the Bay. Therefore, increased nitrogen treatment is recommended for systems in close proximity to the Bay or a tidal tributary.

The level of nitrogen treatment or removal recommended under this approach is determined by the proximity or distance of an onsite system to the Bay or the tidal portion of its tributaries. The horizontal setback used in this approach is defined by the distance between the closest edge of the drainfield and the ordinary high water mark of the Chesapeake Bay or the tidal portion of any tributary to the Bay. Please note that recommended levels of treatment described here could be employed in other nitrogen sensitive embayments outside of the Chesapeake Bay Watershed where similar conditions exist for nitrogen transport in groundwater.

The recommendations proposed below are based, in part, on a recognition that the potential for attenuation, or remediation of nitrogen prior to discharge into the Bay increases with distance to the Chesapeake Bay or a tidal tributary. Nitrogen attenuation can occur as groundwater intersects a freshwater stream, lake or wetland, or, in some cases, where onsite system effluent is migrating through shallow anoxic groundwater and sufficient organic carbon is present in the subsurface sediments to facilitate the denitrification process. For example, Lindsey et al. (2003) looked at residence times and nitrate transport in groundwater discharging to streams in the Bay's watershed. Four small sub-watersheds in different hydro-geomorphic regions were examined, and two streams showed evidence of denitrification occurring within the surface waters. The closer onsite systems are to the shoreline of the Chesapeake Bay, the lower the potential for such attenuation to take place.

Nitrogen attenuation depends on local conditions such as the depth to groundwater, groundwater flow patterns, the residence time of groundwater in potential treatment zones, the type of soils present, and the proximity of surface water features to the discharges. Bachman and Krantz (2000) showed that reducing compounds in marine and estuarine silts and clays in the southern Maryland coastal plain surficial aquifer can act as a substrate for denitrification. Setback distances help to increase the chances of septic effluent coming into contact with these materials. One study conducted in coastal Georgia specifically looked at the natural attenuation of nitrogen loading from septic effluents (Meile et al., 2009). The septic systems in this study were located in poorly drained soils of slow to rapid permeability. In this case, setback distance had a distinct impact on nitrogen reduction, with longer setback distances resulting in greater nitrogen attenuation. The authors conclude that in coastal areas, nitrogen mitigation is sensitive to the distance of the septic plume origin from sulfate containing saline waters, and the reactivity of organic matter.

States may want to take these conditions into account in their onsite system selection criteria and siting requirements. In cases where states have determined that little or no nitrogen attenuation occurs between the discharge point(s) and receiving waters, they may want to set a stricter discharge concentration level to ensure the requisite nitrogen removal goals are being met. States should also consider other local water quality impacts, such as impacts to private or public drinking water supplies as they select their nitrogen treatment approach. Some onsite systems are subject to regulations under the Underground Injection Control program established by the Safe Drinking Water Act to prevent endangerment to underground sources of drinking water.

The recommendations are designed to apply to all systems currently existing within 1,000 feet of the Bay or its tributaries, and to all future systems in the Chesapeake Bay Watershed. For the existing systems, an inspection and upgrade program is recommended to identify and document the extent of upgrades necessary for each onsite system. This process is discussed in Section 4.1. Along with identifying systems needing nitrogen treatment, the inspection process will also identify and upgrade conventional systems that are malfunctioning and discharging wastewater effluent to the ground surface, directly to the Bay, or to a tributary. States may want to consider the timing for upgrading existing systems to provide the nitrogen reduction needed to meet their proposed levels and to support the nitrogen reduction goals in the TMDL. At a minimum, EPA recommends that all new onsite systems incorporate nitrogen treatment systems.

The recommended nitrogen treatment levels for onsite systems located in the Chesapeake Bay Watershed at various distances from the Bay and its tributaries are described below[4].

- **< 100 feet:** No discharge of onsite system effluent should be allowed. Any existing onsite systems that discharge within this 100-foot setback should be upgraded and modified so effluent is discharged beyond 100 feet from the water's edge, potentially through the use of a shared or cluster system. For existing properties where an upgrade cannot be sited outside of 100 feet, the effluent dispersal system should be sited as far from the water's edge as feasible given the lot configuration, and the level of treatment should be the same as for systems located within 100 to 1,000 feet as described below.

- **100 to 1,000 feet:** A total nitrogen concentration of 10 mg/L in the treated effluent prior to discharge is recommended for all systems within 100 to 1,000 feet of the Bay or associated tidal tributary. This translates into an effluent loading rate of 2 lb N/person/yr (1 kg N/person/yr), representing a 74% reduction compared to a conventional system. This concentration limit can be met with an advanced treatment system with denitrification.

- **> 1,000 feet:** A total nitrogen concentration of 20 mg/L in the treated effluent prior to discharge is recommended for all new and upgraded systems located outside a 1,000-foot buffer to the Bay, or the tidal portion of its tributaries. This translates into an effluent loading rate of approximately 5 lb N/person/yr (2 kg N/person/yr), representing a 49% reduction compared to a conventional system. This concentration limit can be met with a variety of alternative technologies.

Based on information from state WIPs, the CBP Watershed Model projects a nitrogen load reduction from onsite systems from a current load of 9 pounds of nitrogen/person/year at the edge of the drainfield for a conventional onsite system to an average of 7.9 lbs/person/year across all systems by 2025. This 12% load reduction at the edge of the septic field would be

[4] These treatment levels are specified as concentrations in total nitrogen in the effluent as it leaves the drainfield, prior to entering groundwater. Actual sampling below the drainfield is impractical, and in an advanced system, the concentration is typically measured prior to dispersal in the drainfield. However, if the total nitrogen concentration is 20 mg/L or less as the effluent enters the drainfield, the maximum concentration entering groundwater should also be 20 mg/L or less.

from upgrading onsite systems to advanced treatment and does not include connecting homes with onsite systems to sewer lines.

The implementation of advanced treatment technologies that meet a nitrogen concentration of 20 mg/L for new systems beyond 1,000 feet from the Bay can help reduce the impact of future development. In addition, the inspection and inventory of existing systems for the purpose of identifying and upgrading malfunctioning and/or failing systems can help reduce potential environmental and public health risks.

2.1. Meeting the Recommended Treatment Levels

As discussed in Section 1.3, conventional onsite systems cannot be operated in a manner consistent with these recommendations. However, the technology currently exists to meet these treatment level goals as discussed in the *Guidance for Federal Land Management in the Chesapeake Bay Watershed* referenced above, and as described in the *La Pine National Demonstration Project Final Report* that evaluated the capabilities of advanced onsite systems for nitrogen removal (Rich, 2005). Additional treatment technologies will likely enter the market over time, and Section 4.10 describes recommendations on how states could collaborate with each other as well as with federal agencies in the evaluation of new advanced treatment technologies that also meet these recommended nitrogen concentrations.

Two currently available options, shallow pressurized effluent dispersal systems and permeable reactive barriers, could potentially be incorporated into an onsite treatment system to meet the recommended treatment levels at various distances from the Bay. Shallow pressurized effluent dispersal systems and permeable reactive barriers are discussed below as examples of available options that can help reduce nitrogen loads to the Bay. They do not represent an exhaustive list of all nitrogen reducing technologies.

SHALLOW PRESSURIZED EFFLUENT DISPERSAL SYSTEMS

According to EPA's *Guidance for Federal Land Management in the Chesapeake Bay Watershed* (EPA 2010a) a shallow pressurized effluent dispersal system can provide additional nitrogen removal beyond that provided by an advanced treatment system. Some research indicates that substantial nitrogen removal from shallow pressurized effluent dispersal systems is possible (MASSTC, 2004).

Shallow pressurized effluent dispersal systems include a pump that directs treated effluent to a series of irrigation or discharge lines, chambers, or other engineered pressurized conveyance systems located in a shallow layer of soil no more than one foot deep (Figure 3). These systems should be pressurized and time-dosed and should only be used where low permeability soils or bedrock are greater than 1.5 feet from the ground surface such that the effluent can readily percolate into the soil layer.

Except in sandy or loamy soils, using a shallow pressurized effluent dispersal system in concert with an advanced treatment system with denitrification may provide a way to reach lower nitrogen concentrations than with the advanced treatment alone.

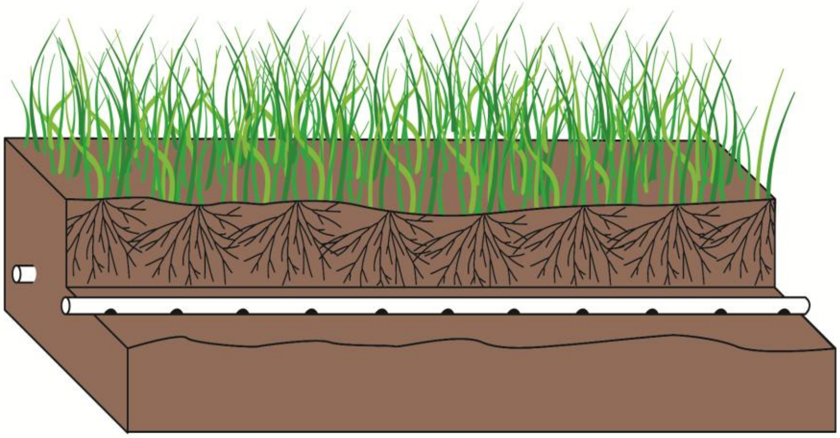

Figure 3. Cross-Section of a Shallow Pressurized Effluent Dispersal System. Other Shallow Pressurized Effluent Dispersal Systems may use chambers and other engineered materials in place of the discharge lines.

The use of a shallow pressurized effluent dispersal system may also be helpful in areas close to the Bay or a tidal tributary where shallow groundwater exists and a traditional dispersal facility is less suitable, or where the elevation of the water table is expected to increase as a result of sea level rise.

<u>PERMEABLE REACTIVE BARRIERS</u>

Permeable reactive barriers (PRBs) treat nitrogen contained in shallow groundwater. They can be installed downgradient of a single drainfield, or downgradient of a cluster of closely spaced onsite systems. They are typically installed as long, narrow trenches (Figure 4) perpendicular to groundwater flow in an area that will capture nitrogen rich groundwater. They are filled with a carbon-based media (such as wood chips, sawdust, or newspaper) with any necessary additions to control changes in pH. Their usefulness will depend on local hydrogeologic conditions. As they are typically shallow structures, they need to be installed either close to a nitrogen source, or in an area where groundwater is migrating upwards to discharge into a surface water. A multi-year study performed in Ontario, Canada, showed that PRBs are capable of removing a significant percentage of the nitrogen that migrates in groundwater through the trench (Robertson et al., 2000).

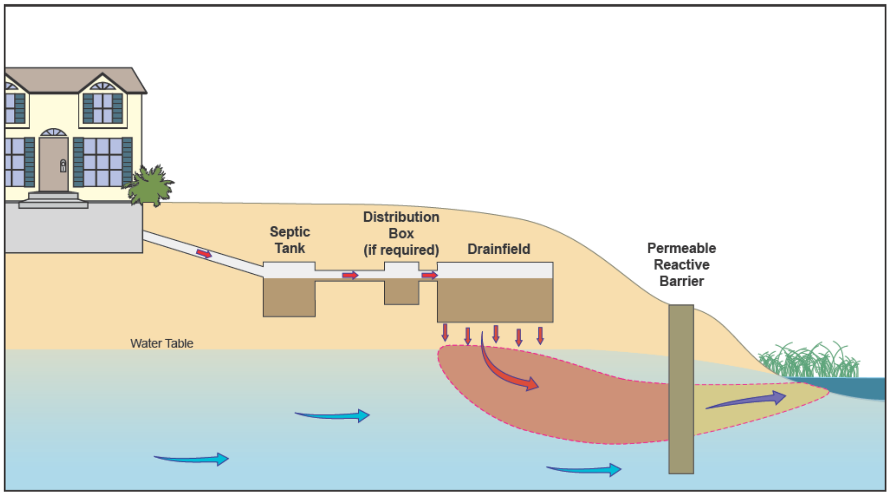

Figure 4. Permeable Reactive Barrier

PRBs can be used to capture and treat effluent discharged to groundwater from a conventional onsite system. They can also be used to polish the effluent discharged from a nitrogen treatment system, and in that manner they can be helpful for meeting the more stringent nitrogen concentrations recommended for areas closer to the Bay.

Similar to all advanced technologies, PRBs require careful design and installation, and should be designed and built by qualified entities. Appropriate siting of a PRB requires a good understanding of groundwater flow patterns and potential septic plume behavior. Confirming groundwater flow in certain areas (e.g., inland relative to the Chesapeake Bay and its tributaries) may require the installation of groundwater monitoring wells, and the monitoring of those wells over a sufficiently long period to identify seasonal flow changes. In areas where significant groundwater investigations are required, PRBs may be more cost-effective for shared or cluster systems.

PRBs are an example of an alternative technology that has been successfully implemented for nitrogen reduction (EPA, 1998), but other technologies are available and may be more appropriate for certain situations or environments.

2.2. The Benefits of Shared or Cluster Systems

Shared or cluster systems provide the opportunity to reduce construction costs, increase the effectiveness of the proposed nitrogen treatment system, and lower the long term O&M costs for the system. Therefore their use is encouraged, especially in areas close to the Bay shore where higher levels of treatment are recommended. Cluster systems have applications both when upgrading existing onsite systems and for new construction where their use can support concentrated development efforts through the implementation of smart growth and other principles.

Past cost analyses (EPA, 2010b) suggest that the use of a cluster system by a group of property owners can reduce their individual costs by up to 30%. The actual cost savings will be dependent on local conditions such as the length of sewer lines, the presence of soils or bedrock that impede sewer line construction, and the level of treatment required from the cluster system. Further information on the benefits of cluster systems is provided in Section 4.5 and in an implementation example below.

2.3. Implementation Examples

Four examples provided below show how property owners can effectively meet the recommended treatment levels at various distances from the Bay. They show how a treatment system can be incorporated into the site design, and highlight approximate costs for each approach, based on cost information provided in the *Guidance for Federal Land Management in the Chesapeake Bay Watershed* (EPA, 2010b).

Example #1: Single Family Home Over 1,000 Feet From the Bay

A property owner resides in a neighborhood that is approximately a half mile from a tributary to the Chesapeake Bay (Figure 5). Following an inspection, his system is found to be failing, and he elects to upgrade his failing system to provide for additional nitrogen treatment. As the site is more than 1,000 feet from the Bay or one of its tributaries, this system should be designed to meet a nitrogen concentration of 20 mg/L in the effluent dispersed to groundwater. Assuming the existing onsite components function properly, the approximate cost for the additional nitrogen treatment component is approximately $5,000 - $9,000.

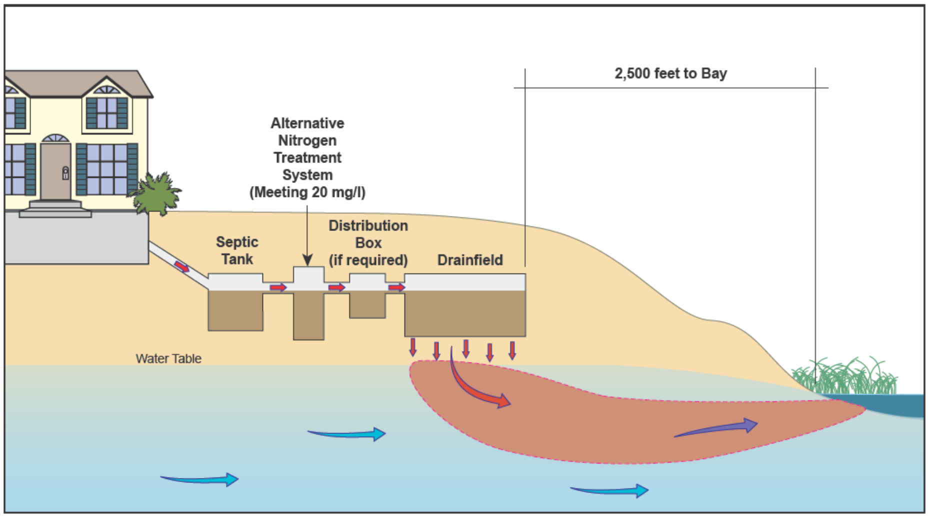

Figure 5. Property within Half a Mile of the Bay

Example #2: Single Family Home within 100 to 1,000 Feet of the Bay Shoreline

This property is located between 100 and 1,000 feet of the Bay Shoreline, and the property owner chooses to upgrade the home's onsite system to meet the recommended nitrogen treatment level of 10 mg/L. This home (Figure 6) is not located in close proximity to any neighboring homes, or sewer connections, so the best option for this homeowner is to upgrade by adding an advanced nitrogen treatment system with denitrification to his existing system. Assuming the existing onsite components function properly, the approximate cost for the additional nitrogen treatment components is approximately $10,000 to $15,000.

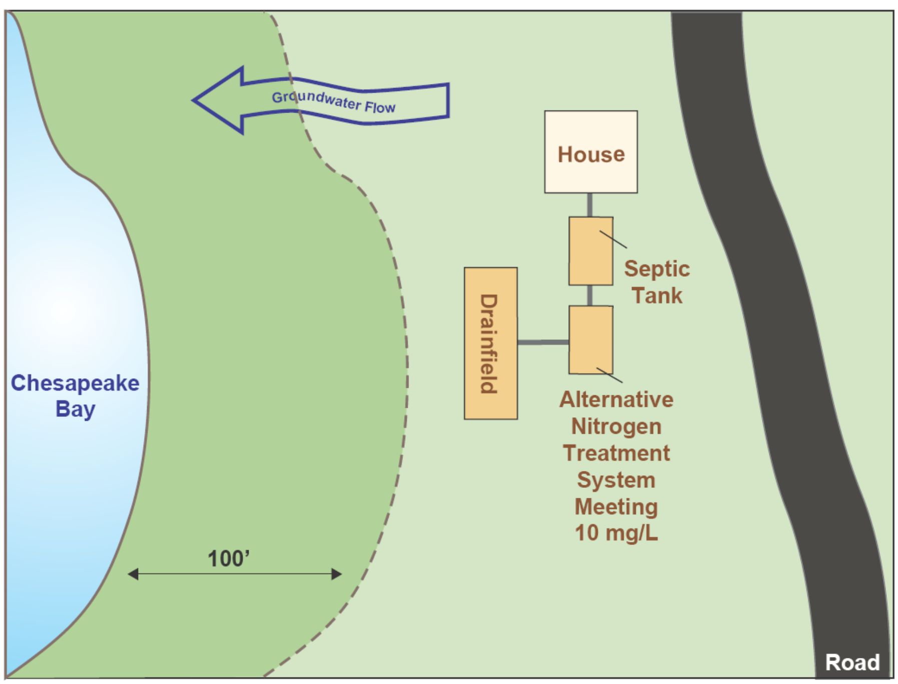

Figure 6. Single Family Home within 100-1,000 Feet of the Bay

Example #3: Cluster System within 100-1,000 Feet of the Bay Shoreline

Three homeowners' properties are located within 100 feet of the Chesapeake Bay and their onsite systems currently disperse effluent to the ground within 100 feet of the Bay (Figure 7). These homeowners own small lots, and cannot move the drainfield beyond 100 feet from the shore. To upgrade their system, they enter into an agreement for a shared or cluster system on an abutting lot, providing treatment for four participating property owners. The cluster system is placed 250 feet from the shoreline, and is designed to meet the 10 mg/L recommended nitrogen discharge concentration. As mentioned above, the cost savings achieved by using a cluster system can be up to 30% compared to each property constructing their own treatment system.

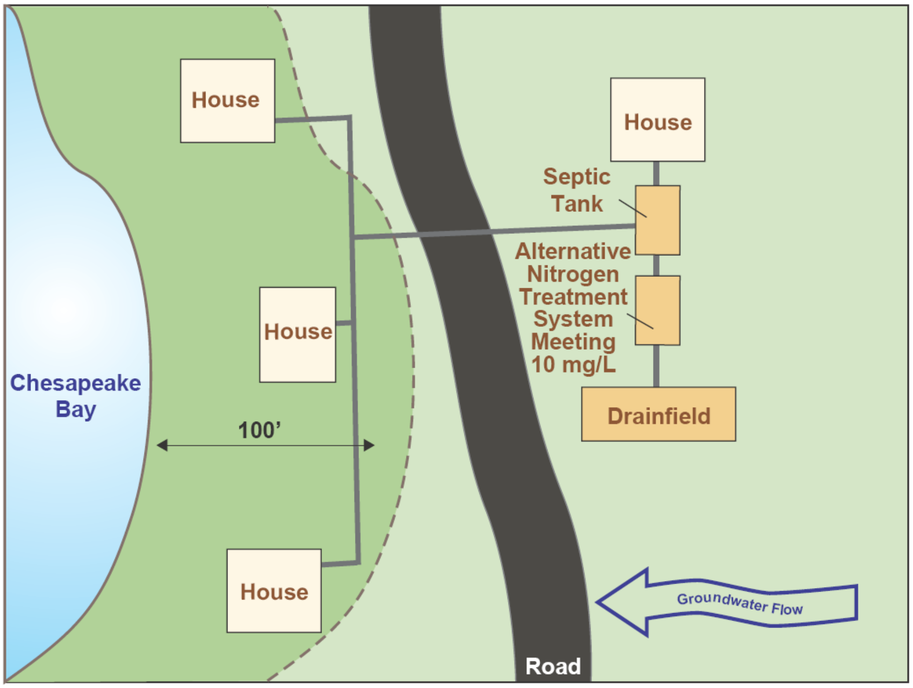

Figure 7. Cluster System within 100-1,000 Feet of the Bay

Example #4: Use of a Permeable Reactive Barrier

A property owner, with an onsite system located between 100 and 1,000 feet of the Bay wants to meet a 10 mg/L nitrogen concentration (Figure 8). Instead of using a shallow pressurized effluent dispersal system to meet this concentration, she elects to maintain her existing drainfield, and to use a treatment system to meet 20 mg/L and then install a PRB downgradient of the drainfield to further treat the effluent in groundwater downgradient of the drainfield.

