

Septic Vulnerability

Essex County, VA

Fall 2022

PLAC 5863: Climate Adaptation
Planning for Virginia

Prepared By:

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Introduction

The increasing severity and frequency of inundation events as a result of human-induced climate change produces a series of secondary consequences beyond the immediate aspects of flooding. Among these secondary consequences is contamination via wastewater released from private septic systems as filtering efficacy and structural integrity are challenged by saturated soils and saltwater intrusion. Mitigation and adaptation strategies that address this issue face the particular challenge of coordinating action among disorganized stakeholders who are each responsible for the maintenance of their respective systems. Despite the reality that septic tank degradation is a chronic issue that affects infrastructure on a regional level due to particular geographic characteristics, the systems themselves are legally



Source: RAFT

maintained by private property owners and are therefore managed on a case-by-case basis. Moreover, since the absence of a public sewer system often implies the absence of an incorporated urban community, these property owners are predominantly residents of rural localities and frequently do not possess the resources to adequately maintain their septic tanks. Combined with a regulatory framework that can leverage hefty penalties against owners who do not comply with the septic code, many rural areas must contend with private septic infrastructure that is undermaintained yet underreported. This is particularly severe in low-lying coastal communities whose rural character produces the aforementioned issues in management and regulation and whose geographic and climatic conditions can accelerate the physical deterioration of septic systems.

Essex County, Virginia, is currently in the process of identifying infrastructural initiatives which can protect the area's long-term water quality. This is coordinated through the efforts of the Resilience Adaptation Feasibility Tool (RAFT), a "collaborative approach to climate resilience that leverages the expertise and resources of multidisciplinary partners and diverse stakeholders to assist coastal localities to increase their resilience (RAFT, 2022)," which is developed and managed through a partnership between the University of Virginia's Institute for Engagement and Negotiation (IEN), the Virginia Coastal Policy Center (VCPC) at William & Mary Law School, and Old Dominion University/Virginia Sea Grant (ODU). The early stages of the RAFT process saw community partners in Essex identify five goals that would guide subsequent action during the RAFT's subsequent year-long implementation process. One of the goals that the partners identified is the "protection and mitigation of impacts to the availability of clean water," which concerns acute and long-term quality issues stemming from storm events, saltwater intrusion, and sea-level rise. Private septic maintenance in Essex is especially relevant to this goal. The authors of this report who are currently working on the RAFT, have partnered with representatives from Chesapeake Bay National Estuarine Research Reserve (CBNERR) and Friends of the Rappahannock (FOR) to develop material that will aid in outreach/education efforts to property owners so as to mitigate the impacts of chronic septic degradation. Additionally, a working paper has been developed which outlines broader issues with long-term septic infrastructure in coastal communities and offers suggestions for adaptation strategies that exist outside the purview of this project's resources or direct influence.

Background

Septic systems, as opposed to septic sewers, are defined here as decentralized treatment systems which treat low volumes of wastewater from residences or small businesses. Unlike septic sewers, which are typically public infrastructure networks that serve a given municipality, septic systems provide water treatment for individual buildings and are managed by the building's owner. These systems are usually buried underground and process wastewater through anaerobic digestion before releasing it into surrounding soil via the system's drainfield. This soil serves as the final filtration medium and therefore absorbs any material which remains after being processed through the septic tank (EPA, 2022). Issues can arise when substances such as household chemicals and pharmaceuticals, which are not properly broken down through anaerobic digestion, are sent through the septic system and flushed into the landscape. Additional issues can arise when systems are damaged or malfunctioning and wastewater is improperly treated. Pathogens, nutrients, and harmful chemicals can contaminate the surrounding soil or water, with subsequent consequences including eutrophic algal blooms, damage to agricultural food supplies, and degradation of an area's recreational capacity.

In Essex County, Virginia, several social and environmental factors risk compromising thousands of private septic systems. Wet soil decreases the efficacy of a system's drainfield and low-lying coastal areas in the Southeastern United States have relatively high rates of soil moisture which is exacerbated by the increasing frequency and severity of inland flooding events. Sea level rise, observed at some of the highest levels in Tidewater Virginia, can severely compromise a septic tank's structural integrity through saltwater intrusion. Many homes and auxiliary infrastructure in the area were constructed several decades ago, and even assuming favorable environmental conditions, their natural lifespan would require replacement or maintenance



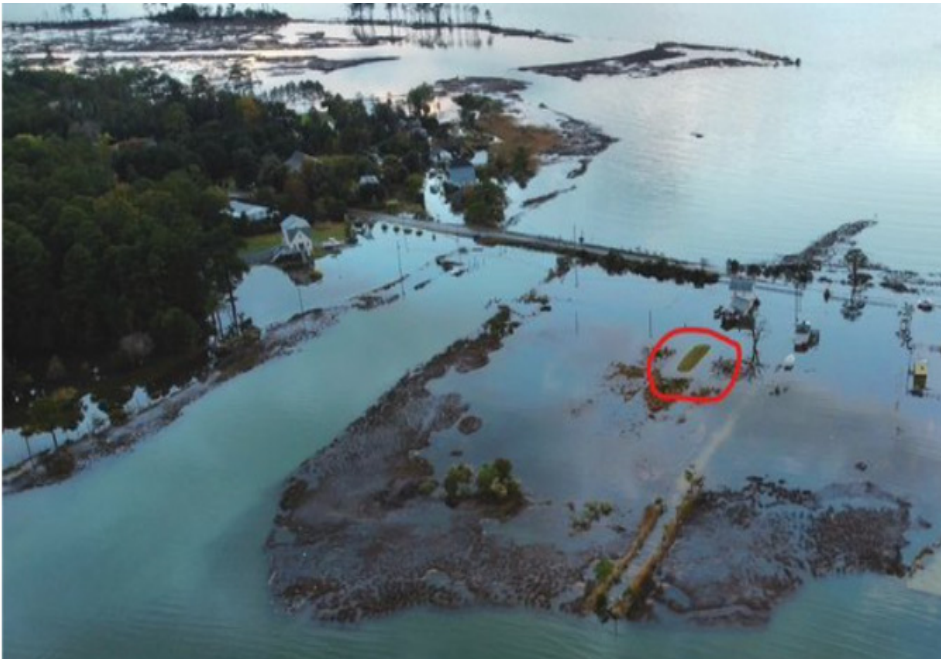
Source: EPA

so as to ensure a continuity of effective wastewater treatment. We believe these factors indicate that initiatives in Essex County that concern the identification of damaged or malfunctioning systems, replacement or pumping-out of said damaged systems, and politically structural assistance for pump-outs or replacements should be of paramount importance. However, the reality of Virginia's regulatory framework for septic systems provides substantial obstacles to this endeavor.

