TRIANGLE ENVIRONMENTAL
HEALTH INITIATIVE

Onsite treatment and water reuse systems in climate-threatened coastal regions

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Est. 2016

Disclaimer

The materials being presented represent our own opinions, and do NOT reflect the opinions of NOWRA.

Our Background

- Founded in 2016
- **Mission:** Develop improved water and sanitation technologies with a focus on the environment and underserved communities
- Supported design, testing, and implementation of over 20+ prototypes in 12 countries.
- Currently developing 3 circular economy products for US onsite wastewater funded by the US EPA

What We Do

Consulting

Early-stage R&D

Field Testing

Product Refinement

Internal Product Development

BACKGROUND

Recent Articles

The Washington Post Sign in

CLIMATE & ENVIRONMENT

Backed-up pipes, stinky yards: Climate change is wrecking septic tanks

April 12, 2022

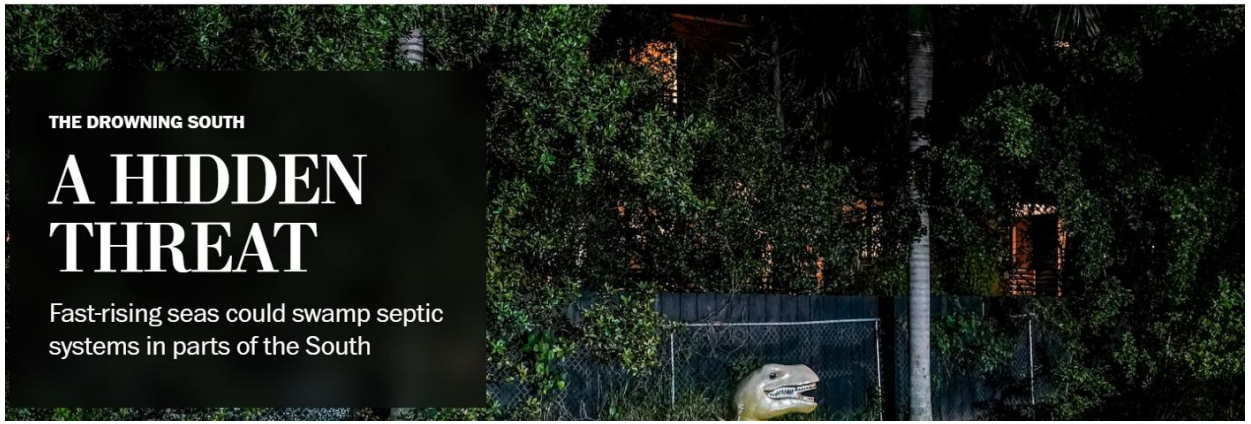
10 min

This trench was dug to help alleviate rainwater issues in the yard of Roosevelt Jones, whose septic system has increasingly failed at his Suffolk, Va., home. (Kristen Zeis for The Washington Post)

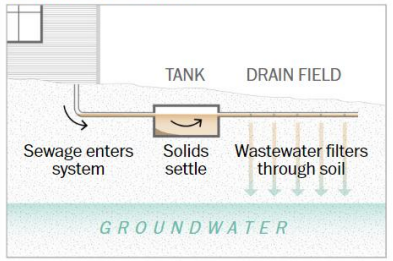
*"…**septic repair capital of the East Coast…**And it's only going to get worse."*

The Washington Post
Democracy Dies in Darkness

May 22, 2024

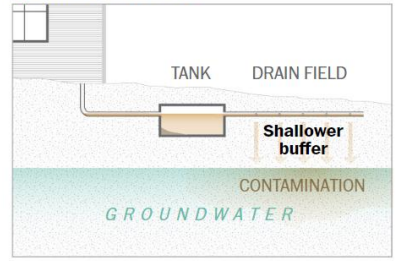


Normal operation



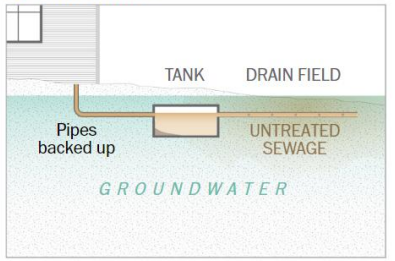
The soil acts as a natural filter, neutralizing germs and pollutants before they can contaminate groundwater.

Rising water table



Sea level rise and extreme rainfall are raising groundwater levels, resulting in more shallow buffers of soil that help protect local waterways and underground aquifers.