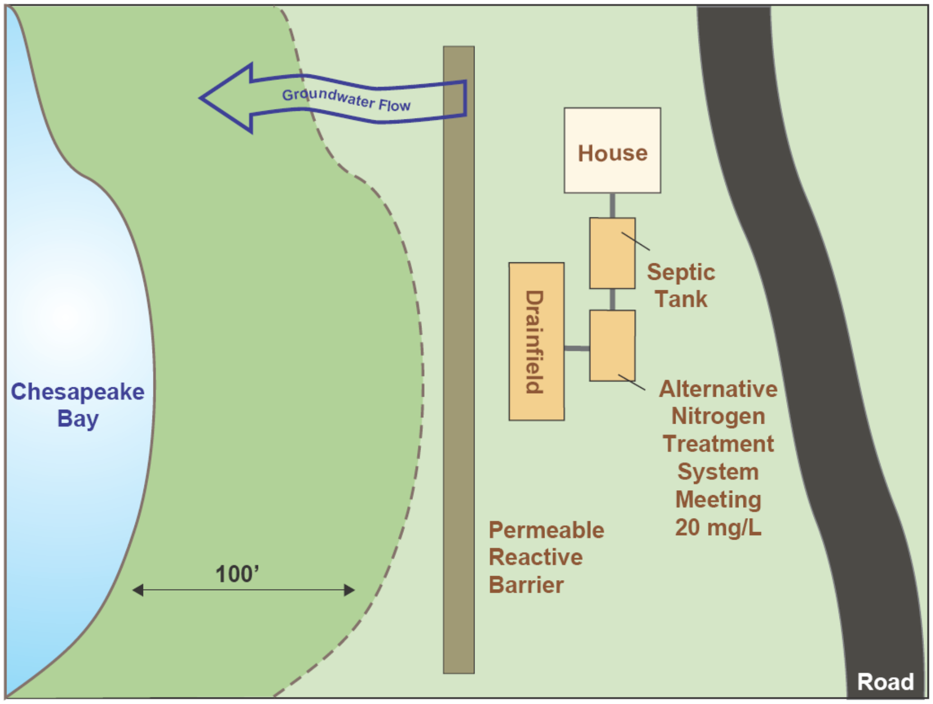

Figure 8. Use of a Permeable Reactive Barrier

Assuming the existing onsite components function properly, the approximate cost for additional nitrogen treatment components and the PRB is approximately $10,000 to $15,000 per equivalent dwelling unit (i.e., in the plume sourcing area), depending on soils, geology, depth to groundwater, subsurface hydrology, construction access, existing infrastructure, and other factors (EPA, 2010b). This cost estimate represents expected construction costs, assuming that the direction of groundwater flow is known on the property. While the direction of groundwater flow should be straightforward to determine for a property at the edge of the Bay, additional investigations may be required for properties located further from the Bay, with the potential to increase the expected cost for a PRB.

3.0 Onsite System Management Approaches

Management of onsite systems that provide nitrogen treatment requires a greater level of oversight to ensure these complex systems properly operate and consistently provide the necessary level of nitrogen reduction (Obropta, 2005). For the purposes of this document, the goals for onsite system management include:

1. Proper oversight of onsite treatment systems to ensure that the appropriate O&M is performed and that nitrogen treatment levels are met consistently; and
2. Ongoing record keeping and accounting of nitrogen reductions to document that the nitrogen reduction targets in the TMDL are met.

Implementation of a management approach that meets these goals may vary for each state, county, and local agency, since each entity has a different approach for using onsite systems to meet nitrogen reduction goals. Government agencies also have different regulations and enabling legislation that impact the selection of a management approach. The ability of local governments and residents to manage onsite systems also varies, especially in economically disadvantaged or underserved communities, and local regulatory authorities should consider the capacity of a community's residents to manage onsite systems when selecting a management approach.

EPA previously developed five onsite system management models in the publication titled *Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems* (EPA, 2003a). These templates, or models, were designed for use by state and local officials to provide the appropriate local level of oversight via different ownership or O&M methods. For systems designed to treat nitrogen, Models 3-5, or some combination, might be appropriate to support the nitrogen reduction goals needed for the Bay (Table 2).

Table 2. Summary of Onsite System Management Approaches

Model #	Description	Comments
1	Homeowner Awareness	Homeowner management of existing systems is promoted through outreach and education programs. Appropriate for conventional systems which provide very limited nitrogen removal.
2	Maintenance Contracts	A property owner contracts with a qualified service provider to ensure O&M is conducted and nitrogen removal goals are met.
3	Operating Permits	The regulatory agency issues a limited-term operating permit to the property owner that requires sustained performance levels for nitrogen reduction. O&M is performed by a qualified service provider with regular monitoring. This provides a greater level of oversight and accountability compared to Model #2.
4	Responsible Management Entity (RME) O&M	Frequent and highly reliable O&M is the responsibility of a management entity, further increasing the level of accountability. This approach is appropriate for clustered systems or complex treatment systems providing high levels of nitrogen reduction.
5	RME Ownership	Ownership passes to the management entity which is responsible for all management aspects, similar to publicly owned treatment works, providing a high level of assurance that nitrogen removal goals are met.

In the Chesapeake Bay Watershed, Model 3 is the EPA-recommended minimum level of onsite system management. If a state or local government adopts the Model 3 approach, a property owner would be issued an operating permit for their system that details the level of performance required, and includes a provision that the system be maintained by a qualified service provider. The operating permits issued under the Model 3 approach should require regular monitoring and provide the level of oversight needed to ensure that nitrogen reductions are achieved. If a system is not functioning properly, or if proper records are not provided, the regulatory agency can address these issues at the renewal date of the permit.

Management Model 4 is recommended by EPA as the minimum level of management for clustered systems with multiple owners and in situations where advanced technology is needed to achieve significant nitrogen reductions such as meeting a 10 mg/L nitrogen effluent concentration. This model provides for frequent and highly reliable O&M through an operating permit issued to an RME, a designated legal entity that has the technical, managerial, and financial capacity to ensure viable, long-term O&M of all systems within their jurisdiction (EPA, 2003a). A state or local agency could function as the RME, or a partnership of the regulatory authority and public or private service providers with the appropriate expertise could serve in this role. Another option is to enlist an existing sanitation or other special district as the RME.

In the Model 4 approach, property owners retain ownership of their systems, while the RME coordinates system inspections, performs required maintenance, and ensures the effective operation of their systems. An RME management approach might be appropriate for economically disadvantaged communities where funding for certain costs (e.g., capital and management costs) can be acquired to support nitrogen reduction systems for property owners who could be challenged to support this service on their own. Because it manages multiple systems within a community, an RME can have access to discounted system installation costs through bidding the construction or upgrade of multiple systems at once, and can generate economies of scale in the O&M of these systems. Both the capital and O&M savings would be passed on to the economically disadvantaged community, potentially making the system more affordable. Further information on the application of an RME can be found in a series of RME Guidance Fact Sheets developed by the Water Environment Research Foundation at: http://www.werf.org/i/c/KnowledgeAreas/DecentralizedSystems/RMEsite/RMEs_2.aspx.

The choice of a management approach depends on the goals a state or local agency sets for nitrogen reduction balanced against the associated O&M and record keeping needed to meet these goals. Management models 3-5 discussed in Table 2 are approaches that have proven successful in other areas and could be considered by the Chesapeake Bay states. The management models are intended as guides for oversight and support to achieve nitrogen reductions for the Chesapeake Bay. While each model can stand on its own, state and local agencies can also use more than one management model within a jurisdiction or use components of individual models as appropriate for their circumstances.

4.0 Additional Components of a Model Program

This section provides additional components of a model onsite system management program beyond the treatment recommendations and management approaches discussed above, and it follows the process that state and local officials typically use to inspect, evaluate, design, construct, operate and maintain onsite wastewater systems. This section also provides recommendations for the approval and verification of advanced treatment systems, and suggests programmatic components to support the management of onsite systems designed to treat for nitrogen.

4.1. Inventory and Inspection of Existing Onsite Systems

States are encouraged to implement onsite system inspection and inventory programs since they provide the most efficient way to identify onsite systems that do not meet the targeted nitrogen reduction recommendations described in Section 2, and to facilitate upgrades to meet these recommendations. They also provide an opportunity to evaluate onsite system performance over time, identify problems needing correction, and educate property owners on the proper use and maintenance of their system.

The locations of existing systems need to be known in order to conduct inspections. Therefore an inventory of existing onsite systems and their treatment capabilities should be created by the regulatory authority. One way this inventory could be initially created is by using all available "desktop" data and information, including board of health records identifying clusters of failing systems, geographic information system (GIS) data, population density information, and proximity to the Chesapeake Bay, its tributaries, or other sensitive water bodies. An initial desktop analysis would enable the regulatory authority to prioritize physical inspections of systems using available information prior to expending resources in the field.

The initial inventory can help identify systems or areas that should be prioritized for inspections as well as manage all information collected during inspections. It could identify high density areas where a large number of onsite systems do not meet the standards, and for which upgrades could be grouped into cluster systems, potentially reducing the cost of upgrade for individual homeowners.

One main outcome of the initial inventory, followed by a prioritized inspection, is the identification of systems that should be upgraded due to one of the following reasons:

- A system fails an inspection because it does not comply with the basic design, construction, or operational requirements contained in the state or local regulations; or
- A system is located in close proximity to the Bay or one of its tributaries and does not meet the performance recommendations in Section 2.

Following the initial inventory, field inspections can verify and confirm a system's location relative to the setback distances, and identify the location of failing systems. All field inspections should be prioritized to address the areas with the highest potential nitrogen contribution or upgrade potential.

Following inspection, it is recommended that all underperforming systems be upgraded within two to five years of the initial inspection such that they meet the nitrogen reduction goals for their location. The inspection process can also help regulatory authorities identify systems that are out of compliance with existing design regulations and allow them to work with property owners to bring them back into compliance. The following are some recommendations for implementing an inventory and inspection program.

ONSITE SYSTEM INVENTORIES

Prior to inspections, the first step is to compile a complete and accurate inventory of all land parcels that contain an onsite system. Some states and local governments are conducting inventories of onsite systems, including states such as Minnesota[5], counties in Maryland, and Rhode Island towns[6].

An inventory can be developed based upon permits that have been issued or other records that document the location of existing onsite systems. In the absence of good onsite system records, areas with onsite systems can be mapped by overlaying locations of centralized sewers on a tax assessor's map or other appropriate figure. The developed properties not adjacent to the existing sewer lines are likely served by onsite systems.

The inventory should be kept in an electronic database that is consistent with any software program used on a state-wide basis. These databases, most often maintained by health officials either at the county or local level, should document specific information such as date of installation, location, soil type, system type, nitrogen treatment capabilities, permit status, violations, and any complaints received. The data can also be used to identify the oldest systems (i.e., most likely to fail) for prioritizing future inspections. A Geographical Information System (GIS) map and database may be the most efficient and effective method to store and analyze these data. More information on available database technologies for onsite systems and how they can be used to document load reductions is provided in Section 4.8.

ONSITE SYSTEM INSPECTIONS

A certified/licensed inspector should inspect all systems and develop an inspection report. The inspection should identify basic information for the system, (e.g., the system type, size, date of installation, functionality, and condition). In addition, the inspector should confirm the location of the system and, therefore, the level of nitrogen treatment needed to meet the applicable nitrogen reduction goals. In cases where a system as-built plan is not available, the inspection report should include a plan showing the location of the various system components relative to seasonal high groundwater, sensitive resource areas, and all other design boundaries such as buildings and property lines.

Conducting inspections to determine the level of nitrogen treatment needed for onsite systems provides the added value of identifying existing malfunctioning systems that may pose a threat to public health and/or the environment. For older systems, recognition of a failure to meet design requirements often does not occur until a formal inspection of the system is conducted. The inspection can also potentially establish links between problems with individual systems and degraded water quality in a nearby well or water body that would not otherwise be identified. The inspection reports should include documentation of any signs of system malfunction or impending malfunction and any system maintenance needs.

INSPECTION FREQUENCY

State and local regulatory authorities should phase inspection requirements such that the highest priority is given to systems located closest to the Bay and its tributaries. The regulatory

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[5] http://www.pumper.com/editorial/2010/04/minnesota-may-inventory-inspect-all-state-septic-tanks
[6] http://www.dem.ri.gov/programs/benviron/water/finance/non/pdfs/munisep.pdf

authority could begin this process by notifying owners of properties with onsite systems that they must have an inspection performed and reported by a certified/licensed inspector within a specified timeframe. EPA recommends that the regulatory authority require inspections based on the inspection frequencies listed below for existing systems. The regulatory authority should plan to complete the inspection process within five years of the initiation of its nitrogen management program.

Ongoing inspections should follow the initial inspection to ensure proper operation of all systems. The recommended frequencies are as follows:

- Once every three years for existing systems outside the 1,000 foot setback to the Bay or its tributaries (EPA, 2010b);
- Semi-annually for advanced treatment systems, cluster systems, and those serving commercial, institutional, or industrial facilities (EPA, 2010b); and
- Prior to site modification, real estate transfer, and at the time of reported violations or complaints for all existing systems.

> The time between inspections could increase from inspections every 3 years to every 5 years for conventional residential systems (i.e., not advanced, not clustered) in areas of headwater states not subject to other local water quality concerns.

Initial and ongoing inspections can represent a challenge to regulatory authorities from both an administrative and staffing standpoint, but can also provide valuable information on how to appropriately manage onsite systems, and should be an integral part of a model program. As discussed earlier in this section, inspections could be prioritized based on an initial desktop analysis of available information. In addition, to increase the number of inspections conducted in a given year while reducing the burden on regulatory authority staff, inspections could be conducted by other qualified personnel. States or local communities could require that this be paid for by property owners.

Recommended Inspection Reporting and Upgrade Requirements

Certified/licensed inspectors should submit inspection reports to the appropriate regulatory authority and should identify any required upgrades, especially those needed to meet the applicable nitrogen treatment levels. EPA recommends that the inspection reports document system status as follows:

- System is functioning and in compliance with current design standards and the applicable nitrogen treatment goals;
- System is functioning and meets current design codes; however, it does not comply with the applicable nitrogen treatment goals; or
- System is malfunctioning based on current design standards.

Onsite systems that do not achieve applicable nitrogen treatment levels should be prioritized for upgrade or retrofit. Systems located within 100 feet of the Chesapeake Bay or its tributaries should be considered the highest priority for upgrade. These systems should be addressed first, by moving them out of the 100-foot setback, if possible, or connecting those homes to cluster systems that discharge outside the setback. These system upgrades should be followed by upgrades to systems located between 100 and 1,000 feet. System upgrades to meet the nitrogen treatment levels should be completed within two to five years from the time of inspection (EPA, 2002), or within a timeline negotiated between the regulatory authority and owner (EPA, 2003a). A regulatory authority could consider a longer upgrade timeframe for owners of functioning out-of-compliance systems installed within the last five years, those who may not have the ability to connect to a sewer system extension, or if it is not financially feasible for the owner to immediately cover the upgrade costs. Upgrades needed to bring systems into compliance with existing standards governing basic siting and construction practices (such as depth to high groundwater requirements) should be completed according to existing regulatory authority timeframes.

INSPECTION AND SYSTEM UPGRADE REQUIREMENT PRIOR TO PROPERTY IMPROVEMENTS

EPA recommends that regulatory authorities require system inspections prior to any site improvements that result in an increase in design flow to ensure that the onsite system can manage the increase. An inspection of the existing system should document that there is sufficient capacity and adequate nitrogen removal capacity for any increased flow resulting from the site modification. Systems that are undersized for the increased flow or that do not provide the applicable nitrogen treatment should be upgraded in concert with any property improvements. System upgrades should include any necessary nitrogen treatment plus any other improvements needed to meet existing design standards such as drainfield sizing requirements or depth to groundwater. The appropriate regulatory authority should oversee the design and construction of any improvements.

4.2. Site Evaluation

A site evaluation is used to identify and map the physical characteristics of the site, including the system's proximity to the Bay or its tributaries, a key factor for determining the level of nitrogen treatment needed for a new or upgraded system. The site evaluation is also used to document regional geologic and hydrogeologic features, the depth to groundwater, the soil type, the proximity to other wetlands or surface waters, and any other information needed to properly design the system.

Since this document focuses on nitrogen management, further information on the site evaluation process focuses on those components that assist in nitrogen reduction, including mapping the depth to high groundwater as this depth plays a role in designing shallow pressurized effluent dispersal systems. As discussed in Section 4.3, site evaluations should also provide information on how climate change and sea level rise will impact the system design.

SEASONAL HIGH GROUNDWATER

Depth to seasonal high groundwater is an important component of the site evaluation. At least two to four feet of unsaturated soil below an absorption field are recommended (EPA, 1993). A greater depth to groundwater will help remove bacteria before the bacteria can enter groundwater and can prevent pathogen outbreaks. Greater depths to groundwater also accommodate fluctuations in groundwater elevation during wet weather.

The estimation of the seasonal high water table along with the observed native soil conditions is critical to the proper design of any drainfield, including a shallow pressurized effluent dispersal system. The following methods are commonly accepted for estimating seasonal high groundwater:

- Observation and measurement of depth to groundwater in a test hole performed during the wettest time of year;
- Identification and interpretation of redoximorphic features. Redoximorphic features, a term that replaces "soil mottling," refer to a blotchy soil color pattern (often gray, red, orange, and/or yellow) resulting from seasonal fluctuation of the water table. Redoximorphic features observed in soil are significant because they indicate the height of the average seasonal high water table which is typically present from year to year along the sidewall of a test hole. Redoximorphic soil features could be evaluated at any time, and multiple evaluations over time would not be needed because redoximorphic soil features are reflective of the actual long term conditions at the site;
- Approximation of seasonal high groundwater based on measurement of depth to groundwater in a test hole at any time of the year, and then adjusted to seasonal high groundwater based on historic seasonal groundwater fluctuations in nearby monitoring wells; or
- Installation of a monitoring well for the measurement of seasonal high groundwater. Monitoring from these wells should occur over an extended period of time to ensure that the measurements capture seasonal and annual variations.

SITE EVALUATION REPORT

Evaluation of the drainfield is a critical step in system selection and design. The evaluation report summarizes the capacity of the site to accept, disperse, and safely and effectively assimilate the wastewater discharge. The following list outlines recommended steps and information for a site evaluation report:

- Identify a site's proximity to the Bay or its tributaries;
- Estimate the proximity to drinking water sources or wellhead protection areas;
- Determine existing soil topography and groundwater conditions;
- Identify any design constraints associated with the proposed drainfield location; and
- Address any additional siting requirements established by the regulatory agency for system approval.

The regulatory authority should require site evaluation reports that include documentation of site conditions using non-technical language when possible. Also, the regulatory authority might require information on observed site characteristics and any possible constraints for use by other site evaluators, designers, regulators, and contractors.

4.3. Onsite Systems and Climate Change

Section 202(d) of the President's Executive Order for the Chesapeake Bay tasked EPA and other federal agencies with the development of adaptation strategies for infrastructure in the watershed to help increase resiliency under changing climate conditions. Given this direction, it is important for state and local officials, as well as property owners, to evaluate climate change impacts on the siting and operation of onsite systems.

The U.S. Global Change Research Program estimates that sea level will rise an estimated two feet by the end of the century in the Chesapeake Bay region[7]. In low lying areas, sea level rise can potentially increase flooding and limit the land suitable for onsite systems based on the horizontal setback distances and associated nitrogen treatment recommendations described in Section 2. In addition, as sea level rises, the groundwater elevation in areas directly adjacent to the Bay will rise proportionately, reducing the separation between the bottom of the drainfield and the seasonal high groundwater level.

A graphic example of the expected rise in sea level can be seen by comparing the water level at a normal high tide to that at an extreme high tide or king tide, the highest astronomical tide of the year. Figure 9 shows the normal high tide and the king tide at a residence in a coastal embayment where the king tide is 1.5 feet above the normal high tide, about the same as the expected sea level rise from climate change. From these photos, it is easy to recognize the potential impacts to an onsite system serving this residence. The setback to the high water line is reduced significantly and one can envision that the depth to groundwater below the system is significantly reduced as well.

Figure 9. Comparison of a Normal High Tide to the King Tide
The king tide is the highest astronomical tide of the year and provides a good visualization of what a normal high tide may be following sea level rise.

EPA recommends that regulatory authorities require designers to consider the changes in the location of the shoreline under changing climate conditions. This consideration is important when siting a system to meet the minimum 100-foot setback between the Bay and a drainfield as recommended in Section 2. A two-foot sea level rise will cause the shoreline to move inland, reducing the current setback of a system installed today. For example, an onsite system installed 105 feet from today's shoreline, consistent with EPA's recommendation that no system be placed within 100 feet of the shore, could be inconsistent with EPA's recommendation at 90 feet from the shoreline under future conditions as sea level rises (Figure 10).

[7] http://www.globalchange.gov/images/cir/pdf/coasts.pdf

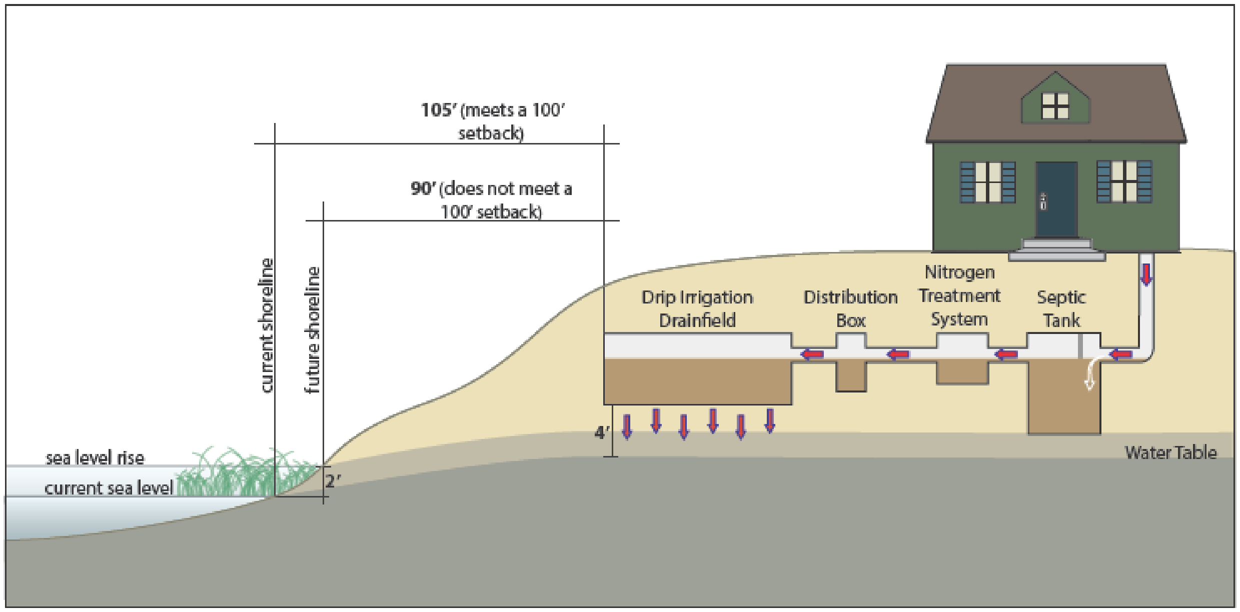

Figure 10. Impacts of Rising Sea Level

EPA also recommends that regulatory authorities and designers evaluate the extent of water table rise associated with sea level rise. Estimating the depth to high groundwater below an onsite system assists designers and regulators in ensuring proper siting and design with adequate separation between the onsite system's drainfield and the seasonal water table in order to prevent pathogens in the wastewater from contaminating groundwater and coastal waters. If a state or local regulatory authority requires a four-foot separation to high groundwater, it may want to consider raising this requirement (perhaps to five or six feet) to adapt to rising groundwater levels associated with sea level rise.