Until 1990, information on private septic systems was regularly collected by the American Census Bureau. When this ended, data collection in Virginia became the responsibility of local health districts operating under the Virginia Department of Health (VDH) (Sewage Handling and Disposal Regulations, 2022). Essex County is within the jurisdiction of Three Rivers Health District, the organization which collected information on septic systems during installation and stored its physical documentation in its regional office. In 2003, VDH established a database that served to centralize and digitize all septic information gathered by local health offices. VDH's efforts to move all dispersed physical documentation to this central database are ongoing, but there remains a significant hole regarding the information on the prevalence and location of private systems in the state, particularly in rural areas such as Essex. Additionally, changes were made to Virginia's septic code in 2000 which allowed for the installation of "alternative" systems whose drainfield filters were augmented by technology rather than relying solely on the surrounding soil. Since the first three years of alternative system installation predated the establishment of VDH's database, a lot of the initial information regarding these systems' prevalence and location is missing. These alternative systems, unlike standard private septic systems, also require a five-year maintenance report to be submitted to VDH in order to monitor filtration efficacy (Sewage Handling and Disposal Regulations, 2022). It is estimated that 58% of owners have not complied (Vogelsong, 2020).

It is our view that underreporting of septic tank malfunction is a product of the state’s regulatory framework. State septic code, as well as penalties for violations, are set by the Virginia Administrative Process Act. VDH is responsible for enforcing the code and therefore has the ability to report violators who are potentially subject to \$25,000 fines for each offense or possible jail time. For standard (non-alternative) systems, VDH requires an inspection before and after installation but has no mechanism for ongoing inspections (Huffman et al. 2018). Even if the agency had the financial and political resources to send inspectors into rural areas to check on system health, property owners who are financially unable to repair or replace damaged systems have a vested interest in obfuscating disrepair, as code violations would only worsen their situation economically. Combined with structural issues in centralized reporting as detailed above, rural Virginia must simultaneously deal with failing septic systems whose location and status of operation are largely unknown and whose property owners are hesitant to disclose. This hesitation has affected the efficacy of financial assistance opportunities provided by organizations like VDH, Virginia Cooperative Extension (VCE), Southeast Rural Assistance Project (SERCAP), and the Department of Agriculture (USDA).

With this in mind, community partners involved in the RAFT have identified educational and outreach events that provide residents with instructions on how to properly maintain a septic tank, and which are supplemented by information regarding assistance opportunities, as an immediate mitigation strategy. These outreach events will be centered around the construction of a septic system exhibit which will ideally provide community members with an interactive experience on private septic health and maintenance. This will also be supplemented with a draft submitted to IEN’s Working Paper series which addresses the long-term feasibility of private septic infrastructure and provides recommendations for adaptation strategies as they relate to coastal managed retreat.



Flooded Septic Tank
Source: Virginia Mercury

Methodology

As part of the RAFT process, stakeholders in Essex County defined a “Resilience Action Checklist (RAC)” of priority actions to increase community resilience. Essex County’s fourth RAC item, “protect the availability of clean water during storm events and in the long-term,” regards potential impacts of acute and long-term water quality challenges (RAFT, 2022). This RAC item considers flooded wells and septic systems and highlights opportunities to address chronic surface water contaminants including contamination from septic systems.

During an Implementation Team meeting with stakeholders from Essex County, Cirse Gonzalez, Coastal Training Program Coordinator at CBNERR, suggested that the RAFT partners could create an exhibit to educate members of the Essex community about the impacts of septic pollution. The suggestion was widely accepted by the group, and we recognized the project as one that could fulfill the requirements for this class and reached out to Cirse about a partnership.

During the initial meeting with Cirse, she referred to an educational exhibit created by Teri King, Aquaculture and Marine Water Quality Specialist at Washington Sea Grant. Teri has worked for decades as an environmental educator, specifically focusing on issues of septic safety and related water contamination. Cirse suggested that the exhibit project be modeled on work that Teri has done in coastal Washington.



Figure 1: Septic exhibit

A call was set up with Teri to discuss the process of building a septic system exhibit and how to display it through community events. She referred us to several helpful resources, provided images of her own septic exhibit (Figures 1 and 2), and gave us instructions for our own construction. Teri assembled the septic exhibit at community events and used it to educate owners of septic systems about the inner workings of their systems. She accompanied the exhibit with educational resources that provided information about how to maintain a system and the impacts of a system failure.



Figure 2: Entrance to the septic exhibit

In addition to Teri King, Molly Mitchell, an environmental scientist at Virginia Institute of Marine Sciences (VIMS) who is working with a team to assemble data about septic systems in the Middle Peninsula of Virginia, was contacted. Molly shared helpful resources including the [Virginia Wastewater Data Viewer](#), and the [Septic Vulnerability Viewer](#). Although she agreed to send the data used on these viewers, she has since not responded to emails containing follow-up requests. Consequently, the data used to inform this project is not as granular as initially intended. This will be discussed further in the limitations section.

Later in the project process, Brent Hunsinger, Friends of the Rappahannock River Steward, shared that FOR is interested in septic education for the Middle Peninsula. Brent has applied for funding for a project from the RAFT Fund and is willing to partner on this project. FOR had not outlined an explicit educational program for the grant, and they have expressed willingness to direct additional capacity allowed by funding towards the educational exhibit formulated for this project. We anticipate RAFT grant results to be released in early January, giving a rough timeline to hand off partial exhibit management to FOR. Coordination between FOR, CBNERR, and RAFT is ongoing.

Vulnerability & Risk Assessment

We define the following terms according to definitions provided by the Virginia Coastal Policy Center (VCPC). Resilience is the ability to prepare and plan for, absorb, recover from, or more successfully adapt to actual or potential adverse events. Vulnerability refers to the characteristics of an individual or group that influence their capacity to anticipate, cope with, resist, and recover from a physical hazard (Franklin and Henshaw, 2021).

In Essex County, many residents are vulnerable to septic-related water pollution. Flooded systems are likely to fail and pollute surrounding waters with nutrients and chemicals. Community members rely on industries including shellfishing that can be disrupted by water pollution. Additionally, many residents use private wells for drinking water. These wells can become impaired when septic systems fail. The most vulnerable people are owners of private septic systems who are unable to replace or regularly pump out their systems, residents in vulnerable areas who do not have the resources to relocate, and those who are reliant on vulnerable industries.

VIMS Septic Vulnerability Viewer indicates building parcels within and outside of the 100-year flood plain. Although the 100-year flood plain is an imperfect measure of vulnerability, VCPC uses it to indicate where septic systems may be at risk from sea level rise. Figure 3 shows parcels in Essex County that are entirely or partially within this floodplain. Most parcels in Essex County are at least partially within the 100-year floodplain. Therefore, the land is not suitable for new septic systems, and existing systems are at risk of failure.

In addition to showing at-risk parcels, the VIMS Septic Vulnerability viewer uses a social vulnerability index to show areas that are at higher risk because of factors including income, age, and race. Figure 4 shows the composite social vulnerability score. Areas between Caret and Tappahannock have the higher vulnerability composite score because of age, race, income, and other factors. Between 25 and 50 percent of residents in most parts of Essex County qualify as low-income (Figure 5). Residents in these areas are likely to be unable to replace or regularly pump out their systems, and will not have the resources to relocate.