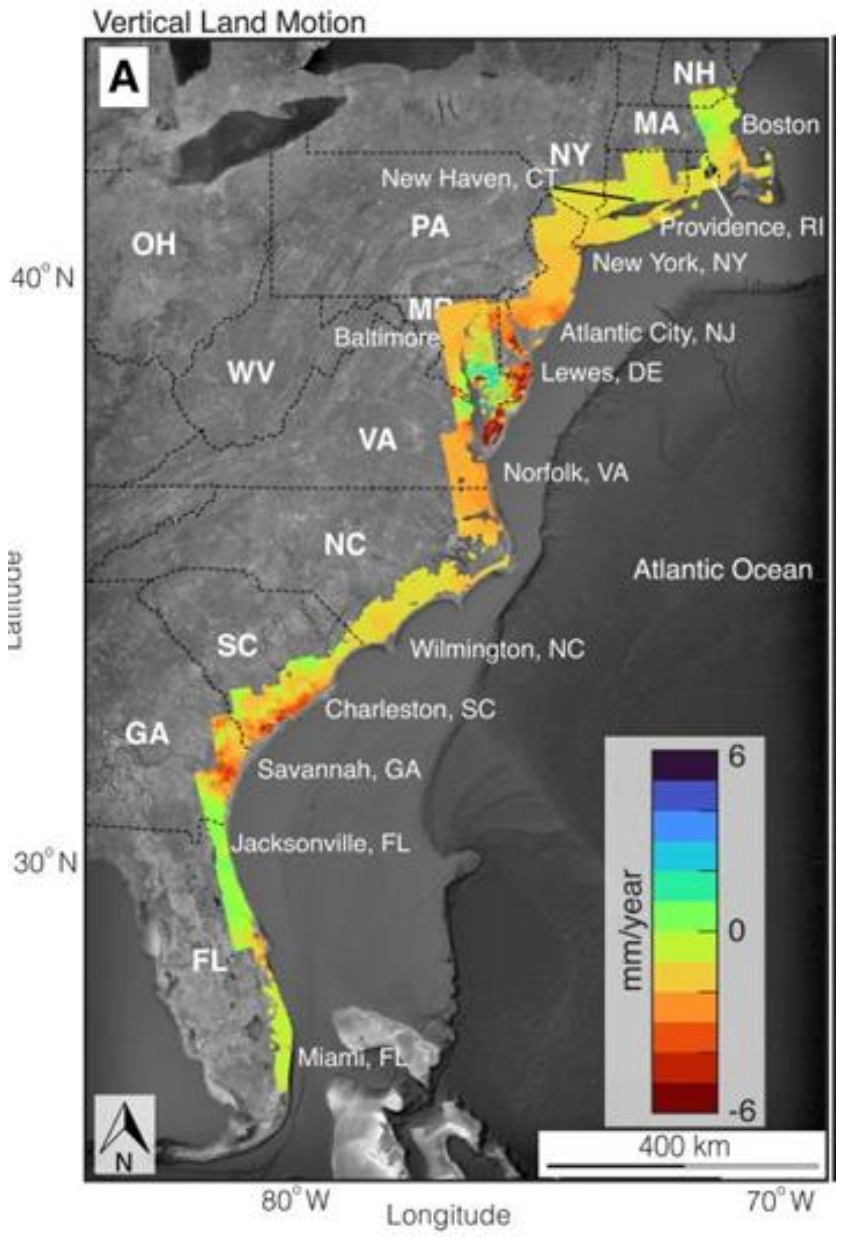
System failure



If a conventional septic system becomes submerged, wastewater will not be properly treated. Toilets can stop working and sewage can flood yards.

"**120,000 septic systems** remain in Miami-Dade County … **about half are at risk** during severe storms or particularly wet years"

Atlantic Coastal Challenges – Relative Sea-Level Rise



PNAS nexus

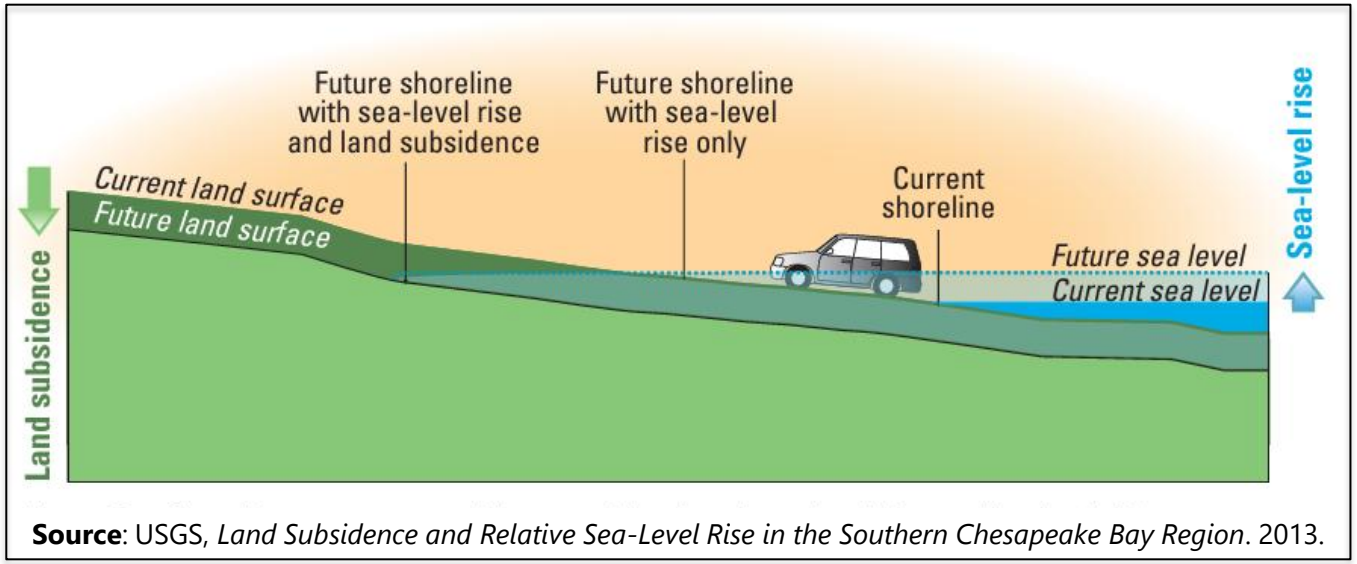
PNAS Nexus, 2024, **3**, 1–14
https://doi.org/10.1093/pnasnexus/pgad426
Advance access publication 2 January 2024
Research Report