Overall, regulatory authorities are encouraged to anticipate climate change impacts and adapt their onsite programs to accommodate them. These requirements can be adjusted over time as projections of sea level rise and the subsequent rise in groundwater levels are refined. If topographic data are available, GIS can be used to map how sea level rise will impact a region's shoreline and help determine the magnitude of the issue in each community. These maps can also be used to help site new or upgraded systems taking into account rising water levels so that onsite systems will continue to function properly into the future.

4.4. System Design Criteria

All six Chesapeake Bay states have system design criteria, managed at the state or local levels, which govern how onsite systems are constructed within their communities. Recommendations to update or improve these criteria and minimize nitrogen impacts to the Chesapeake Bay are the focus of the discussion that follows.

<u>WATERTIGHTNESS</u>

Regardless of the technology used, watertightness and structural integrity of the septic tank and of other components of an advanced onsite system is critical to the performance of the entire onsite wastewater system. Leaks in the system can contribute to an increased nitrogen load. Detailed design and testing recommendations for septic tank watertightness are provided in Section 4.6 of EPA's *Onsite Wastewater Treatment Systems Manual* (EPA, 2002).

TECHNOLOGY SPECIFICATIONS

Advanced treatment technologies vary greatly from one manufacturer to the next. Some advanced treatment systems feature suspended or attached growth treatment modules located between the septic tank and drainfield and often employ float valves and pumps to control effluent processing. The design and operation specifications of these systems can vary from one system type to another due to differences in treatment components and use of proprietary treatment units. Therefore, for systems approved for use by the state and accepted by the local regulatory authority, EPA recommends that the state or local program collect the following information from manufacturers:

- Description of the various system components;
- Schematics showing the treatment process components and connections;
- Plans and details showing the location of mechanical devices such as pumps, aerators, and mixing units along with power requirements;
- Estimated O&M needs for a typical installation; and
- Identification of system operational constraints.

A system designer licensed/certified by the state, or other appropriate authority approved by the state, should design all onsite systems. The system designer should use the manufacturer's information when selecting the appropriate advanced treatment technology to fit the site, facility, and owner.

Advanced treatment systems have different requirements for flow composition and volume that allow the technology to react optimally to achieve the desired nitrogen reduction. In some cases, chemical additives might be used to adjust the level of available carbon or pH to facilitate the treatment process. The potential need for additives should be identified early in the design process and taken into consideration when choosing a technology, as some technologies might be more appropriate than others, depending on the composition of the wastewater.

In addition to flow composition, the designer should assess whether the system will experience intermittent or short-term peak flows. For example, certain systems may have low weekday flows and high weekend flows. This may require the installation of an equalization tank(s) in the treatment train or an adjustment of other system components in the design such as the pumps and recirculation ratios. A large variation in flow in the treatment train will affect the level of treatment and effectiveness of the advanced treatment technology. Excessive flow will push wastewater through the system at a faster rate than designed, adversely influencing the residence time in system components, which could reduce the level of treatment. Alternatively, flows less than the system design flow might require adjustment of recirculation ratios and system additives to maintain biological activity.

TREATMENT SYSTEM SPECIFICATIONS

System designers should use the specifications and design criteria provided by treatment system manufacturers to select and design a nitrogen removal system. The information submitted by a manufacturer typically includes sufficient detail to allow a designer to assume that under similar conditions the system will meet the same level of treatment. State approvals of alternative technologies often will condition the use of the system on specific design criteria, and designers should evaluate these requirements if they exist. Further information on the system approval process is provided in Section 4.10. Information on O&M requirements provided by the manufacturer should also be incorporated into system design.

DESIGN RECOMMENDATIONS THAT FACILITATE OPERATION AND MAINTENANCE

Regulatory authorities should consider including the following system requirements in design codes to facilitate ongoing inspections, operation, maintenance, and monitoring:

- Risers and covers at grade for all access manholes to septic tanks, distribution boxes, pump chambers, grease traps, etc.;
- Leaching system designs that include inspection ports over lateral lines, or over subsurface structures where chamber type units are used;
- Pressurized systems that have cleanouts with access to grade at the end of each lateral for system inspection, operation, and maintenance;
- Advanced treatment systems that include access for system monitoring and sampling prior to discharge to the drainfield; and
- Advanced treatment system components that include all operation, maintenance, and inspection access requirements per the manufacturer's recommendations.

Regulatory authorities should also consider requiring backup sources of power for advanced systems where effluent does not flow by gravity to avoid unpermitted discharges and wastewater backups. EPA recommends that the following factors be considered for systems that require an electrical power source to treat and discharge effluent:

- Systems should be designed to provide sufficient storage capacity in the event of a power outage; and
- An emergency contingency plan should be prepared in the event of a long-term power outage to prevent a wastewater backup.[8]

For further information on backup generators, see www.epa.gov/reg3wapd/pdf/pdf_drinking/110331-generator-brochure.pdf.

4.5. Shared or Cluster Systems

Shared or cluster systems provide an opportunity for cost savings in both the construction and operation of the system. Building and operating one larger system is often less expensive than operating many small systems unless the homes using the system are far apart and the costs to connect them by sewer are high. Cluster systems also provide an opportunity to offset nitrogen discharges from other systems where upgrades are less feasible. Regulatory authorities and community planners might want to provide additional incentives for developers or homeowners who build and operate systems that may exceed the recommended nitrogen levels. For example, a provision for expedited permitting of cluster systems could offset the ease of obtaining approvals for individual systems. Regardless of the incentives, cluster systems should be tracked

[8] www.epa.gov/safewater/watersecurity/pubs/small_medium_ERP_guidance040704.pdf

and monitored carefully for adequate maintenance, but also for any density bonus or nitrogen credit awarded as described below.

Jurisdictions should consider implementing incentives to encourage cluster systems in parallel with an education and outreach program for developers and homeowners (See Section 4.12). There are many benefits to cluster systems, but homeowners and developers might not be familiar with them, or could find it more convenient to work with traditional development layouts and systems. If cluster systems are designed to exceed the recommended performance levels, a density bonus (such as an increase in the number of houses allowed on a property) could be offered to the property owner as an incentive. An additional density bonus might be offered for cluster systems allowing hook-ups from existing properties with conventional systems (i.e., the upgrade of a neighbor's system) if the overall cluster system meets or exceeds the required nitrogen treatment levels. For example, if the required treatment level is 20 mg/L of nitrogen, but the cluster system meets the concentration of 10 mg/L or lower, a developer could be granted a density bonus that would allow a greater density of building units at a site than may be allowed under the applicable zoning and other local regulations.

> Wastewater Reuse:
> Permit applications for larger cluster systems could be encouraged to investigate wastewater reuse opportunities for the cluster system. A density bonus for wastewater reuse implementation could incentivize developers to treat wastewater to reuse standards and achieve beneficial reuse and reduced nitrogen loading.

EPA recommends cluster systems with advanced nitrogen removal technologies for all new development and for densely populated areas (EPA, 2009a and 2010b). Jurisdictions who want to encourage cluster systems should review their growth management strategy and consider the management responsibilities and financial guarantees that they need to require from system owners and/or management entities. While cluster systems can be easily implemented for new development, retrofitting an existing area to a cluster system may pose both financial and engineering challenges. For example, the cost of piping the wastewater from each individual property to the cluster system could be a significant expense, particularly in low density areas. The construction of new collection systems and the availability of land for cluster systems also pose engineering challenges. Dense areas or areas with historical failures might provide the most opportunities for retrofitting conventional systems to cluster systems.

States could require developers and homeowners seeking to cluster their systems to consider alternatives like connecting nearby existing systems to their cluster systems. This approach could also potentially include the connection of disadvantaged or underserved communities to the cluster system. Suitable incentives could be provided to encourage these activities.

Cluster system applicants should demonstrate that they have adequate agreements in place to provide for annual O&M costs as well as replacement costs with allowances for the regulatory authority to step in, if necessary, to ensure O&M is conducted. The use of an RME to operate and maintain the system provides a higher level of oversight and is recommended by EPA for cluster systems. A detailed O&M plan with assigned responsibilities and frequencies for critical tasks should be developed. Provisions giving the regulatory authority or RME a right-of-entry on the property should be created by the designer and approved by those owning and/or operating the system. Cluster systems should be inspected at least twice a year. Cluster system O&M should follow the recommendations described in Section 4.7.

Large cluster systems sited close to the Chesapeake Bay with large effluent volumes may warrant reducing total nitrogen concentrations further than the recommended standards in this document. Some onsite treatment technologies may also be limited in size, and the design for large onsite systems may be closer to that of a discharging system than that of an individual onsite system.

4.6. Construction Inspection and Start-up

Poor installation can adversely affect performance of both conventional and advanced systems that rely on soil dispersion and treatment (EPA 2010a). Most jurisdictions allow installation or construction to begin after issuance of a construction permit, which occurs after the design and site evaluation reports have been reviewed and approved by the regulatory authority. Performance issues linked to installation/construction typically result from soil wetness during construction, operation of heavy equipment on soil infiltration areas, use of unapproved construction materials (e.g., unwashed aggregate containing clay or other fines), and overall construction practices (e.g., altering trench depth, slope, length, differing subsoils, location). The effects of improperly installed soil-based systems generally occur within the first year of operation in the form of wastewater backups. The effect of improper construction practices might not be immediately evident and could take years to manifest themselves in the form of degraded groundwater or surface water quality.

> *"Towns that contemplate the wide-scale use of Innovative/Alternative (I/A) systems to address nutrient issues should understand that the oversight of operation and maintenance of I/A systems is an essential part of ensuring a level of success. Quite simply, I/A systems that are not regularly inspected and occasionally monitored will not achieve treatment objectives."* (Heufelder et al., 2007)

Because of the increased complexity of advanced nitrogen treatment systems, regulatory authorities are encouraged to require a greater level of construction oversight. The regulatory authority may consider requiring all onsite systems under their jurisdiction to be constructed by certified installers. EPA recommends that both the regulatory authority and other certified professionals conduct inspections at several stages during the system installation process to ensure compliance with design and regulatory requirements.

CONSTRUCTION INSPECTIONS

The following recommendations are provided for construction inspections to ensure nitrogen treatment systems function properly. Prior to the start of construction, the regulatory authority should require the installer to stake out system components to ensure their proper location and to check that all critical setbacks are maintained (for example, see Delaware DNREC, 2005). The certified installer should contact the regulatory authority 24 hours prior to the start of construction to obtain authorization to begin construction. The regulatory authority might choose to field verify the stakeout locations prior to authorizing the start of construction.

Regular inspections should be conducted by both the regulatory authority and the system designer to ensure the proper installation of the onsite system. It should be the installers' responsibility to contact the designated inspector to request all required inspections, and installers should provide a minimum of 24 hours notice for the requested inspection. The inspections could be performed by one or more of the following:

- Regulatory authority staff;
- A certified designer or his/her approved representative; and
- Any other person officially authorized by the regulatory authority to perform inspections of onsite systems.

The regulatory authority could require both the designer of record and other authorized personnel to perform additional critical inspections in order to monitor the rest of the installation. It is recommended that the regulatory authority consider requiring the following inspections during the system installation process to ensure compliance with applicable design and regulatory requirements.

Bottom of Bed Inspection

Upon completion of the excavation of the dispersal field, the system installer should request an inspection to confirm that the underlying soil material meets the design requirements. A bottom of bed inspection should be conducted prior to beginning construction of the dispersal bed to confirm that the underlying soil material in the area of the dispersal field is consistent with the site evaluation and the bottom of bed elevation will meet the groundwater separation requirements.

> *Septic System Checkup: the Rhode Island Handbook* provides information about septic system inspections. It also provides guidelines for performing inspections and answers a number of important questions regarding the operation and maintenance of septic systems.
> http://www.dem.ri.gov/pubs/regs/regs/water/isdsbook.pdf

Pre-Cover Inspection

A pre-cover inspection should be conducted prior to backfilling the components of the treatment system to confirm proper installation, invert elevations, groundwater separation, and setback requirements. Prior to backfilling, the regulatory authority should require the installer to provide a manufacturer certification that they tested the septic tank for water tightness or conducted an in-field water tight test. It is typically the responsibility of the system installer to request the pre-cover inspection prior to backfilling. Upon completion of the inspection and confirmation of all applicable critical design requirements, the system may be covered as specified in the approved permit. The regulatory authority should require backfilling of the system within ten days of a satisfactory pre-cover inspection (weather permitting).

Final Cover Inspection

Systems with earthen caps and all mound systems should have a final cover inspection. It is the responsibility of the system installer to request the final cover inspection.

An inspection form should be completed by the system designer for each inspection and provided to the regulatory authority as documentation that the inspections have been completed and the design is in compliance with the operating permit. During the entire construction process, the installer should submit all proper construction materials documentation to the designer of record for review and approval prior to installation. The submittals should include sand media, aggregate, piping, septic tank, distribution box, and all other wastewater components per the specified requirements. The designer of record should be responsible for maintaining all records and documentation from the construction for a stipulated time period as deemed appropriate by the regulatory authority.

SYSTEM START-UP

A representative of the advanced treatment manufacturer should be required to provide system start-up and initial testing services prior to operating the onsite system. These services could be required as a condition of approval for the use of the technology, and could be provided by a manufacturer's representative or a manufacturer certified service provider. The system start-up service should include an inspection of the overall technology installation to ensure it meets the manufacturer's recommended installation guidelines, and a start-up of the system to ensure proper function and operation.

CERTIFICATE OF COMPLIANCE

The system designer should verify that the construction of an onsite system is substantially in compliance with the approved plans, specifications, and conditions of the operating permit. After the completion of the installation, inspections, and system start-up, this process should entail a construction report provided to the regulatory authority stating that the system complies with the regulations and operating permit requirements. An "as-built" drawing showing the installed locations of all system components, inverts, and swing ties to manholes and risers should also be provided to the regulatory authority by the designer. If any approved changes were made to the system, these changes should be reflected and noted in the "as-built" drawing.

Changes to a permit which result in a minor relocation of the onsite system could be done by submitting a pre-inspection "as-built" drawing to the regulatory authority to ensure the system is still located within approved soils and that all required setback distances are met. The regulatory authority should develop a field guide brochure for system installers that can be used to assist with installation and that outlines allowable design tolerances not requiring regulatory design approval. The completed "as-built" drawing and certificate of compliance should be recorded with the regulatory authority. Upon receipt of all required documentation and confirmation of compliance with the regulations and conditions of the permit, the regulatory authority should issue a certificate of compliance.

4.7. Operation and Maintenance

EPA recommends that all onsite systems be operated and maintained properly to ensure that the system performs as designed for its service life. Both individual and clustered systems should be monitored by properly trained service providers to ensure proper performance and achievement of the regulatory authority's goals (EPA, 2002). O&M for most conventional systems typically requires minimal service and could include educating the user on proper use and care, cleaning effluent filters, and periodic tank pumping. The proper O&M is critical for the more complex designs of nitrogen reducing onsite systems to ensure the successful long-term operation of these systems to meet designed performance levels. Systems that employ advanced treatment technologies with mechanical components require more intensive and frequent O&M to be performed by properly trained and certified service providers. The maintenance requirements for these systems are typically provided by the manufacturer to the operator and could also be described as part of a state's approval of an advanced technology (discussed further in Section 4.10). A sample O&M schedule for flows up to 40,000 gallons per day (gpd) is provided in Table 3.

Table 3. Sample Minimum Operation and Maintenance Schedule for Onsite Systems up to 40,000 gpd

Average Daily Flow	Initial Visit	Regular Visits Following Initial Visit
≤ 1,000 gpd	Within 180 calendar days of the issuance of the operation permit	Every 12 months
>1,000 gpd to10,000 gpd	First week of actual operation	Quarterly
>10,000 gpd to 40,000 gpd	First week of actual operation	Monthly

Source: Virginia Department of Health, 2011 Regulations for Alternative Onsite Sewage Systems, 12 VAC 5-613

EPA recommends that the regulatory authority provide owners/users with educational materials regarding onsite system use and care such as the Chesapeake, VA Health Department's *Onsite Sewage Systems Pamphlet* (Chesapeake, 2008) or the *EPA's Home Owner's Guide to Septic Systems* (EPA, 2005a). Educational materials could be tailored to specific local conditions.

Larger decentralized or cluster systems designed to achieve greater nitrogen removal than conventional systems generally need frequent maintenance. If system failures occur, these larger onsite systems can pose a greater risk to the surrounding environment and the receiving waters due to the volume of effluent. EPA recommends management by an RME for these larger decentralized or cluster systems due to the greater environmental risk these systems pose. Influent and effluent sampling and analysis should be conducted regularly by the RME to confirm a system is operating properly and to help diagnose any identified problems. EPA's specific recommendations for the O&M of nitrogen treatment systems, including the monitoring of their performance, follow below.

SEPTIC TANK PUMPING

Most tanks need to be pumped out every three to five years to ensure they function properly and do not clog. However, the regulatory authority should consider several factors when determining the pumping frequency requirements. These factors include (Mancl and Magette, 1991):

- Capacity of the tank;
- Flow of wastewater (based on family size); and
- Volume of solids in the wastewater (more solids are produced if a garbage disposal is used).

Malfunctions will not occur immediately if an onsite system is not pumped regularly; however, continued neglect can lead to system failure due to the clogging of the dispersal field with solids. Table 4 provides an example of how pumping frequency can vary based on tank and household size.

Table 4. Example of Septic Tank Pumping Frequencies Based on Tank and Household Sizes (EPA, 1993)

Tank size (gal)	Household size, number of people									
	1	2	3	4	5	6	7	8	9	10
	Pumping frequency, years									
500	5.8	2.6	1.5	1	0.7	0.4	0.3	0.2	0.1	-
750	9.1	4.2	2.6	1.8	1.3	1	0.7	0.6	0.4	0.3
1,000	12.4	5.9	3.7	2.6	2	1.5	1.2	1	0.7	0.7
1,250	15.6	7.5	4.8	3.4	2.6	2	1.7	1.4	1.2	1
1,500	18.9	9.1	5.9	4.2	3.3	2.6	2.1	1.8	1.5	1.3
1,750	22.1	10.7	6.9	5	3.9	3.1	2.6	2.2	1.9	1.6
2,000	25.4	12.4	8	5.9	4.5	3.7	3.1	2.6	2.2	2
2,250	28.6	14	9.1	6.7	5.2	4.2	3.5	3	2.6	2.3
2,500	31.9	15.6	10.2	7.5	5.9	4.8	4	4	3	2.6

SAMPLING AND MONITORING

EPA recommends that all onsite systems be sampled at intervals established by the regulatory authority based upon the complexity of the design, technology approval requirements, system size, and the receiving environment. To document compliance with any performance criteria adopted by the regulatory authority and to measure the effectiveness of the advanced treatment system, the regulatory authority should require sampling and testing of system influent and effluent (prior to discharge to the dispersal area). The regulatory authority should consider requiring sampling for smaller systems (<1,000 gallons) during the required O&M inspection and during any incident response. Similar to the timing for maintenance visits, sampling for larger onsite systems is recommended at more frequent intervals and may include additional sampling parameters.

Typically, sampling is conducted for total, organic and nitrate-nitrogen, biological oxygen demand, and total suspended solids, although the parameters for a specific system will depend on the effluent concentrations it should meet. NSF International has developed sampling protocols for the testing and verification of alternative onsite technologies that provide information on the types of samples to collect (such as grab versus composite samples) and the proper locations for influent and effluent testing to be conducted (NSF, 2000). The sampling and monitoring program could be implemented by the regulatory authority or a certified O&M provider (such as an RME) with oversight by the regulatory authority.

4.8. Data Management, Record Keeping, and Tracking of Nitrogen Reductions

The homeowner, system operator, or the RME and the regulatory authority typically share responsibility for general record keeping for any onsite system. EPA recommends additional record keeping and data management for nitrogen treatment systems to track nitrogen reductions relative to targets or goals in the state WIPs and the Bay TMDL. Achieving these goals may be best supported by some form of tracking for construction of new onsite systems, retrofitting of existing systems with nitrogen removal technologies, and replacement of onsite systems with sewer or cluster system connections resulting in lower nitrogen loads. Information to include in the database relative to nitrogen treatment is discussed below.

As introduced in Section 4.1, EPA recommends implementing a database tracking system to help inventory and assess the number of onsite systems and their ongoing performance (EPA, 2009a). A statewide database tracking system for onsite systems could help track nitrogen reduction progress toward implementing the Bay TMDL. Local regulatory authorities can populate the database by entering system data for their jurisdictions. This database can be populated in a first phase with information about new and upgraded systems based on permit applications, with a goal of including existing systems at the time of inspection. Sufficient geographic information (e.g., latitude and longitude) entered for each system would enable each jurisdiction to map existing systems, analyze patterns (e.g., failures, lack of maintenance), conduct risk assessments, and evaluate feasibility and effectiveness of sewer networks.