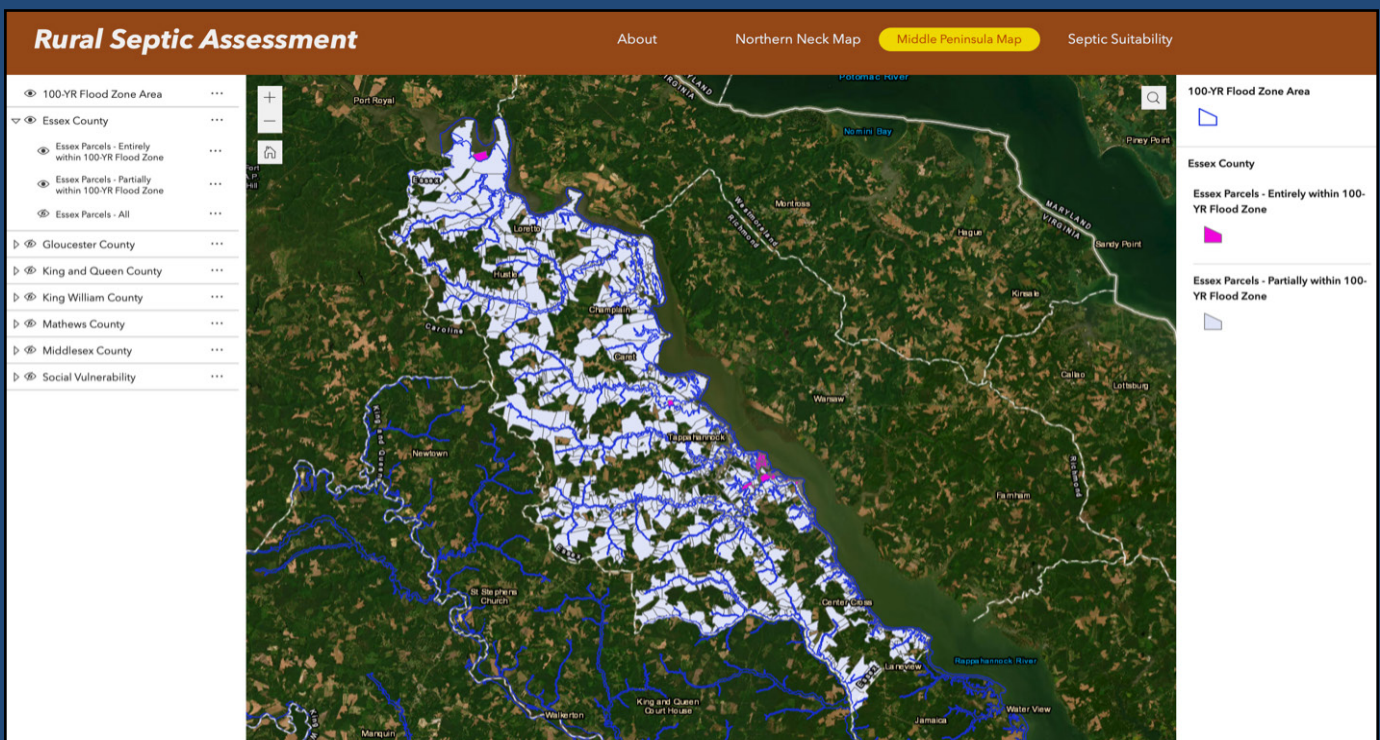


Figure 3: Essex County parcels within the 100-year flood zone

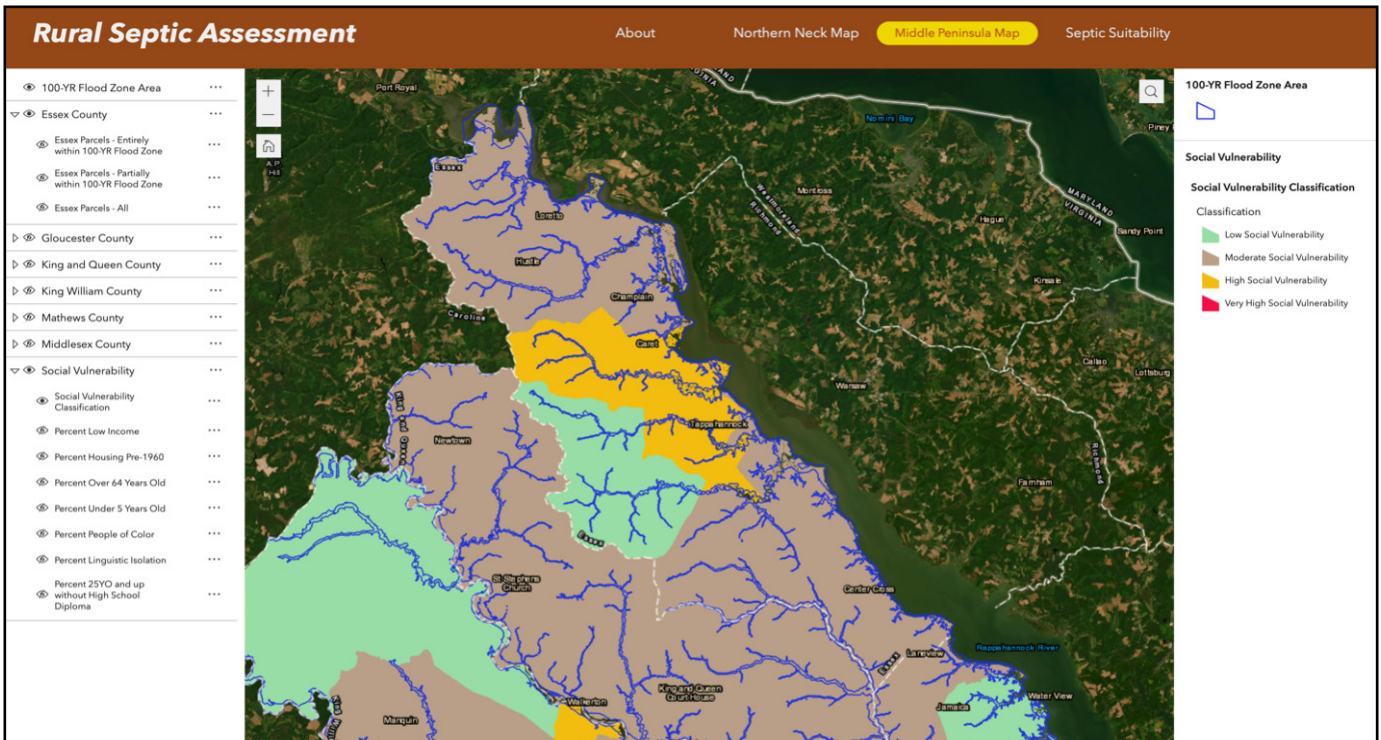


Figure 4: Essex County composite social vulnerability scores



Figure 5: Essex County percent low income

Stakeholder Identification & Power Analysis

The Middle Peninsula Planning District Commission (MPPDC) has implementation authority within the Essex County planning area. They are interested in maintaining regional infrastructure while preserving resources in the area. The Three Rivers Health District is the branch of the Virginia Department of Health (VDH) that serves the area and it is focused on maintaining sanitary standards of septic systems and surrounding dwellings. VDH regulates septic systems and is in the process of creating an inventory of septic systems in the state. Other stakeholders include the Virginia Department of Environmental Quality (VDEQ) which is interested in public health and preventing environmental pollution, Essex County Government, which seeks to maintain county infrastructure and preserve financial resources, and town governments in the area (i.e., Tappahannock) which have similar intentions.

This project involves policy/strategy recommendations with realistic scopes (so as to conserve regional, and municipal funds) which maintain sanitation codes (set by VDH) and which can be implemented on an individual basis (to protect the privacy of homeowners and allow for action to be taken in private residences). Septic education will inform citizen stakeholders about current problems and proposed solutions.