Slowly but surely: Exposure of communities and infrastructure to subsidence on the US east coast

Leonard O. Ohenhen [a,b,*], Manoochehr Shirzaei [a,b,c] and Patrick L. Barnard [d]

- 1.2 to 14 million people and **>50% of infrastructures** in major cities are exposed to subsidence rates between 1 and 2 mm per year

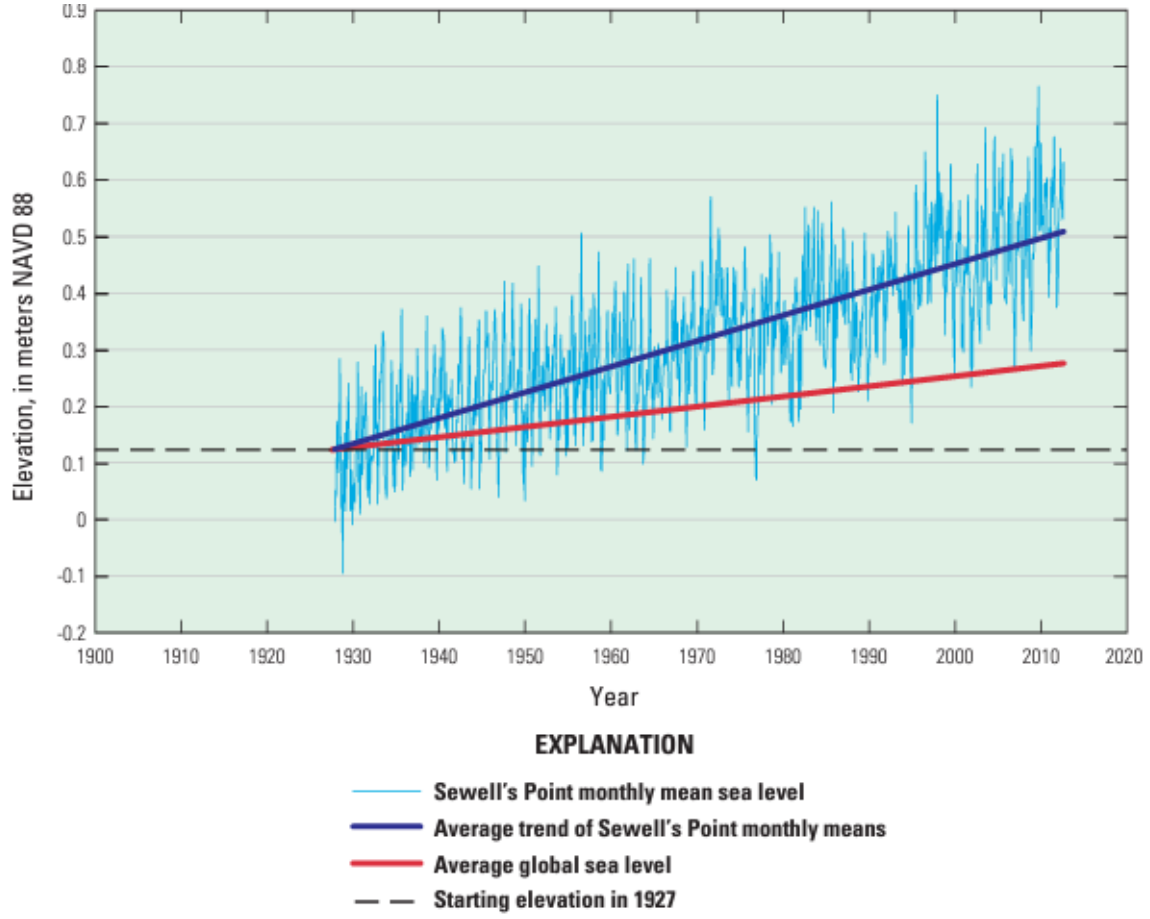
- The **highest subsidence rates** impacting the **largest percent of land were found in coastal VA**