Both the *Guidance for Federal Land Management in the Chesapeake Bay Watershed* (EPA, 2010b) and the EPA *Handbook for Managing Onsite and Clustered Wastewater Treatment Systems* (EPA, 2005b) recommend that system inventories provide, at a minimum, geographic location, system type, design capacity, ownership, installation date, and maintenance information and dates (e.g., tank pump out, inspections, repairs). Both publications indicate that the more advanced recordkeeping programs feature integrated electronic databases with handheld field unit data entry[9]. For water quality and nitrogen reduction tracking purposes, EPA recommends additional data, including:

- Registered complaints;
- Expected nitrogen load, or nitrogen reduction obtained from an advanced system;
- Deed restrictions tied to the onsite system, if any;
- Actual flows, when measured; and
- Ability to track nitrogen offsets and/or credits.

Tracking and comparing of actual and design flows, particularly for cluster systems, provides information on systems with excess capacity available and identifies opportunities for connection of new or existing systems.

A number of databases have been developed for managing onsite systems at various levels, but most commercially available databases are not free of charge. In an effort to provide a free alternative, EPA developed The Wastewater Information System Tool (TWIST)[10], a free management tool to enable state and local health departments to inventory and manage small onsite systems in their jurisdictions. The software (http://water.epa.gov/infrastructure/septic/The-Wastewater-Information-System-Tool-

[9] These field data entry units are electronic devices that enable electronic data collection in the field during the inspections. The data from these units can then be uploaded to the main system after inspectors return from their inspections.

[10] http://water.epa.gov/infrastructure/septic/The-Wastewater-Information-System-Tool-TWIST.cfm

TWIST.cfm) can allow regulatory authorities to track information related to homes and facilities served, permits, site evaluations, system types, inspections and complaints. While free, TWIST has a number of limitations, including use limited to a single computer, and the lack of a hotline or customer assistance line.

> The State of Indiana is using EPA's TWIST database as an inventory platform for onsite systems in the Lake Michigan coastal area. It also plans to expand the database statewide as a Web-based system (EPA, 2010d).

In addition, EPA recommends the use of EPA environmental justice tools including mapping and GIS to scientifically identify and prioritize environmental justice areas. Computer based mapping databases can help track and locate disproportionate concentrations of pollution.

4.9. Professional Training and Certification Programs

TRAINING ONSITE WASTEWATER TREATMENT SYSTEM PROFESSIONALS

Given the complexity of most nitrogen treatment technologies, a variety of professionals and technicians have an increased role in the successful design, installation, and management of these advanced onsite wastewater systems. A statewide training and certification program could ensure that service providers and wastewater professionals are qualified to design, install, and operate various advanced treatment systems. For a management program to be successful, it should require onsite system professionals to have a solid understanding of processes, system components, performance criteria, O&M requirements, and laws/regulations as demonstrated through training completion or certification (EPA, 2010b).

EPA recommends that the state wastewater regulatory authority, health department or other appropriate entity develop and administer a statewide training, testing, and certification program for installers, designers, inspectors, O&M providers, pump haulers, site evaluators, and regulatory staff. States should also develop programs through agreements with other educational or governmental agencies such as local colleges, or through approved third party programs such as system manufacturers.

As part of the advanced technology approval process by the regulatory authority, the manufacturer should provide an installation manual and training program to the approving agency for review. The manufacturer should be required to provide in-state training and potentially certification programs on the proper installation and O&M of their equipment to ensure that qualified onsite design professionals are locally available to design, install, and operate the systems.

Examples of state programs of varying complexity can be found in "*Training and Certification Programs – A Necessary Part of Onsite/Decentralized Wastewater Treatment,"* a discussion paper on certification prepared by the California Wastewater Training and Research Center (CWTRC). Based upon the CWTRC findings, the following components should be considered as part of the certification process for wastewater professional disciplines when developing a comprehensive statewide program:

- Professional Licensure;
- State Certification including:

- Classifications or categories within the disciplines;
- Training/experience requirements;
- Examination;
- Fees; and
- Continuing Education Credits.

As part of this program a list of certified onsite system professionals should be maintained by the regulatory authority and made available to the general public.

RECIPROCITY

States are encouraged to consider adopting universal certification requirements that would allow for reciprocity. Reciprocity between neighboring states could be an effective way to reduce the certification costs for both the state agencies and the wastewater design professionals by minimizing or eliminating overlap in administration, oversight, and training programs. The cooperation between states allows wastewater professionals in neighboring states to efficiently and effectively provide quality services across state boundaries.

Due to the variability observed in current state certification requirements, reciprocity between states should be well coordinated prior to developing individual state certification programs. The CWTRC found that terminology was not consistent when reviewing various state requirements. The terms "registration", "certification", "license", "permitted", and "approved" were all used differently among various state regulations. This inconsistency between states could prove to be a stumbling block when considering certification reciprocity between states. In an effort to minimize cost and inconsistency, neighboring states could consider the creation or use of an existing non-profit regional onsite wastewater organization to oversee the certification and training of wastewater professionals. The establishment of such a system could be similar to the training and certification of wastewater treatment plant operators. Regional organizations can efficiently coordinate efforts on a regional basis and serve as a valuable resource to state agencies.

The discussion that follows encompasses the wide range of wastewater professionals that could be included in a required statewide certification program. Not all wastewater professionals need to be included in the state certification and very few states include all the disciplines listed below. As wastewater treatment requirements are increased and onsite wastewater treatment systems become more advanced, a comprehensive certification and training program including all disciplines should be encouraged to ensure the proper design, installation, operation and maintenance of these systems.

ENGINEERS AND SYSTEM DESIGNERS

Certification programs for system designers should require qualifications beyond general professional licensure (i.e., professional engineer, or, P.E.) and include additional prerequisites such as training, experience, and testing on the design standards and requirements established by the regulatory authority.

Some states have established certified design categories, or levels, for design professionals based upon the complexity of the wastewater treatment system design. A program following this format may allow less complex designs or repairs to be completed by someone other than a professional engineer, such as a registered land surveyor or installer who meets the certification requirements.

SITE EVALUATORS

Site evaluators should comply with applicable federal, state, tribal, and local requirements in the evaluation of sites for wastewater treatment and dispersal (EPA, 2003b). The certification program should include training and testing on the latest soil evaluation and reporting requirements set by the state or regulatory authority. The regulatory authority should consider prerequisites, such as a substantial knowledge of soils, soil morphology, groundwater hydrology and geology, as most onsite systems use the underlying soil of the system as the final treatment and dispersal medium.

A site evaluator should demonstrate a basic understanding of chemistry, wastewater treatment, and water movement in the soil environment, as well as knowledge of onsite system operation and construction. Many states, including Delaware, Virginia, Pennsylvania, Rhode Island, and Massachusetts have developed statewide certification programs for site evaluators. As part of the certification process, an examination should be required for certification and include a written and field component. The examination should test the applicant on the following:

1. Principles of onsite wastewater treatment;
2. Applicable state regulations;
3. Geology and soils of the region;
4. Soil textural analysis and profile description;
5. Estimating mean seasonal high groundwater elevations using soil morphology; and
6. Soil moisture and drainage characteristics of soils.

INSTALLER

The rapidly changing technologies available for advanced wastewater treatment make it important for state and local regulatory authorities to certify system installers. Certification programs for installers ensure that these professionals understand the design requirements, installation techniques, technical issues, regulatory requirements, and how the treatment train handles incoming wastewater at each stage of the treatment process.

The State of Idaho provides two types of registration (certification) permits required for onsite installers:

1. A standard or conventional system and basic alternative system installer's registration permit; and
2. A complex alternative system installer's registration permit required to install evapotranspiration systems, extended treatment systems, lagoons, large soil absorption fields, pressure distribution systems, intermittent sand filters, in-trench sand filters, sand mound, or other systems as specified.

The Idaho program includes an examination, annual renewal, continuing education (refresher course every three years), and the posting of a construction bond of $5,000 for standard and basic alternative systems or $15,000 for complex alternative systems.

O&M Provider/Pumper/Hauler

Since nitrogen treatment systems are more complex than conventional onsite systems, specialized training and certification of O&M providers is required by many state regulatory agencies. Contractors who pump, transport, and discharge septage should also be certified to ensure that they have basic training on safety, legal requirements, identification of system problems or warnings, and proper operating techniques.

For O&M providers, North Carolina requires that professionals engaged in installation and O&M of onsite wastewater treatment systems be certified by the state Water Pollution Control System Operators Certification Commission. Certification requires meeting certain prerequisites and completion of a subsurface water pollution control system operator training sponsored or co-sponsored by the Commission. Certified professionals must then be registered with the local health departments to practice within their jurisdiction. In this example, the state certifies the professionals and the local jurisdictions have a registration program.

Inspectors

In order for inspectors to keep up with changing technologies of advanced onsite wastewater treatment, the certification program for inspectors should include training and testing for the latest inspection and reporting requirements set by the regulatory authority. Renewal of inspector license/certification should be contingent on individual system inspectors obtaining continuing education credits to meet requirements set by the state or regulatory authority.

In Delaware, onsite wastewater treatment system inspectors are certified as Class H System Inspectors. This certification authorizes individuals to inspect, investigate, and collect the necessary data to determine the operational condition of onsite wastewater treatment and disposal systems. Any person seeking a license is required to pass an examination prepared and administered by the Delaware Department of Natural Resources and Environmental Control to demonstrate relevant competency and knowledge.

Funding

Funding for certification and training programs should be sustainable and supported by wastewater utility fees to the extent practicable and should not place an undue burden on the wastewater professionals requiring certification. Some state programs are partially funded through federally funded sources, such as the Clean Water Act Section 319 non-point source grant funding program (http://water.epa.gov/polwaste/nps/cwact.cfm).

Continuing Education

The state or regulatory authority should require and support continuing education units (CEUs) as part of the renewal process for all certified professionals. CEUs should be made available through established training centers or curricula offered through state universities or community colleges. A CEU program provides an increased level of professionalism to the wastewater community and encourages organizations to offer CEU certified courses. State professional CEU requirements typically range from four to five CEUs per year for each individual certification held. Certification renewal is typically required every two to three years.

The manufacturers of advanced treatment technologies can often help support the CEU system by offering workshops and training seminars approved by the regulatory authority for CEUs. As part of the approval process, the manufacturer is often required to provide in-state training for their products to ensure that local wastewater professionals are qualified to design, install, and operate the systems. These training seminars often provide a cost effective continuing education opportunity for both the state and wastewater professionals.

NATIONAL EDUCATION AND TRAINING RESOURCES

Education and training resources are available at the national level for a variety of professionals and technicians. In recent years, a number of national organizations have created training programs at the national level through collaborative processes among their memberships. Training and accreditation programs by national organizations could be incorporated into state and local administrative frameworks to alleviate some of the training duties for environmental health regulators, as well as help create a uniform standard across state and county jurisdictions.

4.10. Approval and Verification of Advanced Treatment Systems for Nitrogen Reduction

Many states have developed their own technology approval and verification process, which usually applies to a number of advanced technologies, including nitrogen reduction systems. EPA encourages states to continue to evaluate and approve appropriate technologies for nitrogen reduction and also to investigate how they could collaborate further in approving new treatment systems.

EPA recommends that a successful technology verification process for nitrogen reduction include, at a minimum, steps to:

- Verify nitrogen reduction capabilities under constant and varying seasonal flows in both a controlled setting and in real world applications;
- Describe technology-specific design and O&M requirements needed to properly operate the system that the designer could use in their plan development;
- Confirm that recommended O&M requirements are sufficient to obtain consistent nitrogen reduction; and
- Ensure availability of training or certification from the manufacturer for O&M of the system.

A database of technologies approved by the state with their approved nitrogen removal levels should be made easily accessible to the public, including developers and homeowners. The database should enable a designer to promptly understand what the technology is approved for, the documented nitrogen removal capability, and the design, siting, and O&M requirements. These data are particularly important if the treatment performance is tied to climate or soil type. This database should be updated regularly with the approval of new systems. A state could use its own database or use that of a third party organization that evaluates onsite system technologies.

In addition to existing state verification processes, two national verification and certification programs are available for new systems. The Environmental Technology Verification (ETV) program[11] develops test protocols and verifies the performance of innovative technologies for air, water, and land that have the potential to improve protection of human health and the environment. As of April 2011, ETV has verified over 400 innovative technologies. Based on its protocol for testing residential wastewater treatment technologies for nutrient reduction, only six technologies verified for residential nutrient reduction showed significant nitrogen reductions (51% to 64%) for residential onsite systems.[12]

The other verification process at the national level is the NSF Certification program[13] for advanced treatment units, which is a different process from the ETV program described above. NSF is accredited by the American National Standards Institute (ANSI) to develop and publish American National Standards. The NSF/ANSI Standard 245 applies to residential onsite systems designed to provide nitrogen reduction. The standard applies to systems with rated capacities between 400 and 1,500 gpd that meet certain effluent concentrations averaged over the six-month evaluation period, including a minimum 50% removal of total nitrogen from the effluent. As of April 2011, a total of 51 nitrogen reducing systems from nine manufacturers met the NSF/ANSI Standard 245.

States are encouraged to use consistent methods and standards for technology approval and verification. Recognizing approval from the national verification and certification organizations can help streamline the adoption and use of technologies that meet nitrogen reduction goals. This process improves choice for RMEs, developers and homeowners, fosters competition among system manufacturers, and increases the likelihood that effective nitrogen-reducing systems will be installed. There is currently no national clearinghouse for innovative systems, but states could simplify the approval process for systems verified at the federal or national level, either through the ETV or the NSF/ANSI Standard 245. These two verification and certification programs apply primarily to small onsite systems, which are the focus of this model program[14].

> Example: Eight states (MA, PA, NJ, NY, CA, IL, MD, and VA) have signed the Technology Acceptance Reciprocity Partnership (TARP) which prescribes a technology verification protocol for streamlining the approval of new environmental technologies, potentially including wastewater treatment technology. Regulators in each participating state oversee field testing of technologies across the country. The host state performs a critical evaluation of the performance data required in the common protocol and then shares its analysis with collaborating states. Such an approach could serve as a model for reciprocity on the approval of onsite nitrogen treatment systems

EPA encourages states to explore a reciprocity program for testing, where a system approved in another state could either automatically be approved, or be approved with an easier verification process. States are encouraged to work together to compare and improve their verification programs so as to streamline the process and encourage reciprocity opportunities.

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[11] http://www.epa.gov/etv/

[12] http://www.epa.gov/nrmrl/std/etv/pubs/04_vp_nutrient.pdf

[13] http://www.nsf.org/business/wastewater_certification/index.asp?program=WastewaterCer

[14] Larger community systems are more likely to use technologies similar to larger wastewater treatment systems, and can refer to the 2009 EPA Nutrient Control Design Manual available online at: http://www.epa.gov/nrmrl/pubs/600r09012.html.

A reciprocity testing program creates common protocols and data requirements for approving wastewater treatment technologies. States participating in a reciprocity program would make the results of their ongoing technology evaluation and regulatory approval efforts accessible to other states. This approach allows one state to use data collected in another for its own permit or approvals process for new technologies.

A shared verification process can reduce costs and save time for state regulators by reducing duplicative testing and review. This approach would also reduce burdens on vendors and promote verification of new technologies and innovation.

States should also work with local regulatory authorities or RMEs to ensure the ease of adoption and approval of advanced treatment systems. Regulatory authorities and/or RMEs should be informed regularly of newly approved and verified systems, particularly if the advanced systems are meeting some of the stricter nitrogen goals (e.g., 10 mg/L).

4.11. Nutrient Trading or Offset Programs

Development or expansion of a nutrient trading or offset program that includes onsite systems could play an important role in creating incentives to achieve nitrogen reduction goals. This is true for reducing nutrient loads from existing sources and for managing increased loads associated with future growth or development.

For existing sources, if a state or local community is achieving a greater reduction than originally planned for one nitrogen source, that additional nitrogen removal might under appropriate conditions be used to credit, or offset, nitrogen discharges from another source. For example, if a state exceeds its nitrogen reduction target from agricultural sources, it might be able to reduce the loading reductions planned for onsite systems. Conversely, the additional nitrogen removed through a successful onsite program could potentially be credited to the agricultural sector, reducing the extent of reduction measures implemented on farms. States should review all nitrogen reduction opportunities available to them, and identify and prioritize the most cost-effective ones. Additional discussion on nutrient trading programs can be found in *Water Quality Trading Policy* (EPA, 2003c), *Water Quality Trading Toolkit for Permit Writers* (EPA, 2007), and *Chesapeake Bay Program Nutrient Trading Fundamental Principles and Guideline* (Chesapeake Bay Program, 2001).

> Example: The Cape Cod Commission, a regional planning agency on Cape Cod, requires developers of new properties to offset their nitrogen load in watersheds to nitrogen limited estuaries. They must treat wastewater from an abutting property or find a comparable offset such that the impact from their new project is offset by reducing the nitrogen load from another source in the watershed, thereby minimizing impacts to the estuary. The State of Massachusetts requires a similar offset for wastewater projects with flows in excess of 10,000 gallons per day.

It is important to recognize that future load increases are not specifically accounted for in the load allocations contained in the Chesapeake Bay TMDL. The Chesapeake Bay TMDL identifies the load reductions needed based on the 2009 loadings to the Bay. Since all the Bay states chose to not include an allocation for increased loadings due to growth within the TMDL, the TMDL only contemplates an increased nutrient load, such as a new or expanded onsite system, if it is offset by a load reduction or credit that is clearly understood and quantifiable. Appendix S of the TMDL (EPA 2010c) provides EPA's expectations for offset programs, including the common elements for conducting a credible and transparent offset for any increased nutrient load to the Chesapeake Bay. They include:

- The establishment of an appropriate baseline to use in measuring the extent of any proposed nutrient credit or offset;
- The documentation needed to verify the extent of nutrient load provided by a new source and the amount of nutrient reduction provided by a credit or offset;
- An evaluation of the appropriateness of the offset based on its location relative to the new load source;
- The timing of the offset of the new source versus when a credit comes into effect;
- The techniques to ensure an offset will continue to exist into the future, including the need to identify a responsible party to enforce the offset; and
- The accountability system(s) to confirm the offset is credible and can be tracked over time.

Example: Nutrient trading between fertilizer applications on a golf course and onsite systems to meet a TMDL. A portion of the Town of Brewster, Massachusetts lies within the Pleasant Bay watershed, a coastal estuary where a TMDL calls for reductions in the amount of nitrogen discharged within the watershed. The Town is working to reduce the amount of nitrogen fertilizer applied to two town-owned golf courses to offset the nitrogen from onsite systems discharging to groundwater within the watershed. A 50% reduction in fertilizer applications on the golf courses is feasible and will minimize the need for expensive upgrades to onsite systems to meet the TMDL.

The management of any new or increased source within the watershed should follow these procedures to ensure consistency with the TMDL, and compliance with the Clean Water Act and federal regulations.

4.12. Stakeholder Engagement and Education

A successful management program should engage all stakeholders, including homeowners, local officials, service providers, and developers. Stakeholders that understand the need for onsite management programs, along with the public health and economic benefits of such programs, will be more likely to support program implementation.

State and local governments and organizations can use a variety of means to engage stakeholders such as distributing information through brochures or fact sheets. Many opportunities exist for reaching out to stakeholders, including mailing of literature, brochures, or fact sheets with existing mailings such as a water or tax bill. EPA and its partners have developed and shared outreach materials for communities including EPA publications on onsite systems, and a Nonpoint Source Outreach Toolbox[15]. In addition to EPA's Onsite Wastewater Treatment

[15] http://cfpub.epa.gov/npstbx/index.html

Systems Manual[16], relevant EPA publications and informational materials include EPA's SepticSmart[17] website that provides information related to homeowner education and stewardship of their onsite systems.

Beyond printed materials, local governments and organizations might want to engage stakeholders through interactions at civic events such as school events or county fairs to provide citizens with opportunities to ask questions and provide feedback. In watersheds with active local environmental programs, communities could collaborate on a "clean watershed day" or develop locally-specific outreach materials for higher impact. Other multi-media outreach opportunities include advertisements on local cable channels and newspapers to educate and encourage owners to upgrade their systems by providing information on funding options or upgrade incentives. The Delaware Department of Natural Resources and Environmental Control used this type of promotion for its onsite system loan program.[18] When community government or organizations can provide funding for upgrades, stakeholder engagement should focus on outreach to historically underserved or economically disadvantaged communities that would most benefit from the available funding. When available, funding should be prioritized based on need.

Successful engagement of stakeholders will provide messages tailored to a particular audience (e.g., homeowners, real estate professionals, building contractors, other service providers). While the information provided for each type of stakeholder can be similar, the exact content and level of detail might differ. Proposed rules and regulations, such as requirements for homeowners to upgrade their systems, will require public engagement in the rulemaking process and also engagement of system owners to implement the rules and regulations once adopted. Even when an RME manages the O&M of individual systems, homeowners need to understand the fees and everyday maintenance requirements of their system. For example, they need to understand what to avoid putting down the drain. When homeowners do not have systems managed by an RME, they need even more information to properly maintain their onsite systems. Local governments should provide a list of approved service providers and reminders of basic maintenance practices to homeowners.

4.13. Cost, Funding, and Financial Assistance

Successful implementation of a nitrogen management program requires continuous and sustainable funding. Individual homeowners willing or required to upgrade their onsite systems may need financial assistance.

<u>COSTS FOR ADVANCED SYSTEMS</u>

Advanced systems for reducing nitrogen can be costly for the individuals and homeowners who need to use such a system on their property. For example, ETV-verified advanced systems that reduce nitrogen to a concentration averaging 20 mg/L range in cost from $4,000 to $10,000

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16 http://yosemite.epa.gov/water/owrccatalog.nsf/e673c95b11602f2385256ae1007279fe/c2a667735c0cf03e85256b0600724621!OpenDocument

17 http://www.epa.gov/septicsmart

18 http://www.dnrec.state.de.us/water2000/Sections/FAB/FABSepticRehab.htm

(EPA, 2010b). This cost estimate is for the advanced system itself, which should be combined with an existing or a new septic tank and drainfield, but does not include potential increases in energy consumption. Cost estimates for a full system, including primary septic tank and drainfield, range from $12,000 to $17,000. If combined with a pressure distribution drainfield the costs can exceed $20,000. However, costs are significantly reduced for cluster systems, with one example costing $6,800 to $8,000 per home for a 27-home cluster (EPA, 2010b). Onsite systems that meet higher treatment levels (e.g., 10 mg/L) require additional treatment components than those that do not remove as much nitrogen and the associated costs will generally be higher.