Climate change in Essex County will affect groups including homeowners, business owners, and the Rappahannock Tribe. Homeowners are a large constituency and should be directly involved in septic planning and implementation. Business owners constitute a smaller group and should be involved through business organizations like the Chamber of Commerce. This group is less diffuse than homeowners and more able to affect change through their capital. The Rappahannock Tribe is a medium/large constituency and should participate through general citizen participation and through tribal input. Tribes have internal organizational capacity but are disadvantaged by historic socio-economic marginalization. Additionally, this project must consider businesses that sell and install septic systems. This is a small constituency that has a vested interest in wide-scale septic system replacement. They should be directly involved in project formulation, though their interest in wide-scale septic system replacement should be kept in mind. Environmental groups (FOR, CBNERR, etc.) are a small constituency, but are explicitly concerned with the environmental degradation that will impact industry and the ecology in the area. They have high organizational capacity and vested interest and should be directly involved in planning. Government agencies (City Planning, DEQ, VDH, VDEM, Social Services) are a small/medium constituency responsible for planning and regulation and must be directly involved. Finally, faith/community Groups (e.g., Churches) are a small/medium constituency that provides aid to affected communities. They have a very high organizational capacity and are potentially the most effective avenue for citizen outreach and participation. They should be directly involved in any endeavors that concern widespread event advertisement.



Source: Town of Tappahannock

Community Engagement Process

This educational exhibit is designed to engage community members in septic issues. Since residents with failing septic systems are hesitant to share details about their systems due to potential regulatory repercussions through VDH, creating an educational handout (Appendix A) and a larger traveling exhibit will aim to provide private property owners with tools to maintain their own systems while avoiding public disclosure of their specific issues. This exhibit will promote the knowledge that many septic systems in the area are at risk due to several climate/infrastructure circumstances (even while many might be very well aware that their particular system is at-risk) and meaningful courses of action to mitigate these effects before any larger scale reform is enacted.

Additionally, the white paper element of this project (Appendix F), will provide broader context for septic vulnerability which can be utilized by the municipal government and regulatory agencies for long-term strategies that could potentially address the root causes of widespread system disruption. As such, local/state/federal government, community groups, and social/environmental nonprofits will necessarily be involved in refining and implementing any proposed solutions. We plan to share the white paper with members of the Middle Peninsula PDC in hopes that it can be utilized for future projects.

VIMS and VDH are in the process of creating an inventory of septic systems in the Northern Neck and Middle Peninsula. However, this data collection does not involve any implementable actions. General flooding education programs currently exist under the Middle Peninsula PDC's Fight the Flood program, but none of these explicitly address septic vulnerability.

Current connections developed through the RAFT's work in Essex County will be leveraged to facilitate community engagement. This broader communication strategy would be administered through a partnership between CBNERR and FOR. Partners can utilize the Contact List (Appendix B), to connect with other stakeholders who can assist in community partnerships. To our knowledge, no initiatives exist in the area to combine existing research and resources into an actionable, educational model which provides short-term mitigation solutions and longer-term adaptation strategies. CBNERR and FOR will partner to construct the exhibit using our design (Appendix C), and material list (Appendix D), and engage community members during events and at public gathering places in Essex County (Appendix E). Events including the Urbanna Oyster Festival are ideal for exhibit display because they draw community members who are invested in the seafood industry and therefore water quality issues.



Source: Chesapeake Bay Magazine

Products

The limited timeframe and available resources of our partners have required the immediate products for this project (exhibit schematics, material and contact lists, supplementary educational fliers) to solely address short-term mitigation strategies. Chronic septic issues relating to sea-level rise, inland flooding, and aging infrastructure cannot be seriously rectified with education endeavors aimed at individual system owners. For this reason, a draft report has also been developed which has been submitted to IEN's Working Paper series in an attempt to reckon with long-term, widespread challenges to coastal infrastructure. This Working Paper is included in this report as (appendix x) and attempts to situate our locality-specific insights within a broader context of American infrastructure replacement. Ideally, these products will work in tandem in order to simultaneously address on-the-ground challenges to present septic disrepair and a longer-term vision that can imagine radically different methods of dwelling and urban systems.



Source: Rethink Rural

Limitations

Several products originally intended for this project were not completed due to gaps in necessary data. A map of septic vulnerability in regard to Essex County, based on data received from VIMS, was originally planned but was not completed as Dr. Mitchell did not respond to several email requests. As a result, VIMS viewers were used to obtain maps of the area, meaning that our data was not nearly as granular as originally hoped. This, combined with issues in system documentation which were detailed early in this report, meant that our knowledge of current system location in the area was severely limited. VDH, in coordination with VIMS, is currently in the process of updating local health department documentation into its central database, so we anticipate this issue will be marginally abated in the future. And while we have attempted to incorporate chronic reporting issues into the subject of this project, our ability to address septic failure in Essex has been limited by this reality.

Additionally, the compressed timeframe inherent in a semester-length project has meant that the services rendered for our client have been primarily planning-oriented. We do not have the space (nor the ability, admittedly) to construct and store an interactive septic exhibit. As such, we have produced a series of illustrations and schematics that can provide a blueprint for CBNERR, FOR, or any other party interested in actually building the exhibit (appendix x).

Finally, measures that actually reckon with adaptation strategies necessary for sustainable septic health are far beyond the purview of our client. Since reorienting septic systems to degrading environmental conditions requires coordination and resources undertaken at a state- or federal-government scale, the best we can provide is a series of brief suggestions contained within our Working Paper. It is unclear whether organizations with the capacity to meet these challenges at the adaptation level will be exposed to this document.

Conclusions

Private septic systems in rural, low-lying coastal areas are at high-risk for degradation due to age, increasing soil moisture, worsening rain seasons, and saltwater intrusion via sea-level rise. Due to its geological conditions, this is particularly true in Tidewater Virginia. Since these systems are treated as discrete private entities, and because of the individual penalties arising from Virginia's particular regulatory framework, there is a severe lack of political or economic will to address a development that risks significant soil and water contamination. In Essex County, this has manifested through widespread system malfunction and a hesitation by owners to report issues to health agencies or take advantage of existing, though disparate, channels for financial assistance.

This project attempts to address this development via a two-pronged approach. First, educational and outreach opportunities have been developed in order to assist owners with the immediate maintenance of their potentially faulty septic systems. This effort has been coordinated through our client at CBNERR and has been subsequently aided by representatives from Friends of the Rappahannock. Work products from this approach include the designs for a traveling septic tank exhibit, a contact list for potential partners, and a list of events and locations where the exhibit can be displayed. Second, a working paper has been developed which articulates long-term strategies for septic-related adaptation and will be submitted to IEN's Working Paper series.



Algal Bloom in the Chesapeake Bay

Source: VDH

Many phenomena observed over the course of this project, including the disorganized management of chronic infrastructural failure, inefficient regulatory structures for rural and economically disadvantaged individuals, and the necessary reimagination of municipal management in the face of climate catastrophe, are analogous to developments far beyond septic failure in rural Virginia. As aging systems, both social and material, are refitted or replaced in an era of rapidly changing climatic conditions, we must ask ourselves if previous norms should be reproduced, or if we should apply a radical imagination to formulate a more equitable and resilient future.