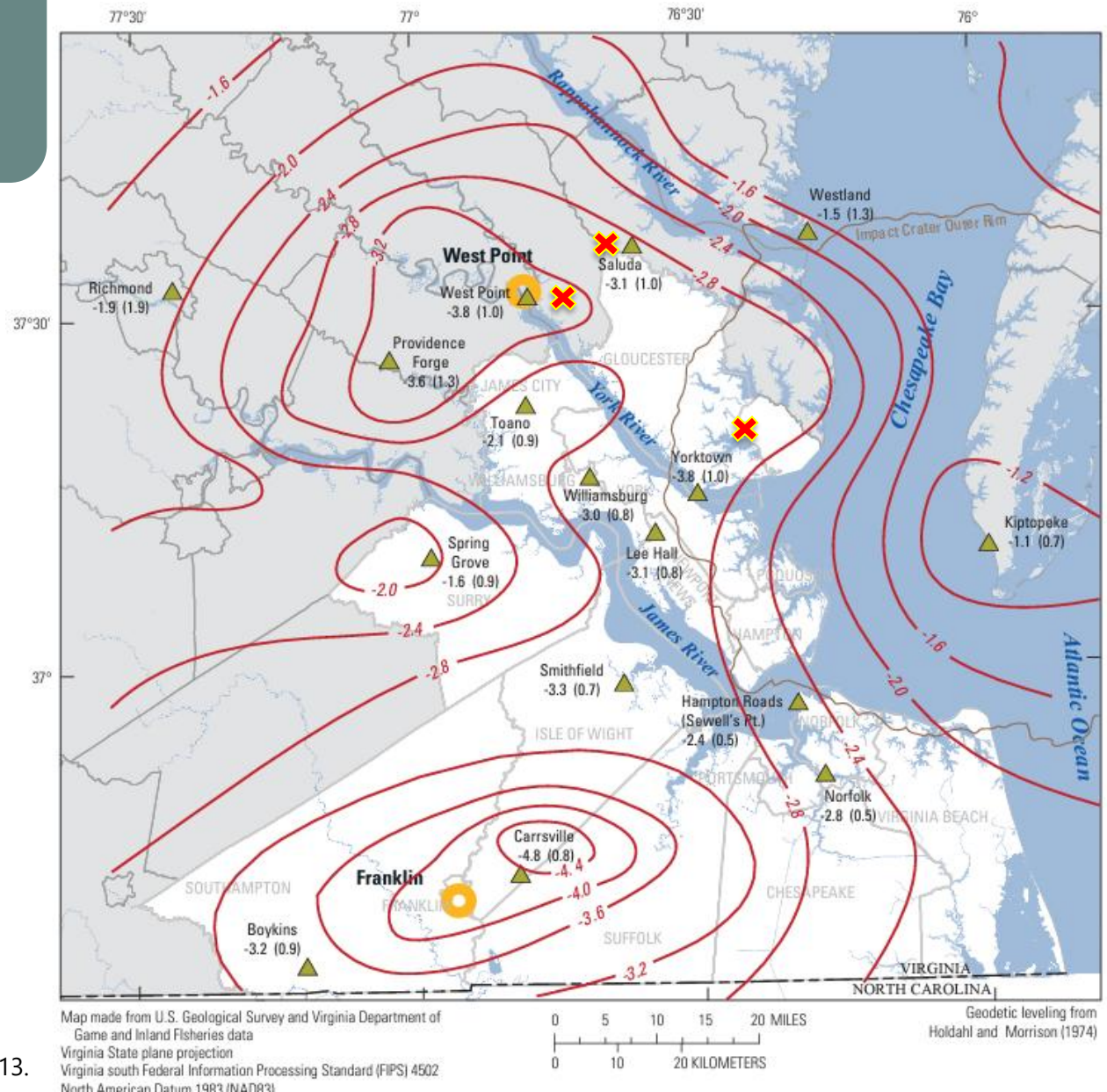


Source: USGS, *Land Subsidence and Relative Sea-Level Rise in the Southern Chesapeake Bay Region*. 2013.

Virginia Relative Sea-Level Rise

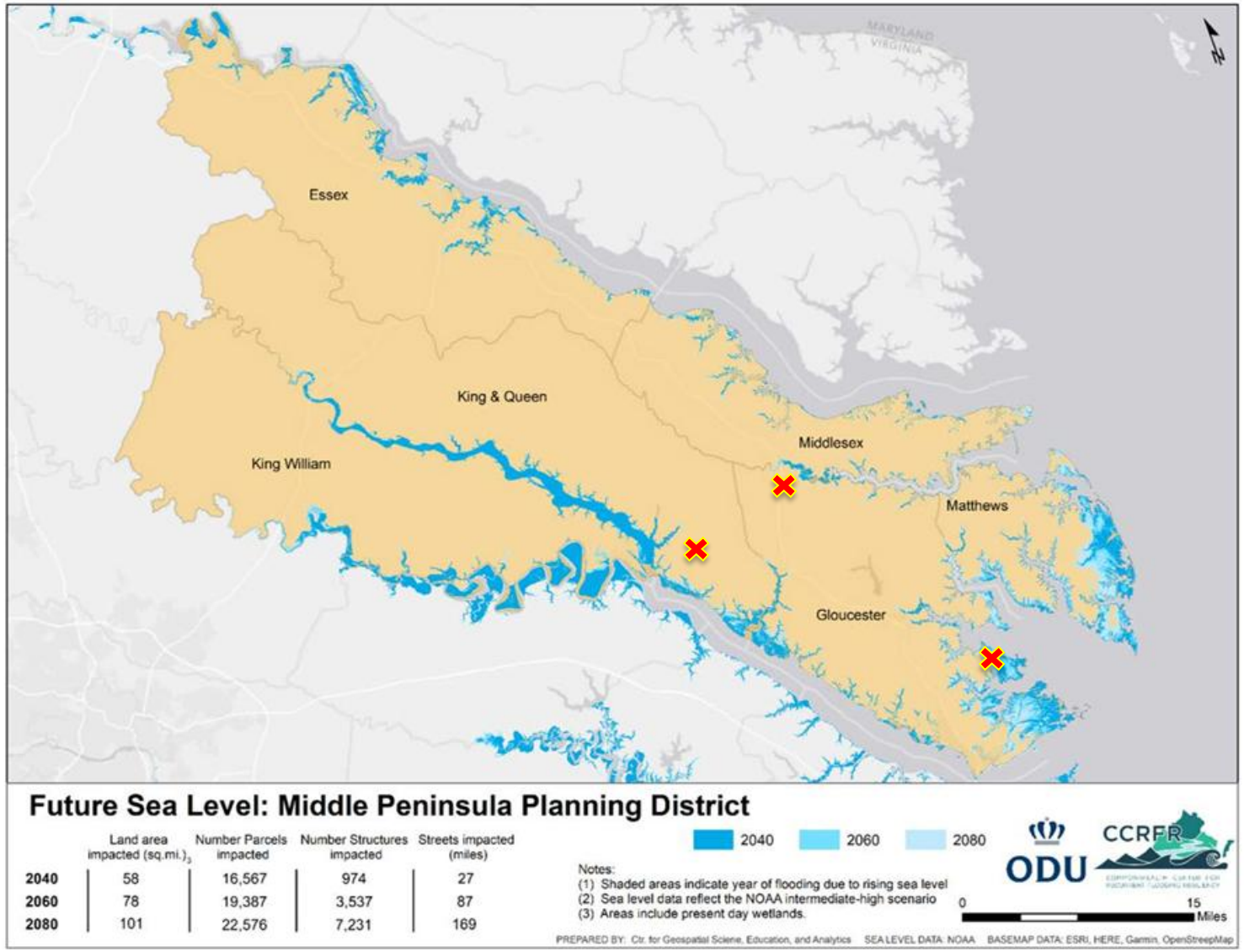
- Land subsidence >50% of relative sea-level rise
- Aquifer-system compaction >50% of the land subsidence