Costs are highly variable across the country, and the cost estimates provided herein are primarily for comparative purposes. Upgrading one system at a time in a community or neighborhood is not the most cost-effective implementation, and significant savings may be achieved when multiple systems are upgraded at the same time. Regardless of the location and implementation strategy, cost estimates should account for the following costs of upgrading a system:

- Permitting;
- Soil testing and evaluation;
- Engineering design and construction supervision;
- Installation of system; and
- All system components.

In addition, homeowners should be aware of the expected annual O&M costs. These include electricity and potential sampling costs, as well as any regular maintenance required on the system.

COSTS FOR MANAGEMENT PROGRAMS

Support for onsite management programs over the long term should come from sources that can provide continuous funding. Monthly service fees, property assessments, regular general fund allocations, and permit and licensing fees can be difficult to initiate but provide the most assurance that management program activities can be supported over the long term. Securing public acceptance of these financing mechanisms requires stakeholder involvement in their development and outreach programs that provide a clear picture of current problems and expected benefits, and an appropriate matching of community resources with management program needs (EPA, 2002).

Costs associated with a management program for onsite systems might be a concern for local and state authorities. Costs associated with administration and management vary based on community specific factors such as the number of systems in the program, specific management needs for that program and alternative technologies used. Overall, it is recognized that "consolidating administration and management (and many O&M functions as well) of multiple small and decentralized systems under one management authority should provide significant costs savings and improved management" (Magliaro and Lovins, 2004).

Base funding from local agencies, grants, or other sources can be supplemented through various fee-for-service mechanisms. For example, programs using the Management Models 4 and 5 described in *Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems (EPA, 2003a)*, that own and/or operate decentralized treatment facilities typically charge fees of between $300 and $450 per residence per year. This annual cost may not include certain one-time costs (e.g., tap-on fees) or fees for special services. Low-level management programs (e.g., Management Model 1) for individual systems typically cost less than $75 per residence per year, mostly to cover periodic inspections, minor system repairs, and pumpouts. Intermediate management programs such as Model 2 (Maintenance Contract) and Model 3 (Permitting) approaches vary widely depending on what services are included, whether private contractors are used, and the types of technologies and monitoring/inspection programs employed (EPA, 2010c). More information on financial resources to support decentralized wastewater management can be found in EPA's *Interactive Handbook for Managing Individual and Clustered (Decentralized) Wastewater Treatment Systems, Resource Guide 5: Financial Assistance*, available online at: www.epa.gov/owm/septic/pubs/dwm_5.pdf.

FUNDING OPPORTUNITIES

The higher costs associated with advanced onsite systems necessitate that jurisdictions develop a series of funding options available to individual homeowners, developers, or RMEs. Options for funding mechanisms ranging from grants and loans to bonds, connection fees for system users, and developer impact fees are described in the EPA *Handbook for Managing Onsite and Clustered Wastewater Treatment Systems* (EPA, 2005b). The handbook also lists funding sources ranging from federal funds to public-private partnerships. Funds from multiple sources will likely be required to successfully implement a nitrogen reduction management program for onsite systems. Federal funds might be available through various federal agencies, including the EPA Clean Water State Revolving Funds (CWSRF)[19], U.S. Department of Agriculture (USDA) loan and grant programs[20], the Rural Community Assistance Partnership (RCAP)[21], and U.S. Department of Housing and Urban Development (HUD) Community Development Block Grants[22]. Jurisdictions could set aside funds or investigate additional funding for inspections, upgrades, and maintenance in underserved communities.

The CWSRF is a low- or no-interest loan program that is also a source of support for the installation, repair, or upgrade of onsite systems in small towns, rural areas, and suburban areas (EPA, 2005b). States administer the program and issue funding based on an annual project ranking process. CWSRF funding could be used for new system installation (both individual and clustered systems) to correct an existing nonpoint source issue, as well as for the replacement, upgrade, or modification of inadequate or malfunctioning systems (EPA, 2009b). Once performance levels such as those described in this document have been adopted, systems that do not meet these standards can be considered inadequate, and may become eligible for funding assistance through the CWSRF. CWSRF monies could also be used to fund costs associated with the establishment of a centralized management entity to oversee onsite systems (e.g., RME). Eligible costs include permitting, legal, and other fees associated with establishing the management entity, as well as capital outlays associated with management programs (e.g.,

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19 http://water.epa.gov/grants_funding/cwsrf/cwsrf_index.cfm
20 http://www.rurdev.usda.gov/rd_loans.html
21 http://www.rcapsolutions.org/financial_services.htm
22 http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs

trucks, storage buildings, spare parts). Approved management entities include cities and counties, special government units such as sanitary districts or county service districts, public or private utilities, private corporations, and nonprofit organizations. Additional information on CWSRF funding for onsite systems is available on EPA's factsheet, downloadable at: http://water.epa.gov/aboutow/eparecovery/upload/2009_11_25_septic_pubs_arra_septic_fs.pdf.

Another funding mechanism related to the CWSRF is provided by certain states through a linked deposit mechanism whereby funds are made available to home-owners through commercial lending institutions at interest rates below market, subsidized by the CWSRF. The linked deposit program was first started in Ohio by the Ohio EPA in 1993, and is now offered in a number of other states, including Maryland[23]. Ohio's lending program is similar to the traditional CWSRF program except that a local banking institution takes on Ohio EPA's lending role. Individual homeowners can apply for funding from Ohio EPA, which reviews the proposed project from an environmental standpoint. The financial aspect (i.e., credit review and paperwork) is then delegated to a local bank. This funding mechanism essentially subsidizes the interest rate for homeowners.

> The Town of Colchester, VT, located on the shore of Lake Champlain, received $450,000 in CWSRF funds to capitalize a homeowner septic system revolving loan fund, providing assistance to local property owners for repairing and replacing septic tanks. Due to its location, water quality is a priority for the Town, but sewer extensions were unpopular with residents concerned about affordability (EPA, 2009c).

Other sources of funding for upgrades to onsite systems might be available from the USDA's grant and local programs including the Rural Housing Service Single-Family Housing Program, Home Repair Loan and Grant Program, Rural Utilities Service, and the Rural Business-Cooperative Service. These programs assist with costs associated with upgrades to onsite systems for homeowners and municipalities. Additional information is available from the USDA's State Rural Development offices: http://www.rurdev.usda.gov/recd_map.html.

Property assessments can be used to recover capital costs for wastewater facilities that benefit property owners within a defined area. For example, properties in a specific neighborhood could be assessed for the cost of installing sewers or a cluster treatment system. Depending on the amount of the assessment, property owners either pay all at once or pay in installments at a set interest rate.

Other funding mechanisms specific to nutrient reduction include nitrogen offsets where the developer of one property connects an abutting property to their wastewater system to offset the additional nitrogen load created by their new

> In an effort to expand its borrower base, the Rhode Island Clean Water Finance Agency developed a Community Septic System Loan Program (CSSLP) to put low interest SRF funds within the reach of all communities. The CSSLP enables communities to access CWSRF funds for the repair or replacement of failed, failing, or substandard septic systems (EPA, 2009c).

[23] http://www.mde.state.md.us/programs/Water/QualityFinancing/LinkedDeposit/Pages/programs/waterprograms/water_quality_finance/link_deposit/index.aspx

development[24]. For example, a commercial development could be required to include certain neighboring homes in a cluster system, where applicable, providing a form of subsidy to residential neighborhoods. Finally, jurisdictions could benefit from financial disincentives to eliminate delinquent systems by either a fee structure or property liens. The fees collected from these homeowners could then fund system upgrades in the community.

Similar to data collection and reporting, funding efforts can be coordinated at the state level, with assistance from local communities. Maryland, for example, developed the Bay Restoration Fund program, which collects a $30 fee, also known as the "flush tax," from all state residents to fund onsite system upgrades and to cover crops to reduce nitrogen loads to the Chesapeake Bay. This fund supports the construction and five years of maintenance for upgraded onsite systems. To ensure proper O&M of systems as well as necessary system upgrades, EPA encourages local governments or management entities to collect fees and establish a funding program (EPA, 2009a).

In an RME structure, part of the fee collected from all residents could be set aside for system upgrades, beginning with the highest priority areas (e.g., within 1,000 feet of the Chesapeake Bay or its tributaries). Jurisdictions can also develop lists of financial assistance programs available to RMEs, either for regular operation or for system upgrades. A full description of RME funding opportunities, including grant programs, low-interest loans, and user fees, is provided in another EPA publication (EPA, 2005b).

Finally, the following additional assistance and subsidy could be made available to small disadvantaged communities:

- Lowering CWSRF interest rates;
- Giving higher priority to small and disadvantaged communities;
- Extending the financing terms;
- Providing loans and grants for planning and design; and
- Providing technical assistance.

5.0 SUMMARY

EPA has prepared this model program to provide information to the Chesapeake Bay states on techniques to improve onsite system management and to reduce the loadings of nitrogen from these systems to the Bay. States can consider the information and recommendations provided here as they develop their approaches to meet nitrogen reduction targets in the Chesapeake Bay TMDL.

Specific nitrogen treatment recommendations, based on the proximity of an onsite system to the Bay, are provided along with suggested management approaches to oversee the operation of nitrogen treatment systems. Proper management is an important component of onsite system

[24] This funding mechanism presumes prior implementation of an offset or trading program, and that the new wastewater system is designed with sufficient capacity and treatment level to accept the abutter's wastewater and provide the offset.

oversight, not only for nitrogen reducing systems that are more complex than conventional systems and require a greater level of operation, maintenance, and monitoring, but also to reduce failing systems that could also release phosphorus and pathogens. In addition, recommendations to improve specific components of onsite system management are provided in those areas where the use of advanced nitrogen treatment systems may require changes in site evaluation, design requirements, construction oversight, and O&M procedures. Finally, opportunities to strengthen the programmatic components of a state's management of onsite systems are provided, recognizing that implementing greater nitrogen reduction may require greater support in training and certifying wastewater professionals, providing outreach to communities and property owners, approving new technologies for nitrogen treatment, and funding programs to support these efforts.

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West Virginia WIP, 17 January 2012
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ATTACHMENT A - FRAMEWORK FOR ONSITE SYSTEM MANAGEMENT IN THE CHESAPEAKE BAY WATERSHED

Introduction

EPA prepared this model program as part of its contribution to the ongoing restoration of the Chesapeake Bay as outlined in President Obama's Executive Order on Chesapeake Bay Protection and Restoration, issued on May 12, 2009. In addition, the model program supports achievement of the pollutant load levels described in the Agency's Total Maximum Daily Load (TMDL) for the Bay and the actions the jurisdictions within the watershed are proposing as part of their Watershed Implementation Plans (WIPs).

The discussion that follows provides further information on the Executive Order, the TMDL, and the WIPs as they provide the framework in which the nitrogen loading reductions from onsite systems are planned. Further information is also provided on the environmental impacts of onsite systems including the nitrogen loading impacts to coastal waters such as the Chesapeake Bay.

Executive Order for Chesapeake Bay Protection and Restoration

In an effort to accelerate the water quality improvements and restoration efforts in the Chesapeake Bay, the President's Executive Order 13508 identifies nutrients (both nitrogen and phosphorus) and sediments delivered from the Chesapeake Bay Watershed as the pollutants largely responsible for both the continued degradation of the Bay and the complexities associated with ongoing restoration activities. The following sections from the Executive Order describe EPA's roles in the restoration efforts.

- Section 202(a) of the Executive Order designates EPA as lead agency for water quality restoration actions and tools, including changes to regulations.
- Section 301 directs EPA to develop water pollution control strategies authorized by its existing authorities.
- Section 204 calls for lead federal agencies (including EPA) to collaborate with state and local partners in developing their strategies and reports on key challenges to the protection and restoration of the Chesapeake Bay.
- Section 302 encourages EPA to establish new performance standards to the extent permitted by law.
- Section 601 directs the protection of the Chesapeake Bay from impacts of a changing climate.

Chesapeake Bay TMDL

The TMDL issued by EPA targets a 25% nitrogen loading reduction for the six states in the Bay's watershed: Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia; and the District of Columbia. Although established by EPA pursuant to the Clean Water Act, the TMDL is the result of a decades-long collaboration between the Bay states and EPA under the

Chesapeake Bay Program partnership. It is also a keystone commitment in meeting President Obama's Executive Order 13508 to restore and protect the Bay.

EPA calculated the nutrient and sediment loadings associated with the Chesapeake Bay TMDL based, in part, on a watershed-wide model (Chesapeake Bay Program Phase 5.3 Watershed Model) that established TMDLs for 92 Chesapeake Bay sub-watersheds. The Chesapeake Bay TMDL identifies an annual maximum nitrogen load of 185.9 million pounds of nitrogen for the Chesapeake Bay, estimated to represent a reduction of 25%. The TMDL further identifies nitrogen load limits for major river basins and jurisdictions (i.e., states and the District of Columbia).

Nitrogen Management with Onsite Systems

Management of onsite systems and other nitrogen sources is important because nitrogen is the limiting nutrient in coastal waters. A limiting nutrient acts like a fertilizer and its presence or absence controls the extent of plant and algae growth within the Bay. If too much nitrogen is present, it promotes the excess growth of nuisance plants and algae. This process is also known as eutrophication. In fresh water systems, phosphorus is the limiting nutrient that controls eutrophication. However, nitrogen is the concern here, both because of its impact on Bay water quality and also because phosphorus does not migrate very far from onsite systems before it is bound up in the subsurface sediments.

Too much algae present in the water column can create significant problems for aquatic environments, including impacts to aquatic vegetation, depleted oxygen levels, modified marine habitat, and fish kills. Increased nutrient levels have altered the ecology of the Chesapeake Bay. For example, nutrient pollution impacts the community structure and productivity of fish and invertebrates that are essential to the Bay's fisheries (Committee on Environment and Natural Resources, 2010).

Agricultural sources are the major contributor of nitrogen to the Bay, followed by atmospheric deposition and wastewater discharges. Onsite systems are not a primary source of nitrogen, but do contribute six percent of the overall load to the Bay (EPA, 2010a).

Traditional onsite systems consist of a septic tank that collects wastewater from the home or business and a drainfield that receives effluent from the septic tank and disperses it to the subsurface. Little treatment of nitrogen takes place as effluent moves through an onsite system. Nitrogen concentrations within the effluent as it leaves the drainfield are assumed to be 39 mg/L or 9 lb N/person/yr (4 kg N/person/yr), the input value in the Chesapeake Bay Program Watershed Model. This loading rate is significantly higher than what coastal waters can typically assimilate.

Nitrogen concentrations of 0.5 mg/L or higher in coastal waters are indicative of impacts from watershed-based nitrogen sources and contribute to eutrophication. Therefore, onsite systems can impact Bay water quality, and communities need to proactively manage the systems to reduce the nitrogen load. Advanced or alternative systems can provide additional treatment to remove nitrogen through the installation of additional components or technologies. Most advanced systems provide about a 50% nitrogen reduction relative to the loading rate from onsite systems used in the CBP Watershed Model. Some systems are capable of providing greater nitrogen reductions.

Onsite system effluent can also impact drinking water quality in private and public water supply wells. If a private well is installed directly downgradient from an onsite system, the plume of effluent from the system can contaminate the water pumped by the well. Elevated nitrogen concentrations (the drinking water standard for nitrogen is 10 mg/L), as well as other contaminants such as solvents or other hazardous materials, can also contaminate well water. Too many onsite systems located within a wellhead protection area to a public supply well can also harm drinking water. A wellhead protection area is the portion of the recharge area for a well that is protected by land use restrictions. Proper management of onsite systems in these settings can minimize impacts to drinking water supplies.

It is recognized that when properly managed, decentralized solutions (e.g., onsite, cluster, and mixed systems) provide several benefits over centralized systems, particularly in less dense or rural areas. They employ lower-cost, lower-maintenance infrastructure, and disperse smaller volumes of treated sewage to the environment. Onsite systems result in less disruption during construction, and their implementation can be phased to address priority areas first.

What States Are Planning for Nitrogen Reductions from Onsite Systems

Each of the six states and the District of Columbia have developed and continue to refine a WIP detailing actions and progress towards meeting pollution reduction goals.

States completed final Phase I WIPs in November and December 2010 and Phase II WIPs on March 30, 2012. Phase III WIPs are expected in 2017 and will define proposed state actions and implementation between 2018 and 2025. Table A1 compares the estimated 2009 nitrogen loads with the 2025 nitrogen TMDLs for the Chesapeake Bay states. The table also includes the 2009 nitrogen loads attributable to onsite systems for each of the states. For states in the Bay's watershed, the nitrogen load from onsite systems ranges from about 3% to 6% of the states' overall nitrogen load to the Bay. Several states have indicated a specific nitrogen reduction target for onsite systems in their WIPs.

Maryland's Phase II WIP sets an overall 38% target reduction in nitrogen loading from onsite systems. Maryland's plan includes upgrading onsite systems (within 1,000 ft. of tidal waters) with nitrogen treatment technology or connecting to wastewater treatment plants, and pumping systems on a 5-year rotating basis to meet nitrogen reduction goals.

Delaware's Phase II WIP aims to reduce nitrogen loading from onsite systems by 37% by 2025 compared to 2009. Delaware's Phase II WIP offers several ways to reduce nitrogen loading, such as revised regulations that would require pump-out and inspection of an onsite system when a property is sold, advanced systems for new or failing systems within 1,000 feet of tidal waters, and new operation and maintenance requirements for large systems and advanced systems. Delaware also identifies the number of onsite systems that are potentially impacted by sea-level rise, and has proposed adding language to its regulations to address this concern.

Virginia's Phase II WIP does not include a specific target for nitrogen reduction from onsite systems. Nitrogen reductions will be achieved through amendments to regulations for alternative systems that require a 50% reduction in nitrogen for all new small alternative systems in the Chesapeake Bay watershed. All larger alternative onsite systems (with a design flow greater than 1,000 gallons per day) will need to comply with a <3 mg/l total nitrogen standard at the project boundary as evidenced by an 8 mg/L applied total nitrogen and a drainfield design with adequate separation distance to limiting features.

West Virginia's Phase II WIP discusses options to build capacity to manage onsite systems at the local level, including the use of Responsible Management Entities, supporting local code requirements for advanced systems in areas close to waterways, reducing failing systems through outreach efforts, and encouraging increased capacity at wastewater treatment plants for connection of onsite systems.

Due to the limited overall contribution of nitrogen from septic systems compared to other sources, and to a limited population growth, New York's draft Phase II WIP does not identify new onsite system measures for direct reduction in nitrogen loads and does not forecast any load reduction from septic systems. However, the State requires municipal separate storm sewer system operators to implement a process to identify and eliminate sub-standard onsite systems that discharge into stormwater systems, is involved in the development of a statewide training program for onsite system management professionals, and has made a GIS-based inventory and tracking software available to local officials, watershed professionals and consultants for inventorying and mapping septic systems.

Pennsylvania's Phase II WIP sets an overall 25% target reduction in nitrogen loading from onsite sources through connecting existing systems to wastewater treatment plants. The District of Columbia is not thought to have significant loading from onsite systems due to extensive sewering, and therefore does not address onsite systems directly in its WIP.

Table A1. Modeled 2009 Nitrogen Load and 2025 TDML for Jurisdictions in the Chesapeake Bay

Jurisdiction	2009 nitrogen load[1] (M lbs/year)	2025 nitrogen TDML[2] (M lbs/year)	Required nitrogen reduction in 2025 TMDL from 2009	2009 nitrogen load from on-site systems (M lbs/year)	Portion of total 2009 nitrogen load from on-site systems
Delaware[3]	4.47	2.95	34.0%	0.154	3.6%
Maryland[4]	52.76	41.17	22.0%	3.00	5.7%
New York	10.5	8.77	16.5%	0.54	5.1%
Pennsylvania	106.4	73.9	30.5%	3.29	3.1%
Virginia	65.3	53.4	18.2%	2.90	4.4%
West Virginia	5.77	5.45	5.5%	0.29	3.0%
D.C.	2.85	2.32	18.6%	n/a	n/a

[1] *Data from EPA's Phase 5.3 watershed model.*
[2] *As reported in the Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus and Sediment (EPA, 2010a).*
[3] *Data from Delaware's Draft Phase II WIP, (March 30, 2012)*
[4] *Data from Maryland's Draft Phase II WIP (March 30, 2012), 2010 year progress data were used for the 2009 nitrogen load from onsite systems.*

ATTACHMENT B - ANNOTATED BIBLIOGRAPHY

This annotated bibliography provides descriptions of key resources pertinent to this document. When available, a link to the resource is provided. The bibliography is separated into two sections, with a first section presenting general resources about components to an onsite program, and a second section referencing relevant model codes prepared by other organizations and relevant state regulations.

<ins>General Resources</ins>

A Homeowner's Guide to Septic Systems. March 2005. U.S. Environmental Protection Agency publication EPA-832-B-02-005.

This EPA outreach publication was developed to educate homeowners about the basics of septic systems. It describes how a septic system works and what homeowners can do to help their systems treat wastewater effectively. It also provides a brief checklist with key information, and a table to keep track of maintenance events. The publication can be customized to include a local health department's address and contact information (http://www.epa.gov/owm/septic/pubs/homeowner_guide_long_customize.pdf), and is also available in Spanish (http://www.epa.gov/owm/septic/pubs/xguiadeldueno06-06.pdf).

Business Attributes of Successful Responsible Management Entities. 2006. Yeager, T., Ehrhard, R., and Murphy, J. Decentralized Water Resources Collaborative.