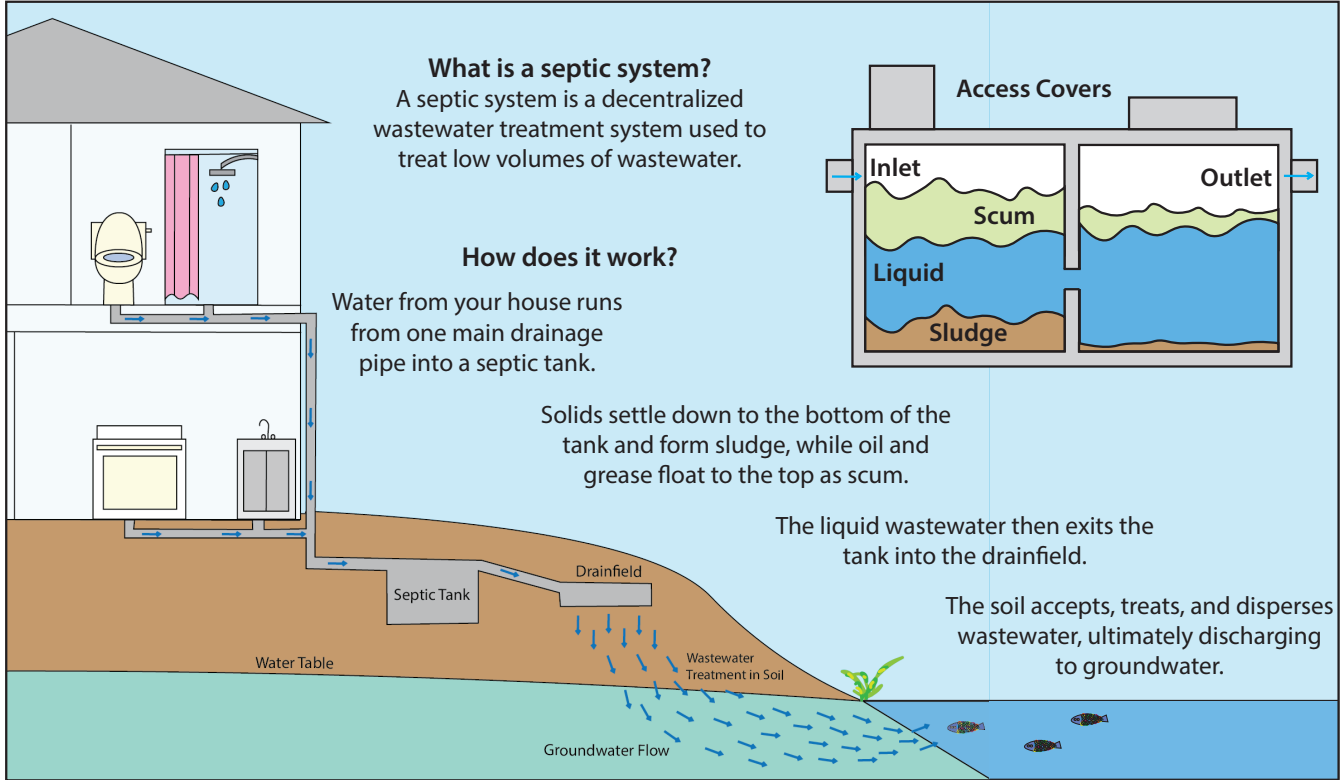
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Appendix A: Educational Handout



What You Should Know About Your Septic System



✔ Dos	and	Don'ts ❌
<p>Have your septic system inspected every three years and pumped when necessary! </p> <p>Limit use of the garbage disposal</p> <p>Properly dispose of coffee grounds</p> <p> Consult a professional before planting trees and shrubs near your system</p> <p> Stagger the use of water-generating appliances</p> <p>Fix plumbing leaks and water-efficient products </p>		<p>Flush chemicals and medications! </p> <p>Put grease down the drain!</p> <p>Pour coffee grounds down the drain!</p> <p> Flush non-degradable products like dental floss, cat litter, paper towels</p> <p>Park on your drainfield</p> <p>Put strain on the system by using the shower, dishwasher, and washing machine at the same time</p>

Pollution Impacts

Broken septic systems can release viruses, nutrients, and bacteria into the water.

Viruses, nutrients, and bacteria can contaminate groundwater and cause many diseases including gastrointestinal illness, cholera, hepatitis A, and typhoid.

When there are too many nutrients in the water, they act as a fertilizer for bacteria and algae.

The algae can reduce water quality, kill aquatic plants and animals, and form toxins in the water.