Source: USGS, *Land Subsidence and Relative Sea-Level Rise in the Southern Chesapeake Bay Region*. 2013.

Rural Coastal Virginia – Middle Peninsula



- 104,000 onsite sewage systems
- Significant inundation by future sea level
- Nearly the entire region will be < 3' above sea level
- ~20,000 systems predicted to fail by 2040
- Upkeep and maintenance of alternative systems is inefficient and cost prohibitive due to conditions

Source: CCRFR, *Future Sea Level and Recurrent Flooding Risk for Coastal Virginia*. 2020.

PROJECT OVERVIEW

Virginia Coastal Resiliency Adaptation Challenge

Septic Systems:

- Technology to replace failing systems
- Affordable CapEx
- Above-ground systems
- Transportable infrastructure
- Bonus: Can recycle some or all of the discharge water for home reuse

Water Supply:

- Water reuse systems
- Solutions must be sustainable, affordable, and permittable under current regulations

GO VIRGINIA

Sea Grant Virginia

MIDDLE PENINSULA PLANNING DISTRICT COMMISSION

RISE

JMU JAMES MADISON UNIVERSITY

Two Challenges, Shared Solution

Wastewater Failures

Water Insecurity

<u>Improved onsite wastewater treatment</u>

Protect public and environmental health

Flood resiliency

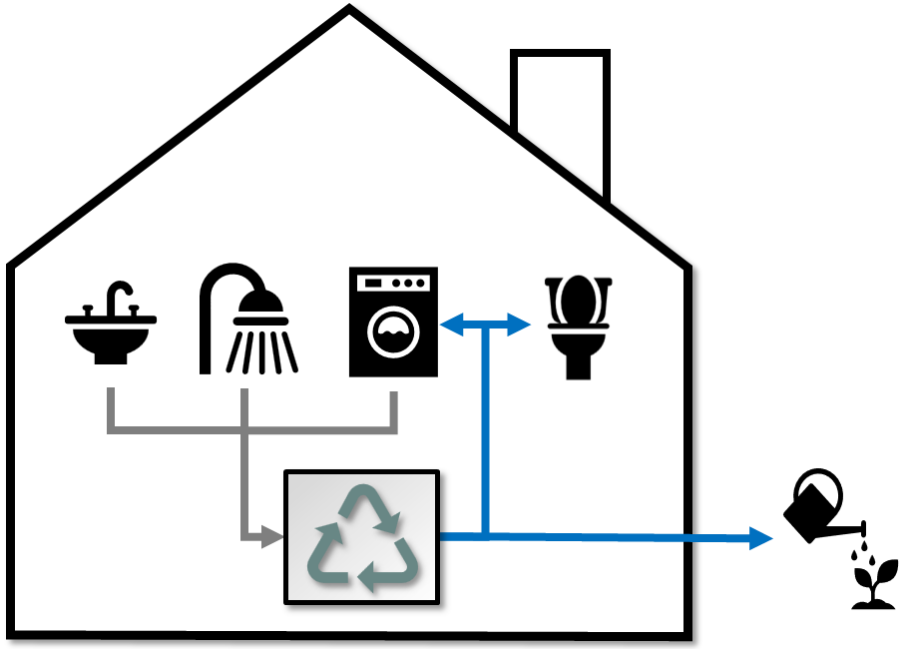
<u>Onsite non-potable water reuse</u>

Reduce potable water consumption by reusing water for irrigation, HVAC, laundry, etc.