This peer-reviewed report summarizes research findings on responsible management entities (RMEs) for onsite system management. After a preliminary review of existing RMEs, the authors selected successfully operating RMEs and identified business characteristics common among them, including technical, managerial, financial, and governance commonalities. This report also provides recommendations for forming a successful RME. It is available online at: http://www.decentralizedwater.org/documents/04-DEC-4SG/04DEC4SG.pdf

Case Studies of Individual and Clustered (Decentralized) Wastewater Management Programs. October 2010 Review Draft. U.S. Environmental Protection Agency.

This draft EPA document is a collection of case studies developed for decision makers in rural, exurban, and suburban communities across the country who want to provide effective, efficient wastewater treatment. It builds on EPA's *Voluntary National Management Guidelines for Onsite and Clustered (Decentralized) Wastewater Treatment Systems*, and demonstrates how management programs can be crafted with existing resources. Although the approaches used varied considerably, the communities featured in this document engaged multiple stakeholders, assessed existing system performance, created new development requirements, and instituted management measures to ensure that all systems were operated and maintained appropriately across a wide variety of treatment technologies – from simple septic systems to advanced treatment clustered units.

Chesapeake Bay Program Nutrient Trading Fundamental Principles and Guidelines. March 2001. Chesapeake Bay Program publication number CBP/TRS 254/01 and U.S. Environmental Protection Agency publication: CBP/TRS 254/01.

This Chesapeake Bay Program and U.S. EPA publication provides information on developing and implementing a nutrient trading program within the Chesapeake Bay Watershed. It summarizes the findings of the multi-stakeholder Nutrient Trading Negotiation Team organized by the Chesapeake Bay Program to explore the feasibility of nutrient trading for point and nonpoint sources in the Chesapeake Bay Watershed and develop nutrient trading guidelines for the Bay jurisdictions to use on a voluntary basis. This document was accepted and endorsed by the Chesapeake Bay Program partners, and is available online at: http://www.chesapeakebay.net/content/publications/cbp_12268.pdf

Environmental Technology Verification (ETV) - Protocol for the Verification of Residential Wastewater Treatment Technologies for Nutrient Reduction. November 2000. NSF International Inc.

This protocol was developed by NSF International for EPA's Environmental Technology Verification (ETV) Program. The purpose of the ETV is to verify the performance characteristics of commercially available environmental technologies through the collection and evaluation of objective and quality-assured data. The ETV protocol was developed to evaluate and verify nutrient reduction associated with onsite systems for individual homes. The protocol is available online at: http://www.nsf.org/business/water_quality_protection_center/pdf/NRFinalProtocol.pdf

Funding Decentralized Wastewater Systems Using the Clean Water State Revolving Fund. Summer 2009. U.S. Environmental Protection Agency publication: EPA 832-F-09-005.

This EPA fact sheet is re-published regularly to provide updates on the Clean Water State Revolving Fund (CWSRF). Each fact sheet describes the latest options for using the CWSRF to finance installation, repair, and upgrading of septic systems. This outreach document provides background on CWSRF programs, information on how to obtain funding, and examples of success stories. The 2009 fact sheet highlights cluster systems as a sustainable solution, and provides information on stimulus funds awarded to the CWSRF. It is available online at: http://www.epa.gov/owm/septic/pubs/arra_septic_fs.pdf

Guidance for Federal Land Management in the Chesapeake Bay Watershed. May 12, 2010. U.S. Environmental Protection Agency publication EPA 841-R-10-002.

This EPA document presents tools and practices to address nonpoint source pollution that is currently contributing nutrients and sediments from federal land management activity in the Chesapeake Bay Watershed. This document addresses the following categories of activity: agriculture, urban and suburban (including turf), forestry, riparian areas, decentralized wastewater treatment systems, and hydromodification. These techniques are applicable beyond federal lands, and can be implemented by states, local governments, conservation districts, watershed organizations, developers, farmers, and citizens in the Chesapeake Bay

Watershed. This document is available online at: http://www.epa.gov/owow_keep/NPS/chesbay502/pdf/chesbay_guidance-all.pdf

Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. 1993. U.S. Environmental Protection Agency publication: EPA 840-B-92-002.

This EPA document specifies management measures for sources of nonpoint pollution in coastal waters, as required under section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA). It provides assistance to states and territories on the types of management measures that should be included in Coastal Nonpoint Pollution Control Programs. Each chapter of this document is dedicated to a particular type of activity, including forestry, and agriculture, among others. Chapter 4: Management Measures for Urban Area, Section V: Onsite Disposal Systems is dedicated to onsite system management. The document is available online at: http://water.epa.gov/polwaste/nps/czara/index.cfm.

Handbook for Managing Individual and Clustered (Decentralized) Wastewater Treatment Systems. 2010. U.S. Environmental Protection Agency.

This EPA handbook is a "how-to guide" for implementing *EPA's Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems*. The guide describes a step-by-step approach for the development of a community management program for onsite systems. It includes specific community examples, provides an overview of the components essential for sound management of these systems, and lists links to resources. It is available online at: http://water.epa.gov/infrastructure/septic/upload/onsite_handbook.pdf

Onsite Wastewater Treatment Systems Manual. February 2002. U.S. Environmental Protection Agency publication number: EPA/625/R-00/008

This EPA document is a follow-up to EPA's 1980 *Design Manual: Onsite Wastewater Treatment and Disposal Systems* which provided detailed information on the design, construction, and operation of onsite systems. This 2002 document provides overview information on treatment technologies, installation practices, and past performance for a variety of traditional and new onsite system designs. This document promotes a performance-based approach to selecting and designing onsite systems. The document is available online at: http://water.epa.gov/aboutow/owm/upload/2004_07_07_septics_septic_2002_osdm_all.pdf

Responsible Management Entities as a Method to Ensure Decentralized Wastewater System Viability. Spring 2002. English, Christopher, D. and Yeager, Tomas, E. Small Flows Quarterly, Volume 3, Number 2.

This paper presents the creation of responsible management entities (RMEs) as a method for ensuring the viability of decentralized wastewater systems. It makes the case for RMEs, describes common wastewater entities functioning as RMEs, provides an overview of the regulatory oversight of onsite systems, and presents a case study of a successful RME. Finally, the paper describes the technical, managerial, and financial capacity needed to successfully set up and operate an RME. The paper is available online at: http://wri.eas.cornell.edu/English&YeagerRME2002.pdf

Responsible Management Entities Guidance Fact Sheets. Water Environment Research Foundation.

This series of ten fact sheets is intended to provide support for successfully establishing and running organizations that manage decentralized wastewater systems - Responsible Management Entities, or "RMEs" as they are called in the sector. These fact sheets are appropriate for a number of organizations, including existing RMEs seeking to improve their operations, prospective RMEs considering starting up, existing organizations looking to enter the decentralized wastewater field (e.g., an existing sewer authority or rural electric cooperative wanting to extend its services). Each individual fact sheet addresses a separate topic, from explaining what constitutes an RME, to providing support for successful operation, marketing, etc. This document is available online at: http://www.werf.org/i/c/KnowledgeAreas/DecentralizedSystems/RMEsite/RMEs_2.aspx

The Next Generation of Tools and Actions to Restore Water Quality in the Chesapeake Bay: A Revised Report Fulfilling Section 202a of Executive Order 13508. November 24, 2009. U.S. Environmental Protection Agency.

This draft EPA document was developed in response to Section 202(a) of the President's Executive Order, Chesapeake Bay Protection and Restoration, addressing the next generation of tools and actions for restoring the Bay under existing legislative authorities. It identifies the pollution control strategies and actions EPA recommends to protect and restore water quality in the Chesapeake Bay. This document is available online at: http://executiveorder.chesapeakebay.net/file.axd?file=2009%2F9%2F202%28a%29+Water+Quality+Draft+Report.pdf

Valuing Decentralized Wastewater Technologies: A Catalog of Benefits, Costs, and Economic Analysis Techniques. November 2004. Magliaro, J. and Lovins, A. Rocky Mountain Institute.

This report was prepared for the EPA and presents a catalog of the economic advantages and disadvantages of decentralized wastewater systems relative to larger scale solutions to inform wastewater facility planning and assist communities in making better choices among their many technology options. It also discusses the issues that should be addressed when site-specific wastewater facility plans are prepared, and provides an annotated check-list to help engineers, planners, and other professionals facilitate a more informed discussion of the advantages and disadvantages of various system options for the communities they serve. This document is available online at: http://www.rmi.org/Knowledge-Center/Library/W04-21_ValuingDecentralizedWastewater

Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems. March 2003. U.S. Environmental Protection Agency publication: EPA 832-B-03-001.

This EPA document provides guidelines developed to enhance the performance and reliability of onsite systems through improved management programs, and to help communities establish comprehensive management programs to ensure that all onsite systems function properly. The guidelines present five management models for onsite systems, from a simple homeowner education model (management model 1) to a full transfer of ownership of onsite systems (management model 5). These models provide progressively increasing management controls as sensitivity of the environment and/or treatment system complexity increases. The document is available online at: http://water.epa.gov/scitech/wastetech/upload/septic_guidelines.pdf

Model Codes and Regulations

Model Code Framework for the Decentralized Wastewater Infrastructure. March 2007. National Onsite Wastewater Recycling Association (NOWRA). Volumes I and II.

The model code framework is intended to serve as a guide to facilitating a number of regulatory activities within states and localities, and is available in two volumes. It is written to inform citizens, policy-level government officials, and code writers about the use and regulation of decentralized wastewater-treatment systems. Volume I: Workbook for Writing the Code presents the working structure for a complete code. It does not offer a "model code" that can be adopted directly. Instead, the structure of the code is built-out with suggested basic language, interspersed with opportunities for inserting jurisdiction-specific language. Volume II: Code Design Philosophy and Guidance presents the core principles under which the model code framework was created. Both volumes are available online at: http://www.nowra.org/content.asp?pl=25&sl=36&contentid=36

Model Performance Code Guidance Document for Advanced Wastewater Treatment Systems. 2006. American Decentralized Wastewater Association.

This document provides model code for state and local regulatory agencies seeking to regulate advanced wastewater treatment systems. This code emphasizes performance certification for people and treatment components, as well as enforced operational maintenance requirements for all onsite systems. It focuses on the use of certified, engineered treatment components that are included in the American Decentralized Wastewater Association's list of approved products.

Regulations for Alternative Onsite Sewage Systems. April 7, 2010. Virginia Department of Health. Virginia Code of Regulations. 12VAC5-613

Regulations for Alternative Onsite Sewage Systems were finalized in December 2011. The regulations establish performance, operation, and monitoring requirements, as well as horizontal setbacks for advanced treatment systems necessary to protect public health and the environment. These new regulations require that a licensed operator visit each advanced treatment system on a mandated frequency and file a report. The regulations are available online at: http://lis.virginia.gov/000/reg/TOC12005.HTM#C0613.

ATTACHMENT C- MODEL PROGRAM CHECKLIST

How to Use This Attachment

This checklist is a simple map to the Model Program presented as a list of questions that can be answered by *yes* or *no*. If the answer to the question is *yes*, the reader can check the box to the right of the question (☑), and move onto the next question. If the reader is unsure of the answer, or cannot answer *yes*, the checklist provides a reference to the relevant page of the model program document that describes EPA's recommendation on the specific topic. This checklist was designed to identify potential gaps in state and local regulations and practices, and assist the relevant entities in filling those gaps.

Nitrogen Treatment Levels	Ref.	Yes?
Have nitrogen treatment levels been recommended to promote advanced treatment from certain onsite systems?	p. 11-14	☐
Are the levels based on proximity or distance between onsite systems and the Chesapeake Bay and its major tributaries (or other water body)?	p. 12-13	☐
Within 100 feet of the Chesapeake Bay and its major tributaries, are onsite systems prohibited?	p. 13	☐
Between 100 and 1,000 feet, is the recommended total nitrogen level in effluent 10 mg/L or less?	p. 13	☐
Beyond 1,000 feet, is the recommended total nitrogen level in effluent 20 mg/L or less for new construction and upgrades of failing systems?	p. 13	☐
Are shallow pressurized effluent dispersal systems an approved method for discharge of onsite system effluent?	p. 14-15	☐
Onsite System Management	Ref.	Yes?
Are operating permits issued for operation and maintenance of onsite systems?	p. 19-21	☐
Are these operating permits issued for a limited time (i.e., do they have to be renewed)?	p. 20-21	☐
Has a Responsible Management Entity (RME) approach to onsite system management been considered?	p. 20-21	☐
Inventory and Inspection of Existing Onsite Systems	Ref.	Yes?
Is an inventory of all existing onsite systems available and up-to-date?	p. 22-23	☐
Is this inventory available electronically?	p. 23	☐
Does this inventory record nitrogen treatment capabilities of the onsite systems?	p. 23	☐
Do inspections record the location of the onsite system relative to seasonal high groundwater and sensitive resources?	p. 22-23	☐
Are inspection frequency requirements based on the location of an onsite system relative to the Chesapeake Bay, and on the complexity of the onsite system?	p. 24	☐

Do inspection results trigger upgrade requirements for onsite systems?	p. 24-25	☐
Do property improvements resulting in increased design flow require an inspection and potential upgrade?	p. 25	☐
SITE EVALUATION	Ref.	Yes?
Do site evaluations include measurement of depth to high groundwater?	p. 25-26	☐
Are site evaluation reports required to summarize the capacity of a site to accept, disperse, and safely and effectively assimilate the wastewater discharge?	p. 26	☐
Do these reports address proximity to sensitive resources, including the Chesapeake Bay and its tributaries?	p. 26	☐
ONSITE SYSTEMS AND CLIMATE CHANGE	Ref.	Yes?
Are sea level rise impacts considered during the evaluation of existing or upgraded onsite systems?	p. 26-28	☐
Are potential changes in the location of a shoreline built into the requirements for horizontal setback distances?	p. 27-28	☐
Are potential changes in groundwater elevation built into the required separation between the bottom of the drainfield and the seasonal high groundwater?	p. 28	☐
SYSTEM DESIGN CRITERIA	Ref.	Yes?
Are manufacturers of approved advanced treatment technologies required to provide detailed technical specifications for their system, including estimated operation and maintenance (O&M) needs?	p. 29	☐
Must designers of advanced treatment technologies be licensed or certified?	p. 29-30	☐
Must the design incorporate certain components that facilitate O&M tasks, particularly for advanced systems?	p. 30	☐
Is back-up power a requirement for advanced treatment systems?	p. 30	☐
SHARED OR CLUSTER SYSTEMS	Ref.	Yes?
Are shared or cluster systems allowed and encouraged (e.g., new systems, densely populated areas)?	p. 30-32	☐
Are cluster systems required to achieve nutrient reduction?	p. 30-31	☐
Are incentives provided to encourage the use of cluster systems, including expedited permitting, nitrogen credit/offset, and density bonus?	p. 31	☐
Are applicants required to review possible connections to existing and potential adjacent properties?	p. 31	☐
CONSTRUCTION INSPECTION AND START-UP	Ref.	Yes?
Are advanced treatment systems constructed by certified installers?	p. 32-33	☐
At a minimum, are the following construction inspections conducted during construction for advanced systems:		
Stake out verification to check on setbacks?	p. 32	☐
Bottom of dispersal bed inspection following excavation?	p. 33	☐

Pre-cover inspection prior to backfilling?	p. 33	☐
Final cover inspection for mounded systems, or systems with earthen caps?	p. 33-34	☐
Are system start-up and initial testing services provided by the manufacturer, or its representative/service provider?	p. 34	☐
Do system designers verify compliance of construction with approved plans, specifications, and relevant operating permits that result in a construction report?	p. 34	☐
Are as-built plans provided as part of the construction report?	p. 34	☐
OPERATION AND MAINTENANCE	Ref.	Yes?
Has a minimum O&M schedule been established for advanced treatment systems based on average flow?	p. 34-5	☐
Is a homeowner education program available for the proper use and care of advanced treatment systems?	p. 35	☐
Are septic tank pumping requirements based on certain factors such as expected tank capacity and effluent flow?	p. 35-36	☐
Are sampling and monitoring requirements scaled to the size and complexity of the onsite system?	p. 36	☐
DATA MANAGEMENT, RECORD KEEPING, AND TRACKING OF NITROGEN REDUCTIONS	Ref.	Yes?
Is a database available for tracking efforts to reduce nitrogen loads from onsite systems?	p. 37-38	☐
Is this database populated with the following data:		
New and upgraded systems with advanced treatment technologies?	p. 37	☐
Existing systems?	p. 37	☐
Geographic information (e.g., coordinates) for each system?	p. 37	☐
Other data for purposes of reducing nutrient loads, to include registered complaints, nutrient credits, actual flows, among others?	p. 37	☐
PROFESSIONAL TRAINING AND CERTIFICATION	Ref.	Yes?
Is a training, testing, and certification program available for onsite system professionals?	p. 38-42	☐
Does that program provide minimum requirements for the following onsite system professionals: engineers and system designers, site evaluators, installers, O&M providers (e.g., pumpers and haulers), and inspectors?	p. 38-42	☐
Are continuing education programs available to onsite system professionals through local universities and community colleges?	p. 41-42	☐
Are technology manufacturers involved in developing and providing training?	p. 38-42	☐
Are additional certifications or training programs available through reciprocity (e.g., neighboring states or regional wastewater organization)?	p. 39	☐
Is a list of certified professionals maintained, and made publicly available?	p. 39	☐

Approval and Verification of Advanced Treatment Systems for Nitrogen Reduction	Ref.	Yes?
Is a verification and approval process established for advanced treatment technologies for nitrogen removal?	p. 42-43	☐
Does the process measure/report nitrogen reductions achieved by the technologies under varying conditions?	p. 42-43	☐
Does the process address O&M requirements for the technology?	p. 42-43	☐
Is a detailed database of approved technologies readily available to all stakeholders, including homeowners?	p. 42	☐
Does that verification and approval process take into account verification or data from the following national processes (e.g., NSF and ETV), or other states?	p. 43-44	☐
Nutrient Trading or Offset Programs	Ref.	Yes?
Has a nutrient trading or offset program been established for managing existing nitrogen loads?	p. 44-45	☐
Does this program address future nitrogen loads?	p. 44-45	☐
Does this program enable trading across nitrogen sources (e.g., onsite systems vs. farming)?	p. 44-45	☐
Stakeholder Engagement and Education	Ref.	Yes?
Is an education and outreach program available to engage and educate all stakeholders, from homeowners to onsite system professionals and local officials?	p. 45-46	☐
Are education and outreach materials tailored to their audience (e.g., outreach materials developed by EPA[25])?	p. 46	☐
Are homeowners informed of the basic maintenance requirements for systems and their associated fees?	p. 46	☐
Cost, Funding, and Financial Assistance	Ref.	Yes?
Are funding sources available for installation and upgrades of advanced treatment technologies?	p. 47	☐
Is funding available for establishing and maintaining a sustainable management program for onsite systems?	p. 47-48	☐
Does the public understand and accept the costs associated with O&M of advanced systems?	p. 46-47	☐
Have additional funding opportunities been explored and made available for onsite system installation, upgrade, and management, including federal (e.g., EPA, USDA) and state funding, and nitrogen offsets?	p. 48-50	☐

[25] Examples of targeted outreach materials are available at http://cfpub.epa.gov/npstbx/index.html.

ATTACHMENT D - MODEL REGULATORY LANGUAGE TO MEET NITROGEN REDUCTION GOALS

HOW TO USE THIS ATTACHMENT

A suite of recommended options for model regulatory language is provided below to assist states to incorporate the nitrogen reduction recommendations from this model program into their individual programs. Specifically, the language addresses nitrogen treatment levels for onsite wastewater management systems, and the inspection, upgrade, design, and operation of nitrogen treatment technologies that are incorporated into the onsite systems to meet those concentration levels. Each state will want to tailor its onsite wastewater management regulations to fit its own needs, and therefore may select only certain relevant aspects of this model language. This language is designed to be incorporated into existing state regulatory language pertaining to onsite wastewater treatment systems and is not necessarily meant to replace existing language. A careful review and revision of this model language will be necessary to ensure that it does not introduce any conflicts with existing language and that terminology in this additional language reflects the terminology in the existing regulations, as appropriate.

For ease of reference, the recommended model language provided below is organized similarly to the main document, as follows:

- Nitrogen Treatment Levels;
- Inventory, Inspection and Upgrade of Existing Nitrogen Treatment Technologies;
- Site Evaluation to Address Nitrogen Treatment Technologies;
- Nitrogen Treatment Technology Design Criteria; and
- Operation and Maintenance of Nitrogen Treatment Technologies.

The language below does not represent a complete model regulation or ordinance to regulate onsite wastewater systems. Each section has a brief introduction in *italics* to provide context for the items in that section. Each numbered item provided within each section below can be considered a separate item that could be inserted individually into existing regulation. Certain items, denoted within [brackets], are placeholders for information specific to each state or municipality and must be provided by them as they are expected to vary based on locale and the language in the individual state's Watershed Implementation Plan. Notes to the user are provided in the grey highlighted areas, as needed.

MODEL REGULATORY LANGUAGE

1. Nitrogen Treatment Levels

The model language provided in this section sets the stage for upgrading all existing onsite wastewater treatment systems and designing all new systems with advanced nitrogen treatment. The exact levels in a given state should be based on its Watershed Implementation Plan.

1.1 The following nitrogen treatment levels apply to all existing or planned onsite wastewater treatment systems, based on the horizontal distances, or setbacks, extending from the discharge location to the ordinary high water mark of the Chesapeake Bay, or the tidal portion of any tributary to the Bay:

Setback Distance	Nitrogen Treatment Level
0 to < 100 feet	No discharge of onsite system effluent is permitted within this setback. Any existing onsite systems that discharge within this setback must be upgraded and modified so effluent is discharged beyond this setback distance.
100 to 1,000 feet	A total nitrogen concentration of 10 mg/L in onsite system effluent discharge is required for all systems within this setback.
Greater than 1,000 feet	A total nitrogen concentration of 20 mg/L is required for all new systems and upgrades to failing systems located outside this setback.

Note: EPA recommends the preceding nitrogen treatment levels for onsite systems for consideration by the Chesapeake Bay states. They are similar, but less stringent than the Agency's recommendations in the *Guidance for Federal Land Management in the Chesapeake Bay Watershed* (EPA, 2010b) for the management of federal lands and federally-owned onsite systems within the watershed. Full application of the treatment recommendations would mean that all new onsite systems, and existing systems within 1,000 feet of the Bay, meet a total nitrogen effluent concentration of 20 mg/L or less. States could adopt these recommendations or implement certain components, depending on the level of nitrogen reduction they propose within their individual Watershed Implementation Plan.