Appendix B: Contact List

First Name	Last Name	Title	Organization	Email
Aaron	Wendt	Environmental Specialist	Virginia Depart. of Conservation and Resources - Shoreline Erosion Advisory Service (DCR-SEAS)	aaron.wendt@dcr.virginia.gov
Alan	Walker	Assistant Director of Multi-Family Housing	Bay Aging	awalker@bayaging.org
Alexis	Burrell	Population Health Coordinator	Three Rivers Health District	alexis.burrell@vdh.virginia.gov
Brenden	Riverbark	Chief Operating Officer	Three Rivers Health District	brenden.riverbark@vdh.virginia.gov
Brent	Hunsinger	Tidal Programs Manager	Friends of the Rappahannock	brent.hunsinger@riverfriends.org
Candace	Mickelborough	Director	Essex County Department of Social Services; Chair of Essex County Resource Council	Candace.Mickelborough@dss.virginia.gov
Carla	Minor-Blake	Community Outreach Liaison	Three Rivers Health District	carla.minor-blake@vdh.virginia.gov
Carolyn	Fortune	Director of Economic Development	Rappahannock Tribe	cfortune@rappahannocktribe.org
Chad	Lewis	Community Resilience Coordinator	The Haven Shelter & Services	chad.lewis@havenshelter.org
Cliff	Gonzalez	Coastal Training Program Coordinator	Chesapeake Bay National Estuarine Research Reserve - VA	cgonzalez@vims.edu
Connie	Jenkins	Student Research Assitant	Institute for Engagement and Negotiation	euw5vk@virginia.edu
Curt	Dalton	Community Development and Zoning Administrator	Town of Tappahannock	cdalton@tappahannock-va.gov
Dana	Smith	Deputy Director	Middle Peninsula PDC	csmith@mppdc.com
Danielle	Smook	Director	Essex County Public Library	dsmook@epiva.org
Dave	Simms	EJ Coordinator Piedmont Region	VDEQ	danielle.simms@deq.virginia.gov
David	McGee	Voluneer Coordinator	American Red Cross	dmcgee1664@gmail.com
Dianna	Fridley	District Director	Three Rivers Health District	david.fridley@vdh.virginia.gov
Donna	Carneal	Commission Member	Tappahannock Planning Commission	dianna.carneal@primisbank.com
Glenn	Pletch	Chief Regional Coordinator, Region 1 / Disaster Services Bureau	Virginia Department of Emergency Management (VDEM)	donna.pletch@vdem.virginia.gov
Grace	Sturm	Essex County Office, Middlesex County Office	Virginia Cooperative Extension	gjsturm@vt.edu
Hunter	Holms	Tidewater Environmental Justice Coordinator	VDEQ	grace.holmes@deq.virginia.gov
Jennifer	LeClair	Program Manager	Bay Aging	hleclair@bayaging.org
Joanne	Sagan	Restoration Technician	Friends of the Rappahannock	jennifer.sagan@riverfriends.org
Kathleen	Brown	Clinical Director	Middle Peninsula-Northern Neck Community Services Board	jbrown@mpnn.state.va.us
Libby	Hughes	Leader	Essex Churches Together	khughes@holidaybarn.com
Linda	Bieri	Lower Rappahannock River Steward	Friends of the Rappahannock	libby.bieri@riverfriends.org
Lorraine	Gerhold Hodges	Executive Director	Middle Peninsula-Northern Neck Community Services Board	lhodges@mpnn.state.va.us
Lydia	Justice	Director of Student Support Services	Rappahannock Community College	ljustice@rappahannock.edu
Matt	Bienlien	Virginia Sea Grant Commonwealth Coastal & Marine Policy Fellow	Department of Conservation and Recreation	lydia.bienlien@dcr.virginia.gov
Michael	Dalon	Resilience Planning Program Manager	Department of Conservation and Recreation	matt.dalon@dcr.virginia.gov
Michelle	Lombardo	County Administrator	Essex County	mlombardo@essex-virginia.org
Patricia	Carter	District Manager	Three Rivers Soil and Water Conservation District	michelle.carter@trswcd.org
Rev. Cornelius	Wolfry	Executive Director of Rappahannock District	American Red Cross	Patricia.wolfrey@redcross.org
Rev. Dr. Barbara	Holmes	Pastor	First Baptist Church Tappahannock, also with ECMA (?)	cornelius19@gmail.com
Robbie	Behon	Associate Pastor; Southside Rappahannock Baptist Association Moderator	Beulah Baptist Church in Tappahannock	favoredbreh@gmail.com
Sierra	Longest	Virginia Cooperative Extension	Agriculture and Natural Resources Extension Agents in the Middle Peninsula	robbiel7@vt.edu
Sophie	Gladfelter	Associate, RAFT Program Manager	Institute for Engagement and Negotiation	sg6us@virginia.edu
Stanley	Delzell	Student Research Assitant	Institute for Engagement and Negotiation	pnh8kb@virginia.edu
Timothy	Clarke	Member	Essex Churches Together	stanleyclarke54@yahoo.com
Tommy	Bradshaw	Vice Chair	Tappahannock Planning Commission	tbradshaw@tappahannock-va.gov
Trent	Hicks	Interim EMS Chief	Essex County	eschief@essex-virginia.org
Waring	Funkhouser	Manager	Tappahannock Farmers Market	manager@tappahannockmarket.com
Warren	Baylor	Conservation Specialist	Three Rivers Soil and Water Conservation District	warren.baylor@trswcd.org
	Coburn	Senior Area Forester, Essex County and Northern Neck	Virginia Department of Forestry	warren.coburn@dof.virginia.gov

Appendix C: Exhibit Display Locations

Locations:

Tappahannock Farmers' Market

Website: <https://tappahannockmainstreet.org/farmers-market>

Date and Time: 3rd Saturday of the month (April – November)

Essex Public Library

Website: <https://eplva.org>

Rappahannock Community College Library

Website: <https://www.rappahannock.edu/library/>

Essex County Museum & Historical Society

Website: <https://ecmhs.org>

Essex County Public Schools

Website: <https://www.essex.k12.va.us>

Events:

Essex County Museum & Historical Society Oyster Roast

Website: <https://ecmhs.org>

Date: November

Urbanna Oyster Festival

Website: <https://www.urbannaoysterfestival.com>

Date: November 4th and 5th

Tappahannock Winter Fest

Website: <https://tappahannockmainstreet.org/winterfest>

Date: December 4th

Master Naturalists

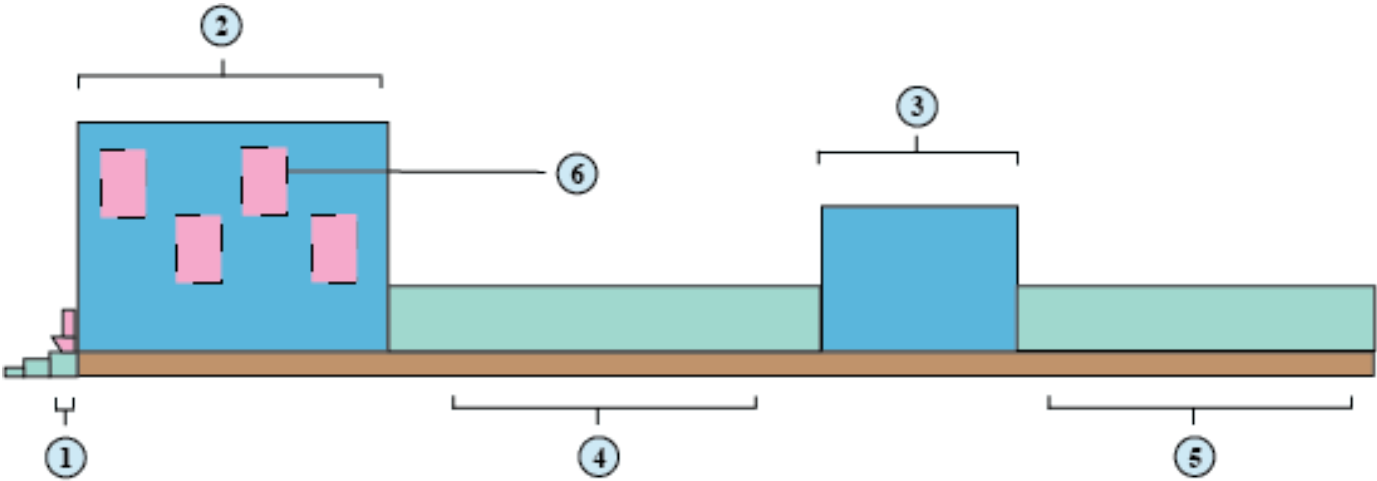
Website: <https://middlepeninsulamasternaturalists.com/>

Appendix D: Material List

Purpose	Material	Size	Number Required	Cost/unit	Total Cost
Toilet	Toilet	n/a	1	\$100-150	\$150
Septic tank	Plywood	9x8ft	2	\$26	\$52
	Plywood	4x8ft	2	\$13	\$26
	Plywood	9x4ft	1	\$13	\$13
Distribution tank	Plywood	4x4ft	5	\$13	\$65
Drainfield/Wastewater transport	Flexible pipe	8ft lengths	6	\$4	\$24
	Black plastic sheeting	8x8 pieces	2	\$50	\$100
Display decoration	Green, brown, gray paint	1 gallon	3	\$15	\$45
Total Display Cost:					\$475

**Costs are estimates based on Home Depot online prices, may vary. Other needs include display signage, materials for construction (hammer, nails, paint brushes)

Appendix E: Exhibit Design



- ① Toilet
- ② Septic Tank
- ③ Distribution Tank
- ④ Wastewater Transport
- ⑤ Drainfield
- ⑥ Educational Materials