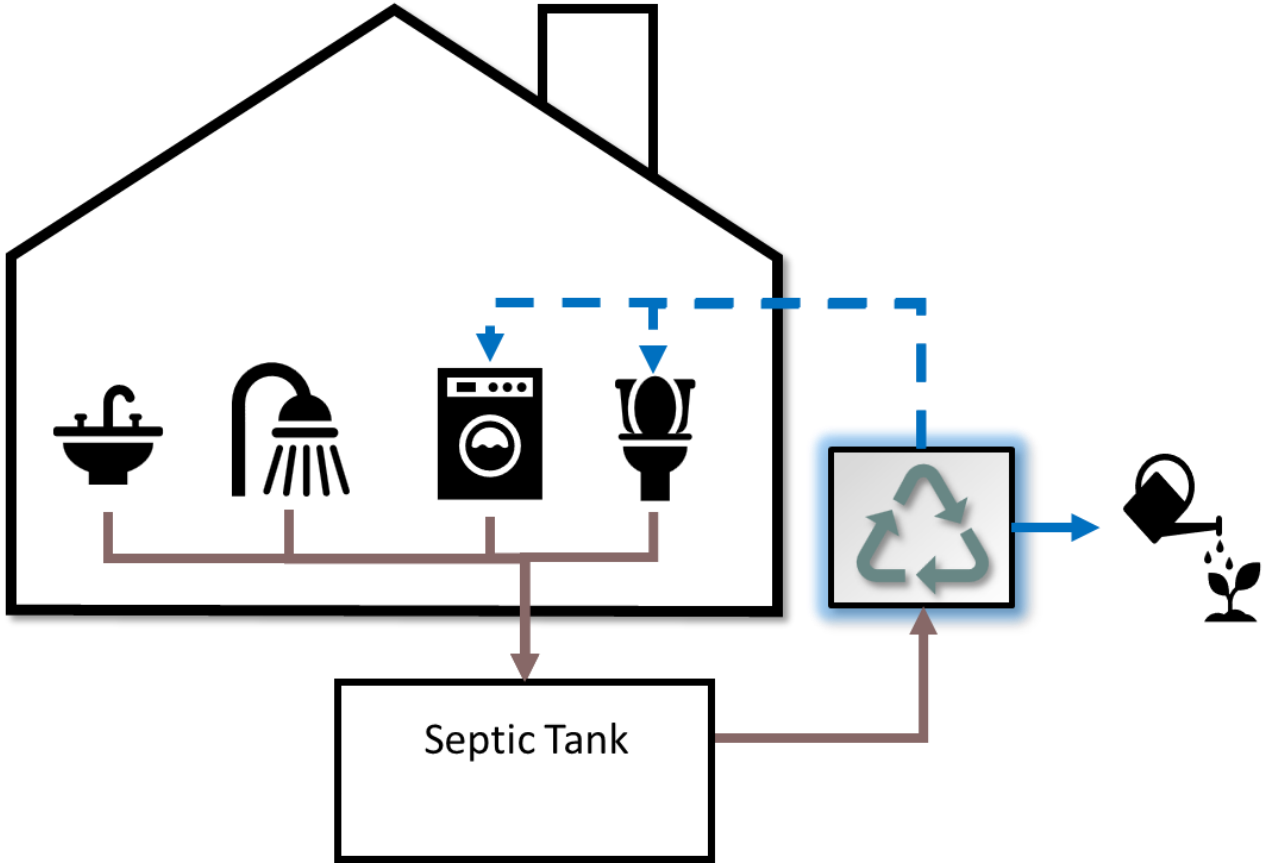
Water supply resiliency

One Solution » Two Applications

Greywater Setup



Septic Tank Effluent Setup



Pilot Sites

Residential:

- 1970s home
- Conventional septic system

Commercial:

- Telework building
- Complete Dec. ’24
- Conventional septic system

Commercial (Interim):

- Convenience store
- Advanced Treatment System

IMPLEMENTATION CHALLENGES

Support From:

VDH VIRGINIA DEPARTMENT OF HEALTH

To protect the health and promote the well-being of all people in Virginia.