2. Inventory, Inspection and Upgrade of Existing Nitrogen Treatment Technologies

The model language provided in this section addresses inventory of existing onsite wastewater treatment systems for the purposes of understanding whether or not they meet the nitrogen treatment recommendations. It is anticipated that many systems will not meet the treatment levels and will require upgrades that incorporate nitrogen treatment technology into the system. In addition, some systems will have deficiencies in the proper operation of the system as is. The language below addresses primarily the inventory, inspection and upgrade requirements for the purposes of improving nitrogen treatment. However, language is included to address the general deficiencies that will inevitably be identified in the existing systems, as can be expected in any inspection program.

Onsite System Inventories and Nitrogen Treatment Upgrades

2.1 Onsite wastewater treatment systems must be identified through an initial inventory and inspection to determine whether the system complies with the applicable nitrogen treatment levels. An inventory and inspection form [Form X] shall be completed and returned to the state [regulatory authority] in accordance with the reporting schedule in section 2.4 below.

2.1.1 The inventory will identify the location, owner, type of system(s), flow capacity, actual flow, applicable nitrogen treatment levels and other necessary information as reasonably determined by the state [regulatory authority] to inventory existing onsite systems for the purposes of meeting the state Watershed Implementation Plan.

2.1.2 The inspection will include an assessment of whether the appropriate treatment technology is included in the system to meet the nitrogen treatment levels, as well as an assessment of whether the system itself is properly functioning as designed.

2.2 Those onsite systems that do not meet their applicable nitrogen treatment level due to a failure of existing system components, but that do not require additional components to be incorporated in order to meet the nitrogen treatment levels, shall be repaired and re-inspected within 30 days of the original inspection, in accordance with the requirements for existing systems [add reference to operation and maintenance requirements within existing regulation].

2.3 Those onsite systems that do not meet their applicable nitrogen treatment level due to a lack of capable treatment technology included in the system shall be updated in accordance with the schedule in Section 2.4 below. Systems located within 1,000 feet of the Chesapeake Bay or its tributaries are designated as the highest priority for upgrades. Systems must be inspected and upgraded in accordance with the schedule in Section 2.4 to bring them into compliance with the applicable nitrogen treatment level.

2.4 Initial Inventory and Inspection for Nitrogen Treatment Compliance

Distance of Discharge from the Chesapeake Bay and its Tributaries	Deadline for initial inventory and inspection for nitrogen treatment compliance	Deadline for nitrogen treatment upgrade
0 to 100 feet	within 1 year of adoption of this regulation	within 1 year of inspection
100 to 1,000 feet	within 2 years of adoption of this regulation	within 2 years of inspection
Greater than 1,000 feet	within 4 years of adoption of this regulation	within 4 years of inspection

2.5 An owner may request a formal extension for the required upgrade for an out-of-compliance system that was installed within the last five years if it is not financially feasible for the owner to immediately cover the upgrade costs. However, upgrades needed to bring onsite systems into compliance with basic design standards not related to the nitrogen removal concentrations, such as depth to high groundwater requirements, must be completed according to existing regulatory authority timeframes.

Ongoing Inspections of Nitrogen Treatment Technologies

2.6 All existing onsite wastewater management systems with nitrogen treatment technologies must be inspected by a certified inspector twice a year, prior to any site modification that alters the setback distances or design flow, or at the time of real estate transfer, reported violations, or complaints.

Note: This inspection frequency recommended by EPA can be adjusted by each state to meet the language and requirements in each state's Watershed Implementation Plan, as well as to coordinate with any existing onsite system inspection requirements.

2.7 This inspection cycle shall begin immediately upon adoption of this regulation.

2.8 Nitrogen Treatment Technology inspection forms must be submitted to the State [regulatory authority] within one month of inspection. Those that do not pass inspection must be repaired within 30 days of the inspection, and must be inspected again to demonstrate compliance. Inspections shall be documented using the standard inspection form [Form X].

Note: States should develop and provide a comprehensive and user friendly inspection form, or addendum to an existing inspection form, which records all necessary data to monitor nitrogen treatment technologies for the purposes of meeting the state's Watershed Implementation Plan. States should consider electronic forms for ease of data collection and analysis.

3. Site Evaluation to Address Nitrogen Treatment Technologies

Section 202(d) of the President's Executive Order for Chesapeake Bay Protection and Restoration tasked EPA and other federal agencies with the development of adaptation strategies for infrastructure in the watershed to help increase resiliency under changing climate conditions. Given this direction, it is important for state and local officials, as well as property owners, to evaluate climate change impacts on the siting and operation of onsite systems. EPA recommends that regulatory authorities require designers to consider the changes in the location of the shoreline under changing climate conditions. This consideration is important when siting a system to meet the minimum 100-foot setback between the Bay and a drainfield as recommended in Section 2 of the Model Program. A two-foot sea level rise will cause the shoreline to move inland, reducing the current setback of a system installed today. EPA also recommends that regulatory authorities and designers evaluate the extent of water table rise associated with sea level rise. If a state requires a four-foot separation to high groundwater, it may want to consider raising this requirement (perhaps to five or six feet) to adapt to rising groundwater levels associated with sea level rise. Overall, regulatory authorities are encouraged to anticipate climate change impacts and adapt their onsite programs to accommodate them and for that reason, this model language is provided. These recommendations can be adjusted over time as scientific projections of sea level rise and the subsequent rise in groundwater levels are refined.

3.1 The Applicant shall provide a Site Evaluation Report that includes the following information:

3.1.1 Estimated depth to seasonal high groundwater at the proposed location of the disposal facility. This can be estimated using one of four approved methodologies, as listed below:

3.1.1.1 Observation and measurement of depth to groundwater in a test hole performed during the wettest time of year;

3.1.1.2 Identification and interpretation of redoximorphic features. Redoximorphic features, a term that replaces "soil mottling," refer to a blotchy soil color pattern (often gray, red, orange, and/or yellow) resulting from seasonal fluctuation of the water table. Redoximorphic features observed in soil are significant because they indicate the height of the average seasonal high water table which is typically present from year to year along the sidewall of a test hole;

3.1.1.3 Approximation of seasonal high groundwater based on measurement of depth to groundwater in a test hole at any time of the year, and then adjusted to seasonal high groundwater based on historic seasonal groundwater fluctuations in nearby monitoring wells; or

3.1.1.4 Installation of a monitoring well for the measurement of seasonal high groundwater.

3.1.2 For all systems located at or below an elevation of [X] feet above normal high tide, a map depicting the boundary of all coastal waters, tributaries and wetlands at ordinary high water within [X] distance of the proposed disposal site. The map shall also show the estimated boundary of the topographic elevation [one or two or X] feet higher than the normal high tide. This boundary will serve as the boundary from which coastal setbacks are to be measured for the project.

Note: Each state may have an existing approved method or methods for estimating the seasonal high groundwater elevation. The section above can simply reference those existing methods, or in the case where such methods are not enumerated, this language can be used to do so.

3.2 Systems within [some distance] of a coastal waterbody shall be designed such that the depth to seasonal high groundwater below the disposal leach field is an additional [X] feet, to account for the projected rise in seasonal high groundwater due to sea level rise.

3.3 Systems within [some distance] of a coastal waterbody shall be sited to meet all setback distances assuming that the ordinary high water line is delineated at an elevation [X] feet higher than the actual ordinary high water line, in order to account for potential sea level rise.

Note: Prior to setting the standards related to sea level rise, states should consider the impact of the regulations and perform a preliminary analysis to better understand how many systems may be affected by the regulations. This will help to develop regulations that are not unnecessarily burdensome and will assist the state in preparing for the implementation of the regulation.

4. Nitrogen Treatment Technology Design Criteria

The model language provided in this section addresses only design criteria that pertain to the nitrogen treatment technology for potential incorporation into an onsite wastewater system to meet the nitrogen treatment levels. It is anticipated that this model language could be inserted in the pertinent sections of a state's existing onsite wastewater system regulations.

Nitrogen Treatment Technologies

4.1 Designers must be licensed by the state of [X] to design onsite wastewater systems with nitrogen treatment technologies and shall design the system in accordance with manufacturer specifications and recommendations.

Treatment System Specifications

4.2 Systems shall be designed in accordance with the designated use, design specifications and design criteria approved by the [state] in the [technology verification and approval program].

Facilitation of Operation and Maintenance of Onsite Wastewater Treatment Systems

4.3 The following system components are required for nitrogen treatment technologies to facilitate ongoing inspections, operation, maintenance, and monitoring:

- 4.4.1 Risers and covers at grade must be provided for all access manholes to septic tanks, distribution boxes, pump chambers, and grease traps;
- 4.4.2 Leaching system design must include inspection ports over lateral lines, or over subsurface structures where chamber type units are used;
- 4.4.3 Pressurized systems must have cleanouts with access to grade at the end of each lateral for system inspection, operation, and maintenance;
- 4.4.4 Nitrogen treatment systems must include access for system monitoring and sampling prior to discharge to the dispersal area; and
- 4.4.5 Nitrogen treatment system components must include all operation, maintenance, and inspection access requirements per the manufacturer's recommendations.

4.5 For nitrogen treatment technologies in which effluent treatment and/or discharge rely upon the use of pumps rather than gravity alone, a backup source of power is required to be provided to avoid unpermitted discharges and wastewater backups. In addition, systems must be designed to meet the following criteria:

- 4.5.1 Sufficient storage capacity must be provided in the event of a power outage with a duration of [X] hours, and
- 4.5.2 An emergency contingency plan must be prepared in the event of a long-term [24 hours or longer] power outage to prevent a wastewater backup.

5. Operation and Maintenance of Nitrogen Treatment Technologies

The model language provided in this section addresses O&M activities related solely to nitrogen treatment technologies. In general, existing state regulations already address O&M requirements for the traditional onsite wastewater management system.

5.1 Maintenance shall be performed on all nitrogen treatment technologies in accordance with the manufacturer's specifications [as approved by the state technology approval and verification program].

Note: O&M is critical to ensure the successful long-term operation of nitrogen treatment technologies to meet design performance standards. Systems that employ advanced nitrogen treatment technologies should be required to comply with more intensive and frequent O&M requirements, and this maintenance should be performed by properly trained and certified service providers. The maintenance requirements for these systems are typically documented by the manufacturer and could be included or referenced as part of a state's approval of a nitrogen treatment technology.

ADDITIONAL RESOURCES

American Decentralized Wastewater Association. *Model Performance Code Guidance Document for Advanced Wastewater Treatment Systems*. 2006.

National Onsite Wastewater Recycling Association (NOWRA). *Model Code Framework for the Decentralized Wastewater Infrastructure.* March 2007. Volumes I and II. Available online at: http://www.nowra.org/content.asp?pl=25&sl=36&contentid=36

ATTACHMENT E - MODEL RECIPROCITY AGREEMENT FOR VERIFICATION AND APPROVAL OF NITROGEN TREATMENT TECHNOLOGIES APPLIED TO ONSITE SYSTEMS

HOW TO USE THIS ATTACHMENT

Verification and approval of new technologies can be burdensome for both the states and the technology vendors. Most nitrogen treatment technologies are self-contained, and treatment occurs through biological activity prior to dispersal in the drainfield. Therefore, their performance is dependent on temperature rather than soils or local geology, and technologies verified in one state are likely to perform in a similar fashion in a neighboring state (i.e., similar temperature ranges). The goal of this model reciprocity agreement is to reduce the burden on states and vendors by providing a vehicle for states to share acceptable verification data. It could be further refined by states prior to adoption, or with assistance from the Chesapeake Bay Partnership's Water Quality Goal Implementation Team and its associated wastewater workgroups and experts.

States may have different approaches to verifying and approving new technologies, and the purpose of this agreement is not to dictate a new approach to be implemented by all states. Rather, this purpose of this model agreement is to recommend a common data collection process for data sharing purposes, and provides a vehicle for states to share their data, as well as an opportunity for states to use data from other states as part of their own verification process. For example, if State A requires data to be collected on 20 systems for verification, but State B needs verification of 25 systems as part of its process, data collected by State A could be used to meet part of the data needs in State B, as long as the data are collected in a manner acceptable to State B.

The recommended acceptable technology verification process begins with an initial certification, including the NSF/ANSI 245 Wastewater Treatment System - Nitrogen Reduction Standard and the Environmental Technology Verification (ETV) Program. This initial certification is then followed by third party field verification based on certain requirements specified in the agreement and the NSF/ANSI 360 Wastewater Treatment Systems - Field Performance Verification Standard.

A reciprocity agreement can be initially entered into by multiple state agencies, with an option for additional participants to enter at a later date through an amendment to this agreement. Expanding the agreement beyond the Chesapeake Bay Watershed would provide an opportunity to access additional verification data. In addition, any signatory to the agreement can terminate their participation without impacting other signatories to this agreement.

In an effort to make this model agreement useful to all states, and to encourage states beyond the Chesapeake Bay Watershed to participate, it references standards and methods developed at the national level as much as possible. If two or more states were to enter into a reciprocity agreement based on this model language, all data collection and sharing efforts would be conducted on a voluntary basis, and states would retain the right to exclude other states' data from their state verification process if the data are not acceptable to them.

Certain items, denoted with [brackets], are details to be specified by the state agencies that are entering into an agreement. Notes to the user are provided in the grey highlighted areas as needed.

MODEL RECIPROCITY AGREEMENT

This reciprocity agreement is made and entered into by and between the following state agencies (jointly referenced herein as the "Signatories"):

Name of State
Primacy Agency Name

Name of State
Primacy Agency Name

Name of State
Primacy Agency Name

Name of State
Primacy Agency Name

Name of State
Primacy Agency Name

Name of State
Primacy Agency Name

I. Purpose

The purpose of this reciprocity agreement ("the Agreement") is to establish guidelines for data collection associated with the verification and approval of nitrogen treatment technologies associated with onsite wastewater systems, and to facilitate and expedite the states' approval processes for these technologies.

The intended outcome is to increase the number of verified and approved nitrogen treatment technologies available to developers and homeowners, and to reduce nutrient loads from onsite wastewater systems without needless duplication of effort for Signatories and vendors.

II. Definitions

Nitrogen treatment technology: Technology that treats residential wastewater and reduces its total nitrogen concentration to less than [40 milligrams per liter (mg/L)].

Note: States may have different ways of defining the levels to which nitrogen treatment technologies should perform for approval. The concentration specified above should be one that all can agree upon, such that the definition identifies a system that provides some form of advanced treatment that reduces the total nitrogen concentration in the effluent to less than the expected 40 mg/L in a traditional onsite system.

Residential wastewater: Domestic liquid waste generated primarily from the non-commercial use of bathrooms, kitchens, and laundry facilities by residential dwellings occupied on a year-round basis.

Note: The definition for residential wastewater should not exclude small clusters of residences connected to a single onsite system.

System owner: The owner of an installed and functioning onsite system equipped with a nitrogen treatment technology.

Technology vendor: A business that manufactures, assembles, or sells nitrogen treatment technologies.

Technology verification: Confirmation of the reduction in total nitrogen concentrations provided by a nitrogen treatment technology conducted according to the process and minimum requirements described in the terms below.

Third party: Entity independent from the technology vendor and system owner conducting the technology verification.

Total nitrogen: The sum of the total Kjehldahl nitrogen (TKN), nitrite-nitrogen (NO_2), and nitrate-nitrogen (NO_3) in a sample, expressed in mg/L of nitrogen.

III. Terms

Duration and Termination

This Agreement shall be effective upon the execution of the authorized signatures of all Signatories, which signatures shall be given below.

This Agreement may be amended at any time through mutual consent of all Signatories, providing the amendment is in writing and signed by all Signatories to the agreement prior to the effective date of the amendment. Amendments may incorporate additional signatories to this Agreement.

Any Signatory may terminate its participation in this Agreement, with at least [ninety (90) days] prior written notice to each of the Signatories to this Agreement. Termination of one or multiple Signatories will not automatically terminate the Agreement for the remaining Signatories.

Acceptable Technology Verification Process

Note: The purpose of this section is to define a nitrogen treatment technology verification process that is acceptable to all states. Data collected using other technology verification methods could still be shared, but EPA recommends that states not be required to review the data if the method is not acceptable to them.

Data collected using the following nitrogen treatment technology verification process shall be acceptable for review by all Signatories. Data collected for nitrogen technology verification following another method may be shared between Signatories, but Signatories shall have the right to exclude these data from their state approval verification process if the method is not acceptable to them.

The technology verification process shall include two phases: an initial certification phase, and a field verification phase. All Signatories shall reserve the right to review and evaluate the data collected during both phases to ensure that the data meet their state's criteria, and that the nitrogen treatment technology achieves the manufacturer's stated nitrogen reduction.

First Phase: Initial Certification

The initial certification shall be obtained by a technology vendor for a nitrogen treatment technology, either under the United States Environmental Protection Agency's Environmental Technology Verification (ETV) Program, or following NSF International's standard NSF/ANSI 245 Wastewater Treatment Systems - Nitrogen Reduction.

Note: Other equivalent certification programs could potentially replace the ETV or NSF certifications, but what is considered "equivalent" should be acceptable to all signatories.

After successful completion of the initial certification, Signatories may review the certification data and issue a conditional approval for the installation of a limited number of nitrogen treatment technology systems within their state. Systems permitted under conditional approval shall become eligible for the field verification phase.

Second Phase: Field Verification

Note: NSF/ANSI Standard 360 provides a comprehensive and thorough methodology for field performance verification that addresses the following key components:

- Field audits and observations;
- Sample collection, handling, and testing processes, including chain of custody;
- Minimum requirements for a testing plan, including experimental approach, sampling and analytical procedures, a quality assurance plan, and data reporting; and
- Minimum quality control requirements.

However, some of the requirements (e.g., number of systems to be tested) may not be compatible with what states currently allow. In addition, NSF/ANSI Standard 360 does not require nitrogen sampling for all systems, but nitrogen sampling should be a requirement for the field verification phase.

This standard could be replaced by another standard, or by a list of requirements, but the latter would create a lengthy agreement that may be difficult for states to approve.

The field verification shall be completed by a third party following the requirements of the NSF International's standard NSF/ANSI 360 Wastewater Treatment Systems - Field Performance Verification, except for the items specified below.

> Number of systems: The verification process shall conduct testing on a minimum of [twelve (12)] systems, which can be located in a single state.
>
> Start up period: The system shall have undergone a start up period of at least [three (3) months] of continuous operation.
>
> Minimum sampling parameters: At a minimum, the nitrogen treatment technology shall be tested for the following parameters and contaminants: pH, temperature, TKN, NO_2, NO_3, total nitrogen, and alkalinity. Sampling requirements should follow NSF/ANSI Standard 360.
>
> Winter sampling requirement: At least one of the four quarterly samples collected for each nitrogen treatment technology system will be collected during winter, defined as [the period from December 15 to February 15].

<u>Data Collection and Sharing</u>

Note: For states that have successfully verified nitrogen treatment technologies through the process described above, EPA recommends that they notify other participating states that the verification has been completed, and share the data with other states. This would not require the remaining states to reach the same conclusion and approve the technology, but it provides an opportunity to review existing data. In addition, there should be a way for states to share long-term data if the data are being collected. An online shared database could provide a central repository for both verification and long-term monitoring data.

If a nitrogen treatment technology has received conditional approval for a number of systems in a Signatory's state, this Signatory shall notify the other Signatories of the conditional approval, and provide access to the data reviewed for the conditional approval upon request from other Signatories. Other Signatories may request the data, perform their own analysis, and grant conditional approval status for the technology in their respective states if the data and results are sufficient to meet their state requirements.

If a nitrogen treatment technology has successfully completed the two-phase verification process described above in a Signatory's state, and has received full approval status, this Signatory shall notify the other Signatories and provide access to the data reviewed for full approval upon request from other Signatories. Other Signatories may request the data, perform their own analysis, and grant full approval status for the technology in their respective states if the data and results are sufficient to meet their state requirements.

After a nitrogen treatment technology has been approved for use, sampling may continue on individual systems as part of a long-term monitoring plan. To the extent possible, Signatories shall share data collected by system owners on an on-going basis with other Signatories.

A common database may be created for data sharing purposes among Signatories. All Signatories shall be provided access to that database for uploading their own data, and viewing other Signatories' data.

IV. Signatures

By signing this Agreement, we, the undersigned in no way abrogate our individual state statutory and regulatory authorities and responsibilities, nor remand, repeal, or otherwise alter the laws or regulations of the respective signatory agencies.

____
Signatory Name, Title
Name of State
Primacy Agency Name
Date

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Signatory Name, Title
Name of State
Primacy Agency Name
Date

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Signatory Name, Title
Name of State
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Signatory Name, Title
Name of State
Primacy Agency Name
Date

ATTACHMENT F - CASE STUDIES ON SUCCESSFUL IMPLEMENTATION OF MODEL PROGRAM COMPONENTS

HOW TO USE THIS ATTACHMENT

This attachment provides case studies of successful implementation of the following regulatory program components, followed by a list of resources consulted to develop these case studies:

- Responsible Management Entity - Peña Blanca, New Mexico
- Onsite System Inventory and Inspection - State of Rhode Island
- Training and Certification - State of Delaware
- Approval and Verification of Advanced Treatment Systems for Nitrogen Reduction - State of Maryland
- Funding - State of Maryland Bay Restoration Fund

<u>CASE STUDIES</u>

Responsible Management Entity for Onsite Systems[26]
Peña Blanca, New Mexico Water and Sanitation District

Problem: Outdated, neglected, or nonexistent wastewater systems posed a public health risk to the 800 citizens of Peña Blanca, New Mexico. Open cesspools and seepage pits emptied into yards and irrigation canals. Surveys revealed that 86 percent of the individual wastewater systems needed repair or replacement. Residents rejected a proposed centralized sewer system at a cost of $3.1 million.

Solution: The community opted to repair/replace 133 of the existing 185 treatment systems with a Water and Sanitation District serving as the operator/manager of the upgraded and new facilities.

Overview

Local officials worked closely with federal and state agencies to establish the Peña Blanca Water and Sanitation District (WSD) and developed a wastewater management program with an emphasis on maintenance. This management program features the following components.