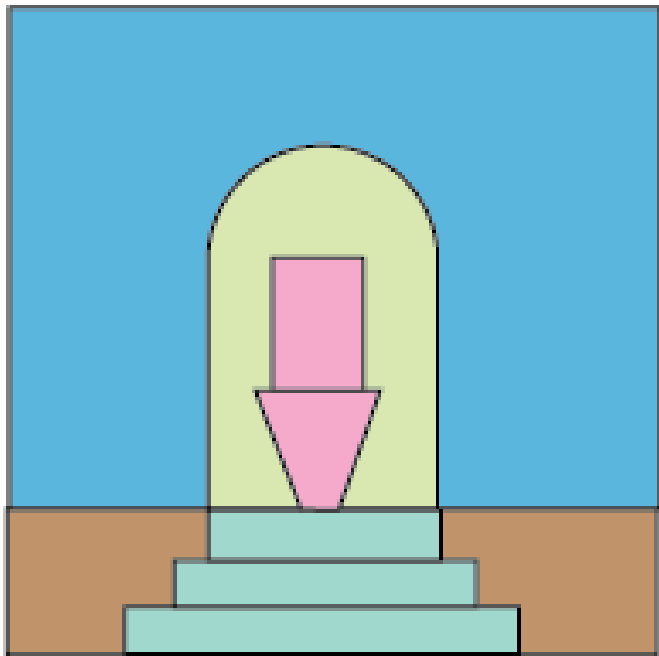


Exhibit entrance

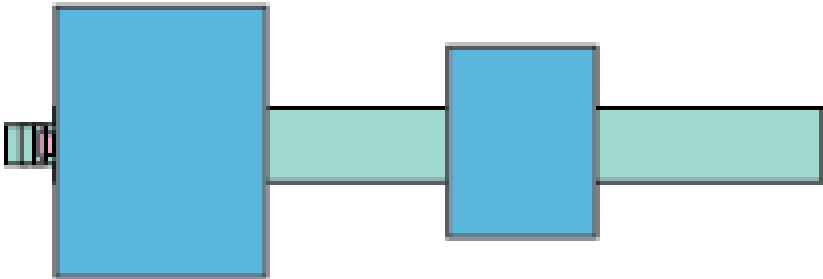


Exhibit Overview

Appendix F: White Paper



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1.1 IEN Working Paper Series

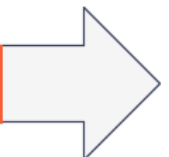
Septic Management in Coastal Virginia

Cliff Jenkins

University of Virginia

Sophie Delzell

University of Virginia



Version: December 15, 2022

DRAFT

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1.2 Abstract

Rising sea levels, increasing inland flooding, and land subsidence in coastal areas of Virginia threaten septic systems that many homeowners rely on. Because of the legal framework that depends on homeowners to maintain their systems and leverages penalties when these systems fail, many septic system failures go unreported. Failing septic systems have human health and environmental consequences. As sea levels rise, this problem will continue to be exacerbated. Current methods including septic system pumpouts are short-term solutions and do not address underlying problems. Therefore, creative methods must be employed to provide longer-term solutions to the problem of failing septic systems.

Keywords: resilience, climate change, adaptation, septic system, sea level rise

1 Introduction

The increasing severity and frequency of inundation events as a result of human-induced climate change produce a series of secondary consequences beyond the immediate aspects of flooding. Among these secondary consequences is contamination via wastewater released from private septic systems as filtering efficacy and structural integrity are challenged by saturated soils and saltwater intrusion. Mitigation and adaptation strategies that address this issue face the particular challenge of coordinating action among disorganized stakeholders who are each responsible for the maintenance of their respective systems. Despite the reality that septic tank degradation is a chronic issue that affects infrastructure on a regional level due to particular geographic characteristics, the systems themselves are legally maintained by private property owners and are therefore managed on a case-by-case basis. Moreover, since the absence of a public sewer system often implies the absence of an incorporated urban community, these property owners are predominantly residents of rural localities and frequently do not possess the resources to adequately maintain their septic tanks. Combined with a regulatory framework that can leverage hefty penalties against owners who do not comply with the septic code, many rural areas must contend with private septic infrastructure that is undermaintained yet underreported. This is particularly severe in low-lying coastal communities whose rural character produces the aforementioned issues in management and regulation and whose geographic and climatic conditions can accelerate the physical deterioration of septic systems.

2 Septic Systems

Septic systems, as opposed to septic sewers, are decentralized treatment systems that treat low volumes of wastewater from residences or small businesses. Unlike septic sewers, which are typically public infrastructure networks that serve a given municipality, septic systems provide water treatment for individual buildings and are managed by the building's owner. These systems are usually buried underground and process wastewater through anaerobic digestion before releasing it into surrounding soil via the system's drainfield. This soil serves as the final filtration medium and therefore absorbs any material which remains after being processed through the septic tank (EPA, 2022).

3 Environmental and Public Health Implications

Because of rising sea levels and coastal subsidence, buried septic systems can become inundated and fail. Additional issues can arise when substances such as household chemicals and pharmaceuticals, which are not properly broken down through anaerobic digestion, are sent through the septic system and flushed into the landscape. When systems are damaged or malfunctioning and wastewater is improperly treated, pathogens, nutrients, and harmful chemicals can contaminate the surrounding soil or water. This creates subsequent consequences including eutrophic algal blooms, damage to agricultural food supplies, and degradation of an area's recreational capacity. Furthermore, pathogens leaked into the surrounding environment can cause illnesses including dysentery, hepatitis, typhoid, and hookworm (Huffman et al. 2018).

3.1 Environmental Justice

Parts of rural, coastal Virginia lack access to affordable wastewater disposal that is protective of human health and the environment. Often, homeowners in these areas rely on private septic systems. Because of racial covenants and systematic disinvestment following emancipation, many residents in low-lying areas are Black (Frank, 2020). Homeowners in impoverished, rural communities cannot afford to repair their systems, let alone pay fines for failing systems. Common issues resulting from failing septic systems are exacerbated by sea level rise and coastal subsidence and have public health and environmental consequences. Failing wastewater systems can release parasites, such as hookworm, that can be transmitted to humans through soil contaminated with fecal matter (McKenna, 2017). In some parts of Virginia, homeowners live without access to indoor plumbing. According to a 2007 study, there were 117 occupied homes on the Eastern Shore with no indoor plumbing. Homeowners resorted to unpermitted solutions including backyard port-a-johns (Skeo Solutions, 2015).

4 Regulatory Framework and Data Collection

Until 1990, information on private septic systems was regularly collected by the American Census Bureau. When this ended, data collection in Virginia became the responsibility of local health districts operating under the Virginia Department of Health (VDH). In 2003, VDH established a database that served to centralize and digitize all septic information gathered by local health offices (Huffman et al., 2018). VDH's efforts to move all dispersed physical documentation to this central database are ongoing, but there remains a significant hole regarding the information on the prevalence and location of private systems in the state, particularly in rural areas. Additionally, changes were made to Virginia's septic code in 2000 which allowed for the installation of "alternative" systems whose drainfield filters were augmented by technology rather than relying solely on the surrounding soil (Huffman et al., 2018). Since the first three years of alternative system installation predated the establishment of VDH's database, a lot of the initial information regarding these systems' prevalence and location is missing. These alternative systems, unlike standard private septic systems, also require a five-year maintenance report to be submitted to VDH in order to monitor filtration efficacy. It is estimated that 58% of owners have not complied (Vogelsohn, 2019).