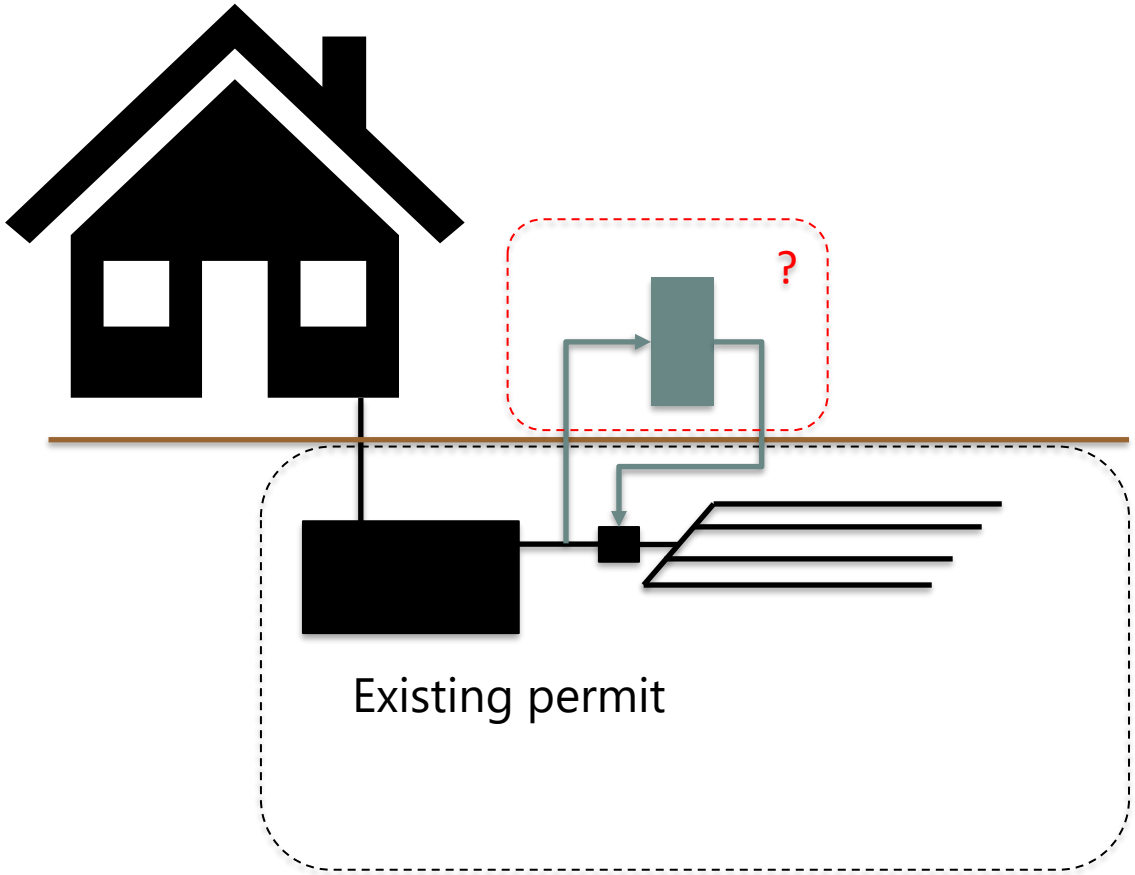
KOONTZ BRYANT JOHNSON WILLIAMS

EDD

ENGINEERING DESIGN & DEVELOPMENT, INC.

CIVIL ENVIRONMENTAL GEOTECHNICAL

Permitting Approach – Demonstration Purposes only



Goals:

- Implement Pilot System into existing, permitted system
  - Intercept wastewater
  - Pass through treatment unit
  - Send effluent back into existing system flow path
- Sampling & analysis at each step
- Do no harm

Permitting Options

VA Permit Route	Requirements
Experimental	- Prior validation from 3rd party testing - Funds for backup/replacement system - Can replace failed conventional system where current AOSSs are not possible

Permitting Options

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Experimental	- Prior validation from 3rd party testing - Funds for backup/replacement system - Can replace failed conventional system where current AOSSs are not possible
Voluntary Upgrade	- Existing system must be inspected and in compliance - Once installed, the upgrade cannot be removed without another permit