- Operating permit and maintenance contract requirements
- Requirements to pump tanks every two years
- Maintenance of system records and reporting requirements

This program is consistent with the Responsible Management Entity (RME) operation and maintenance Model 4 recommended by the U.S. Environmental Protection Agency (EPA) in their *Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems* (EPA, 2003a). Under Model 4, frequent and reliable operation and maintenance is the responsibility of a management entity (i.e., the WSD for Peña Blanca), increasing the level of accountability. RME management is particularly appropriate for clustered systems, and advanced treatment systems providing nitrogen reduction.

Water and Sanitation District Serves as the RME

The Peña Blanca community received an EPA Clean Water Construction Grant of about $760,000 to repair and replace individual wastewater systems and develop new cluster systems. The WSD was formed under the authority of a New Mexico statute in 1990 to manage the systems. The WSD adopted an ordinance to provide for the operation, maintenance, and repair of wastewater treatment systems. The district maintains an inventory of the systems, collects user fees, requires pumping of all tanks once every two years, contracts pumping services and maintains all active systems, and coordinates with the City of Albuquerque to accept septage pumped from the tanks.

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[26] Adapted from U.S. EPA, *Case Studies of Individual and Clustered (Decentralized)Wastewater Management* Programs, October 2010 Review Draft

Ordinance Serves as Maintenance Contract
The WSD ordinance essentially serves as a maintenance contract and authorizes the WSD to pump septic tanks every two years. Homeowners have the option to hire their own pumpers, but must maintain documentation and pay a base fee of $4 per month. Residents installing a new individual wastewater system must sign an easement to allow for maintenance. All systems must also obtain an operating permit from the New Mexico Environment Department. The WSD is responsible for maintaining pumping records. Systems are inspected in response to citizen complaints.

Funding Sources
WSD charges a monthly service fee according to septic tank size, which ranges from $9 to $20 per month. The 2008-2009 operating budget was $27,000.

Results
The program has been in operation since 1991 and serves nearly 200 homes and businesses. The decentralized wastewater option cost less than half the projected cost of a central sewage treatment plant for the 133 homes served by repaired/replaced systems. Sewage surfacing and cesspool discharges throughout the community no longer occur. Post-construction groundwater monitoring measured nitrate levels at 1 milligram per liter (mg/L) or less in the project area, far below the 10 mg/L standard for groundwater used as drinking water.

Onsite System Inventory and Inspection

South Kingstown, Rhode Island's Onsite Wastewater Management Program

Problem: In South Kingstown, RI, a coastal community, onsite systems and cesspools were a significant source of contamination to the Town's ground and surface waters. Due to old age, outdated design, overuse, improper installation, and the lack of needed repair and poor maintenance, onsite systems were prone to failure.

Solution: South Kingstown adopted an Onsite Wastewater Management (OSWM) program requiring septic system inspection and maintenance at regular intervals for all 6,600 onsite systems.

Overview

South Kingstown formed a partnership with the University of Rhode Island Cooperative Extension to develop its OSWM program. In April 2000, the Town sought assistance from the U.S. Environmental Protection Agency (EPA) to fast-track implementation of their wastewater management program as a demonstration for other small communities facing similar challenges. The OSWM program developed by South Kingstown contains the following management standards: 1) mandatory inspections, scheduled based on system type and use, with tank pump outs, maintenance and repairs as needed, and detailed reporting to towns; 2) immediate replacement of failed systems; and 3) complete phase out of cesspools by certain dates.

Onsite System Regulations

South Kingstown's Onsite Wastewater Management Ordinance was adopted by the Town Council on October 15, 2001, and provides a framework for the efficient inspection, repair and maintenance of onsite systems. The regulations require the following:

<u>First Maintenance (Baseline) Inspection</u>: This inspection provides baseline information and is used to determine a routine maintenance schedule, potential upgrade requirements, and location of system components. All cesspools and septic tanks installed prior to 1970 are required to be pumped as part of this inspection to better evaluate the condition of the system. The Town was divided into sections to develop a proposed inspection schedule.

<u>Routine Maintenance Inspections</u>: Routine inspections occur between septic tank pump-outs. The frequency of Routine Maintenance Inspections is determined by the conditions found at the First Maintenance Inspection. Routine Maintenance Inspections may be limited to sludge and scum measurements within a septic tank and can be conducted by property owners who have received proper training.

<u>Inspection Frequency</u>: Onsite system owners receive written notice of the need to schedule the First Maintenance Inspection as well as subsequent Routine Maintenance Inspections. The owner must have the on-site system inspected by an approved inspector within 45 days of the date of notice. Inspection frequency for Routine Maintenance Inspections are based on factors including system age, household occupancy, tank size, sludge and scum measurements, as well as when the system was last pumped.

Inspection Reports: The regulations require documentation of all inspections using a standard inspection form. Property owners provide system inspectors with information including the use, age, location, maintenance history, and design of the onsite system. The completed inspection report details the results of the inspection, pumping or other maintenance requirements, and the time frame for the next inspection and/or upgrade requirements for the onsite system.

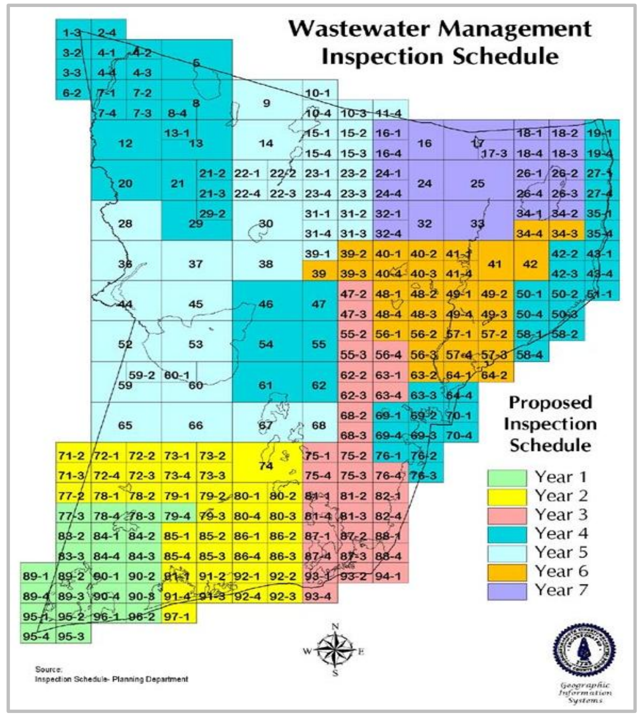

Figure F1. Schedule of Onsite System Inspections in South Kingstown

Failed System: If an inspection reveals a malfunctioning or failed onsite system, the inspector informs both the Town and the system owner. Replacement technologies for failed systems are based on the Town's policy and state requirements regarding treatment standards.

Phasing of Inspections: Inspections of onsite systems are scheduled to occur over a period of seven years (Figure F1). The phasing of inspections prioritizes inspections for areas that are closest to water resources that may be the most sensitive to impacts from onsite systems.

Inspections and maintenance are tracked using an electronic database. The Rhode Island Wastewater Information System (RIWIS) database was established in 2006, and is available to all Rhode Island communities at a low cost ($100/year). The database is a web-accessible system maintained by a software vendor and is not a stand-alone software product (see Figure F2 for a screenshot).

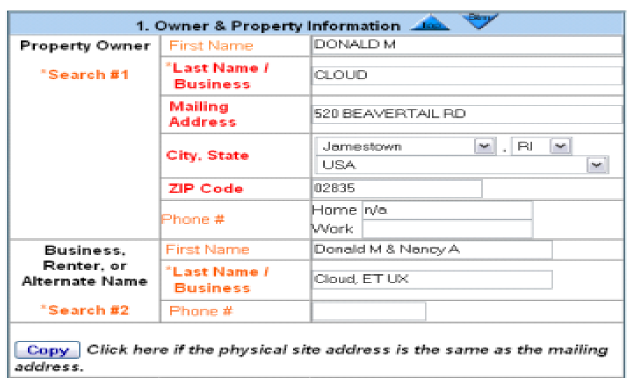

Figure F2. Screenshot of the RIWIS System

Results

As of September 2006, South Kingstown had completed inspections of 89 percent of the approximately 4,800 systems that the Town contacted about inspections. Due to those inspections, 74 cesspools were replaced, and 67 failed conventional systems were repaired or replaced. Also, in 2006 there were approximately 90 advanced treatment systems based on the state's higher treatment requirements for areas sensitive to pollution. The Town's inspection inventory program helps ensure the proper functioning of advanced treatment systems by tracking maintenance through regular inspections.

Training and Certification

Delaware Onsite Wastewater System Training and Certification Program

Problem: Proper installation and maintenance of onsite systems is critical to protecting water resources. The use of advanced onsite systems calls for additional professional training and qualifications to reduce issues associated with design, construction, and maintenance of these systems.

Solution: Delaware's Department of Natural Resources and Environmental Control (DNREC) adopted regulations that require certification for professionals involved with the design, siting, installation, inspection, operation, and maintenance of onsite wastewater systems. Onsite system professionals are also required to obtain continuing education training (CET) credits annually.

Overview

Delaware's onsite system regulations include certification/ licensing requirements to limit issues resulting from improper installations and poor operation and maintenance practices. These regulations have undergone revisions since they were initially adopted in 1985 to reflect the evolving education and experience needed to perform services to onsite systems. Delaware also created an On-Site Systems Advisory Board (OSSAB) charged with overseeing the licensing of onsite system professionals and making decisions regarding licensing matters.

Delaware's OSSAB Members

(1) A representative of the DNREC
(2) A professional engineer
(3) A professional geologist
(4) A representative from the U.S. Department of Agriculture
(5) A Class D site evaluator
(6) A Class E contractor
(7) A Class A liquid waste hauler
(8) A Class H system inspector

State Certification

Applications submitted for certification must provide the following information: 1) Current and previous employment information; 2) years of experience; 3) three references on character and business integrity; 4) licenses currently and previously held; 5) past license suspension or revocation; 6) past or outstanding civil, administrative, or criminal proceedings for any environmental or regulatory violations. Licensed professionals are required to renew their certifications annually, and the OSSAB can approve and revoke licenses.

Table F1 lists the classes of licenses that are available under Delaware's onsite certification program and the requirements for each license class. For some licenses, Delaware's DNREC accepts certificaiton by a professional association to the meet certification requirements. For site evaluators (Class D), DNREC accepts certification through the American Registry of Certified Professional in Agronomy Crops and Soils (ARCPACS). The ARCPACS affiliated Soil Science Society of America (SSSA) sets standards for knowledge for those in soil science professions. For system inspectors (Class H) DNREC accepts National Association of Waste Transporters (NAWT) certification, Pennsylvania Septage Management Association (PSMA) certification, or Delaware Technical and Community College (DTCC) certification to meet the licensing requirements.

Continuing Education Training (CET)

Once a professional obtains a license in a certain area, Delaware requires proof that the professional attended and/or satisfactorily completed a minimum of ten (10) hours per year of CET related to the wastewater industry.

Table F1. List of License Classes in Delaware's Onsite System Certification Program

Class	Type	Requirements
A	Percolation Tester	Passing grade on an examination prepared and administered by DNREC
B	Designer - conventional onsite systems	Application and passing grade on an examination prepared and administered by DNREC
C	Designer - conventional and alternative onsite systems	Registration as a Professional Engineer with the DE Association of Professional Engineers; and a qualifications statement to verify the individual's knowledge and competency in onsite system engineering and design
D	Site evaluator/ soil evaluations	Experience in the field of soil classification and mapping and/or site evaluations for onsite systems; three references; and a combination of professional experience and education credits
E	System contractor/ construction	A qualifications statement to verify the individual's knowledge competency of state regulations; and at least two years experience in onsite system construction
F	Liquid waste hauler	Passing grade on an examination prepared and administered by DNREC
H	System Inspector	Certification of training completed under the National Association of Waste Transporters, the PA Septage Management Association, DE Technical and Community College certification program, or as approved by OSSAB Passing grade on an examination prepared and administered by DNREC

Training and Education Programs

Figure F3. Delaware Tech's Onsite Training Program - Testing Area

Education opportunities are offered by the Delaware Technical and Community College (Delaware Tech) which operates the Environmental Training Center. Delaware Tech provides classroom training to prepare operators to complete the state's licensing examination. For licensed professionals, the Environmental Training Center provides on-going continuing education classes and seminars. Also, many of the programs offered at Delaware Tech meet the training requirements of nearby states, and can be utilized by onsite professionals who work in several states. DNREC provides a list of all approved continuing education courses on its webpage to assist onsite professionals in obtaining the necessary credits to renew their licenses.

Information on Licensed Onsite Professionals

Delaware's DNREC provides the license status of individuals on its website. This helps onsite system owners select a professional with the proper training and educational requirements.

Results

Delaware's training and certification program certified approximately 1,100 onsite system professionals. A key component to Delaware's training and certification program is a requirement for continuing education training annually to ensure that onsite system professionals provide effective services to onsite systems. The CET requirement is supported by programs provided through Delaware Tech's onsite system training program.

Approval and Verification of Advanced Treatment Systems for Nitrogen Reduction
Maryland's Best Available Technology Review Team

Problem: As part of Maryland's Bay Restoration Fund (BRF), fees collected from onsite systems are used to repair failing systems and upgrade onsite systems to advanced treatment systems for nitrogen removal. To achieve the nitrogen reduction goals of the program, the Maryland Department of Environment (MDE) is responsible for approving technologies that work reliably and provide the nitrogen reduction amounts advertised by manufacturers.

Solution: The MDE formed a Best Available Technology (BAT) Review Team to determine which onsite wastewater disposal nitrogen reducing technologies should be considered eligible for grants under the BRF.

Overview
Advanced treatment systems for nitrogen removal ("advanced systems") are conditionally approved and eligible for BRF grant funding if they have undergone the Environmental Protection Agency's Environmental Technology Verification (ETV) Program, NSF 245 Certification, or other equivalent third party verification testing. Third party verification requires an independent party to confirm the nitrogen removal performance of the technology.

The data gathered from the third party testing is analyzed by the BAT Review Team to determine if it performs to the higher standards required by MDE. The Review Team requires independent verification data showing that the technology is meeting the criteria of 50% reduction (or higher), or a total nitrogen concentration of 30 milligrams per liter (mg/L) or less.

Field Testing by MDE
After an advanced system receives conditional approval, it enters a field verification period during which up to 15 installations are allowed until the system has successfully passed the testing requirements. The following additional requirements apply to the testing process.

- Twelve of the installations are used in the initial analysis. The remaining three systems are classified as reserve systems and serve as a replacement for one of the original twelve if needed.
- The vendor/applicant is required to submit a field verification plan that includes detailed instructions for collecting samples and a sampling schedule.
- All technologies must sample a minimum of 12 units four times each in consecutive quarters to include at least one quarter of winter time samples. Winter is defined as December 15 through February 15.

MDE's sampling requirements ensure consistency between different manufacturers and the accuracy of data collected, and include the following components.

- Submission of a model-specific manufacturer sampling protocol for each unit.
- Samples collected by a certified drinking water laboratory (from an approved list).
- Samples collected are to be a representative 24-hour composite or equivalent.
- The testing facility is required to utilize chain of custody procedures and is expected to provide this documentation to MDE.

- The sample collected must be analyzed for Total Nitrogen (TN) and its components of Total Kjeldahl Nitrogen (TKN), Nitrite, and Nitrate
- Other measurements include dissolved oxygen, temperature, and pH.
- All sampling methods should be consistent with "Standard Methods for the Examination of Water and Wastewater," 20th Edition, 1998, A.P.H.A, or any EPA approved method.
- The first 12 units installed in Maryland by each manufacturer are tested quarterly for one year for a total of 48 samples.
- Sampling results and documentation are submitted by the unit manufacturer on a semi-annual basis along with actual laboratory reports.
- After the verification period is over, MDE reserves the right to spot sample any unit installed.

Until completion of the field verification, conditional approval for a system can be revoked based upon analyses performed by MDE and the Bay Restoration Fund Review Committee.

Ranking of Technologies

As required by legislation approved in 2011, MDE is required to rank all BAT nitrogen removal technologies for onsite sewage disposal systems. Rankings are to be provided for the following factors.

- TN reduction for the technologies.
- Total cost of the technology to include operation/maintenance and electrical consumption.
- Cost per pound of nitrogen reduction.

Results

MDE currently has seven conditionally approved BATs for nitrogen removal undergoing field testing, and five technologies that have successfully passed field verification in Maryland. Technologies that have successfully completed field verification by MDE are listed in Table F2.

Table F2: List of MDE Approved Technology, and Field Verified (as of 2/2012)*

Model	Manufacturer	Certifications	MDE Field Performance Analysis	
			TN Removal	Effluent Concentration
Hoot BNR	Hoot Aerobic Systems, Inc.	Other 3rd Party	64%	21 mg/LL
Advantex AX	Orenco Systems, Inc.	Other 3rd Party	71%	17 mg/L
Singulair TNT	Norweco, Inc.	NSF 245, Other 3rd Party	55%	27 mg/L
SeptiTech	SeptiTech, Inc.	ETV, and NSF 245	67%	20 mg/L
RetroFAST	Bio-Microbics, Inc.	ETV	57%	25 mg/L

*Source: http://www.mde.state.md.us/programs/Water/BayRestorationFund/OnsiteDisposalSystems/Pages/water/cbwrf/osds/brf_bat.aspx

Funding
Maryland's Bay Restoration Fund Onsite Sewer Disposal System Grant Program

Problem: Maryland has approximately 420,000 septic systems statewide, with 52,000 systems located within 1,000 feet of tidal waters. Conventional onsite systems do not remove nitrogen and contribute nitrogen to groundwater and ultimately the Chesapeake Bay.

Solution: Maryland's Bay Restoration Fund (BRF) collects a fee from residents with onsite systems to fund upgrades to advanced treatment systems for nitrogen reduction.

Overview
Passed into law in 2004, Maryland's BRF collects a fee from all homes that receive a water and sewer bill as well as households served by onsite systems. The annual $30 fee, commonly referred to as a "flush fee," is collected from users based on the schedule shown in Table F3. Fees collected from homes served by onsite systems are held in a dedicated "Septic Fund," and fees collected from sewered homes are dedicated to upgrading wastewater treatment facilities. Approximately $12 million is collected annually from homes with onsite systems. Sixty percent of these funds are used for septic system upgrades, and the remaining forty percent are used to fund cover crops, since cover crops are the state's most cost-effective Best Management Practice (BMP) for preventing nitrogen movement to groundwater.

Table F3: BRF User Fees

User Group	BRF Fee Amount	Collection Type
Households that receive a water/sewer bill	$2.50/month ($30/yr)	Collected with water/sewer bills
Commercial and Industrial users	$2.50/month per EDU	Collected with water/sewer bills
Users of onsite systems or holding tanks	$30/yr	Collected by the county

*(one EDU, or equivalent dwelling unit, corresponds to a flow of 250 gallons per day)

The Maryland Department of the Environment (MDE) then disseminates the Flush Fee funds through the Septic Best Available Technology (BAT) Program for the purposes of upgrading onsite septic systems to improve nitrogen removal. MDE prioritizes funding for septic system upgrades toward those systems that pose the greatest threat to clean waterways and drinking water as shown in Table F4.

Table F4: Funding Priority for Bay Restoration Fee

Priority	Onsite System Location/Condition
1 (highest)	Failing septic systems within 1,000 ft. of tidal waters
2	Failing septic systems outside 1,000 ft. of tidal waters
3	Non-failing systems within 1,000 ft. of tidal waters
4 (lowest)	All other systems, including new construction

The Septic BAT Program is implemented by local county health departments or other municipal departments, and funding is allowed for the following costs:

- The cost attributable to upgrading an onsite system to BAT for nitrogen removal;
- The cost differential between a conventional onsite system and one that utilizes BAT for nitrogen removal;

- The cost for repairing or replacing a failing onsite system with one that utilizes BAT for nitrogen removal (this option is only available to low-income owners);
- The cost, up to the sum of the costs authorized under "b" of each individual system, of replacing multiple onsite systems located in the same community with a new community system that is owned by a local government and achieves enhanced nutrient removal; and
- The cost up to the sum of the costs authorized under "c" of each individual system, to connect properties to an existing municipal wastewater facility achieving enhanced nutrient removal.

The local billing authority may exempt certain residential users from paying the BRF fee due to financial hardship. Billing authorities are allowed to consider the following as evidence of financial hardship: receiving an energy assistance subsidy, public assistance, food stamps, or social security disability benefits; being a veteran; or meeting income levels for assistance programs. The subsidy amount provided for a Septic BAT upgrade is based on income levels (Table F5).

Maryland's Comptroller's Office reimburses counties up to 5% of fees deposited for reasonable incremental administrative costs associated with the BRF fee billing and collection. Unrecovered administrative costs can be carried forward and recovered over subsequent quarters/years.

Table F5: Income Eligibility for Septic BAT Program (2012)

% Septic BAT Grant Subsidy	Federal Marginal Tax Rate	2010 Taxable Income (Single)	2010 Taxable Income (Married –Jointly filing)
100	10-15%	0 – 34,000	0 – 68,000
75	25%	34,000 – 82,400	68,000– 137,300
50	28%	82,400 – 171, 850	137,300– 209, 250
25	33-35%	Over 171, 850	Over 209, 250

Other Funding Sources

Maryland has two additional sources of funding for homeowners to upgrade their onsite septic systems. One is the "Linked Deposit Program" run by the MDE's Water Quality Financing Administration (WQFA) in which the agency finances below-market interest rate loans through an agreement with participating lenders for the purpose of funding certain water quality and drinking water capital projects.

A second program is Maryland's Water Quality and Drinking Water State Revolving Loan Fund Program (RLF), which uses EPA funds to provide low-interest loans to local governments to finance wastewater treatment plant upgrades, nonpoint source projects, and other water quality and public health improvement projects.

Results

Since 2004, the BRF has upgraded over 3,000 onsite systems to advanced treatment systems for nitrogen reduction. The legislature is currently considering doubling the "flush fee" from $30 to $60 dollars per year for all users in order to meet its Phase 1 Watershed Implementation Plan (WIP) 2017 goals for reducing nitrogen.

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