State septic code, as well as penalties for violations, are set by the Virginia Administrative Process Act. VDH is responsible for enforcing the code and therefore has the ability to report violators who are potentially subject to \$25,000 fines for each offense or possible jail time. For standard (non-alternative) systems, VDH requires an inspection before and after installation but has no mechanism for ongoing inspections (Sewage Handling and Disposal Regulations, 2022). Even if the agency had the financial and political resources to send inspectors into rural areas to check on system health, property owners who are financially unable to repair or replace damaged systems have a vested interest in obfuscating disrepair, as code violations would only worsen their situation economically. Combined with structural issues in centralized reporting as detailed above, rural Virginia must simultaneously deal with failing septic systems whose location and status of the operation are largely unknown and whose property owners are hesitant to disclose. This hesitation has affected the efficacy of financial assistance opportunities provided by organizations like VDH, Virginia Cooperative Extension (VCE), Southeast Rural Assistance Project (SERCAP), and the Department of Agriculture (USDA).

5 Mitigation Strategies

Septic education can be leveraged to prevent system failure, water quality, and human health impacts. Septic owners who are knowledgeable about how to properly maintain their systems are more likely to preemptively address issues and prevent system failures. Additionally, septic owners who are aware of available resources can leverage financial assistance to maintain their systems. When systems fail, owners have three options – septic pumpouts, system replacement, and system relocation. Septic pumpout refers to the extraction of material that is clogging a system and disrupting wastewater treatment and is the cheapest option, but it is a short-term solution that does not address underlying issues. System replacement refers to the installation of a new system in the same place as its nonfunctioning predecessor. This is a medium-term solution that properly addresses all issues stemming from the system itself, but does not reckon with the surrounding context which potentially accelerates degradation. System relocation refers to the installation of a new septic system, or the use of a public sewer system, in a more geographically viable location, and has the potential to deal with environmental conditions brought about by climate change. For the purpose of this project, pumpouts and replacement will be treated as a mitigation strategy, while relocation will serve as an adaptation measure.

6 Adaptation Measures

The vast majority of coastal Virginia is vulnerable to a series of common consequences produced by climate change in the Eastern United States, including sea level rise, increasingly frequent inland flooding, and intensifying hurricane seasons. The extent of this vulnerability is based on the rate of sea level rise, annual precipitation, frequency of storm-induced inundation, and the relative rate of land subsidence (Adapt VA, 2022). Since many of these vulnerable areas rely on septic systems, it is critical to think of longer-term adaptation measures that can be used to prevent human health and water quality impacts when septic systems inevitably fail. Longer-term solutions include changes to the regulatory framework, external funding for wide-scale infrastructure replacement, and managed retreat strategies.

6.1 Changes to Regulatory Framework

Because of the current structure of VDH's regulatory framework, homeowners are responsible for the maintenance and repair of their septic systems. There are three areas of this framework that could be altered for more thorough reporting by individual homeowners: penalty reduction, ongoing maintenance updates, and structural public funding. By reducing punitive measures outlined in the Virginia Administrative Process Act, hesitation from homeowners to self-report failing systems could be abated. As it functions now, owners with dysfunctional systems who are unable to pay for pump-outs or replacements are deterred from reporting issues due to additional financial burdens potentially brought by hefty fines (up to \$25,000). This could also affect willingness to seek out existing funding opportunities. However, penalty reduction should be employed in tandem with an actual mechanism to regularly collect maintenance reports, which does not currently exist for the majority of Virginia's standard private septic systems. Alternative systems, which were first legalized in 2000 and utilize technology to aid wastewater filtration, require five-year maintenance reports to be submitted to VDH. Systems within the authority of the Chesapeake Bay Preservation Act are also

subject to regular on-site inspections and must install specific plastic filtration devices to augment treatment. These standards can be extended to all systems state-wide so as to provide a useful political scaffolding that records system location and ensures ongoing health. These standards must also be employed with structural changes to public repair and replacement funding if they are to overcome social resistance to more stringent requirements. This will be elaborated further in the following section, but the disparate nature of current funding opportunities precludes a meaningful address to the chronic and economically dire reality of widespread coastal septic failure.

6.2 External Funding Solutions

Many funding sources exist to help property owners with onsite septic systems, including regional nonprofits (SERCAP), federal (USDA), and state agencies (VDH, VCE). Although these options exist, they are limited in the amount of funding available, and some have eligibility requirements. System owners may also be unaware that such opportunities exist, meaning centralization of available resources in an accessible location (both digitally and physically) could be a good first step. More broadly speaking, however, current assistance funding treats the issue at a piecemeal level, assuming that an owner unable to meet the financial burden of system repair is a sporadic phenomenon that is not necessarily reflective of an entire region. Environmental and socio-economic conditions in areas like Tidewater Virginia produce system disrepair on a scale that must be handled on a structural level, and a broader, coordinated approach is necessary to sufficiently address this challenge. Private dams and waterworks often benefit from structural assistance via public funds and low-interest loans, despite ownership remaining private following construction (VCPC, 2018). This rationale can be extended to private septic systems, which are currently treated as discrete units but could be conceptually bundled together so as to better situate public-private partnerships. Specific commonwealth-level assistance programs can also be bolstered and modeled after states like Minnesota, Oregon, and Washington, which have developed innovative solutions beyond scattered agency programs. For instance, in Minnesota, a state sales tax contributes to a Clean Water Fund that is distributed to counties for grants to low-income homeowners with non-compliant systems (Wysocky, 2013).

6.3 Managed Retreat

It is worth considering that parts of Virginia's coast that will be inundated by sea level rise should not be inhabited in the future. Managed retreat from these areas could prevent impacts on homeowners including septic problems. Relocating these vulnerable communities, while immensely challenging, has the potential to resolve current and future human health and water pollution challenges stemming from septic system failure. Extending the rationale behind the relocation, which states that the financial, social, and ecological ramifications of rebuilding in areas prone to flooding, to the installation and maintenance of septic systems lead to possibly radical solutions (Hino, 2017). For instance, if a series of properties within a given area are relocated due to their presence in a floodplain, they could be centralized in a safer location to an extent that would allow for the installation of a public sewer system. This would transfer authority to public works departments and allow for transparent and tax-funded maintenance in areas especially vulnerable to soil and water contamination. There are obvious implications as it regards industries such as agriculture or shellfishing (both very prevalent in coastal Virginia), but the placement of dwellings within a region is often defined by necessitated conditions that are no longer persistent. Managed

retreat provides a rare opportunity to fundamentally reorient infrastructural organization around anticipated climate impacts.

7 Discussion and Conclusions

Failing septic systems contaminate surrounding waters and threaten human health. These issues are exacerbated by sea level rise due to human-caused climate change. Despite the reality that septic system degradation is a chronic issue that affects Virginia's coastal infrastructure, the responsibility of system maintenance falls upon private property owners who may not possess the resources to adequately maintain their systems. Combined with a regulatory framework that can leverage hefty penalties against owners who do not comply with the septic code, many rural areas must contend with private septic infrastructure that is undermaintained and underreported. Short-term solutions including septic pumpouts and replacement do not address larger structural issues and will not be adequate as sea levels continue to rise. Therefore, broader solutions including changes to the regulatory framework, innovative funding methods, and managed-retreat strategies should be leveraged by coastal communities to ensure the health and safety of residents.

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