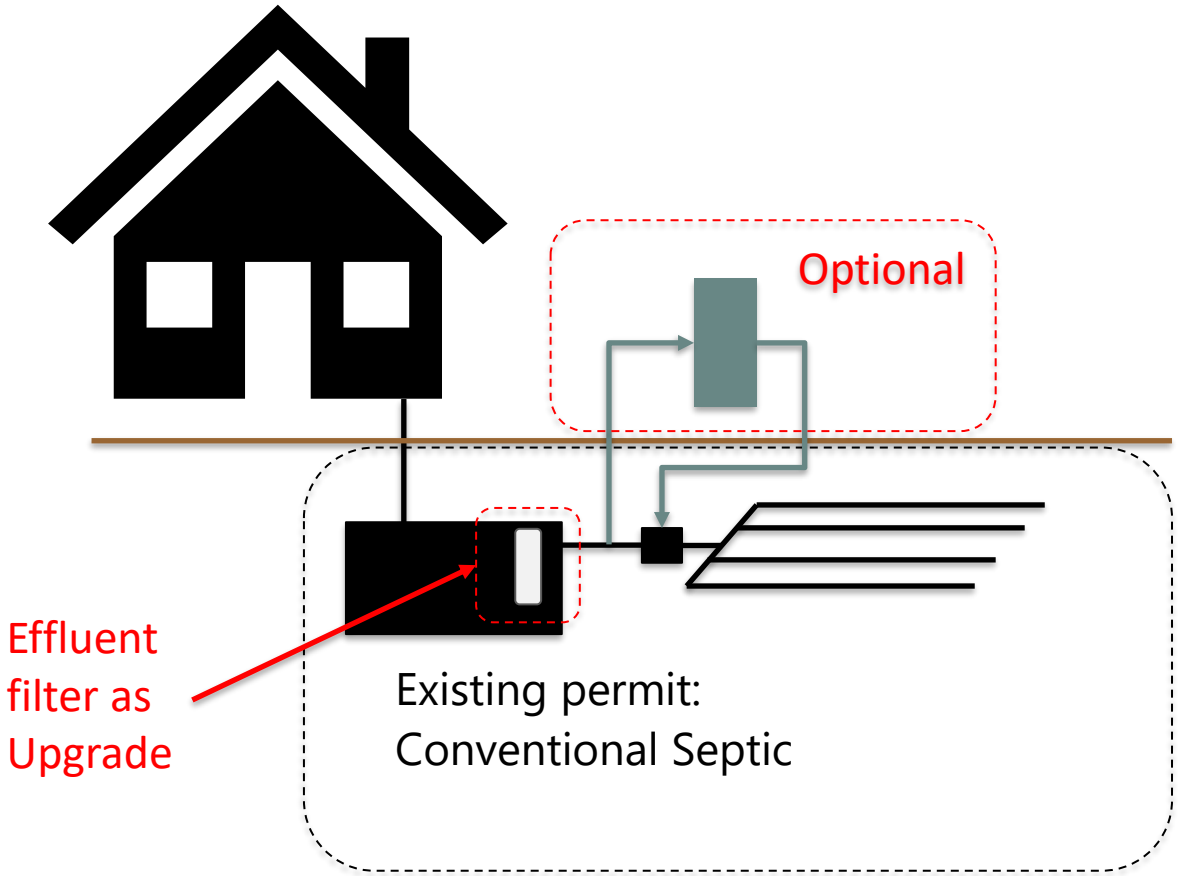
Permitting Options

VA Permit Route	Requirements
Experimental	- Prior validation from 3rd party testing - Funds for backup/replacement system - Can replace failed conventional system where current AOSSs are not possible
Voluntary Upgrade	- Existing system must be inspected and in compliance - Once installed, the upgrade cannot be removed without another permit
Minor Modification	- Does not result in an increase in treatment level

Permitting Options

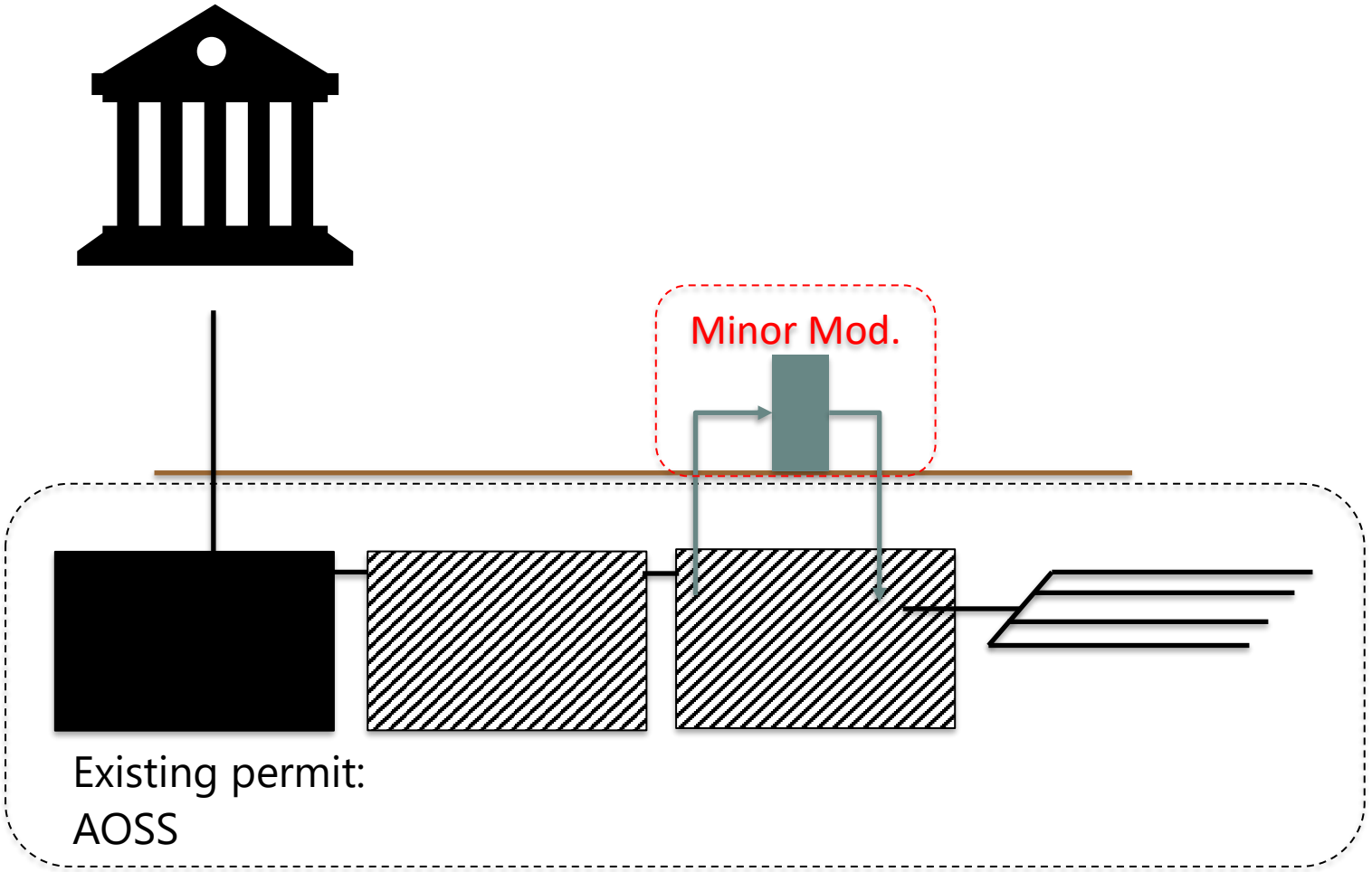
VA Permit Route	Requirements
Experimental	- Prior validation from 3rd party testing - Funds for backup/replacement system - Can replace failed conventional system where current AOSSs are not possible
Voluntary Upgrade	- Existing system must be inspected and in compliance - Once installed, the upgrade cannot be removed without another permit
Minor Modification	- Does not result in an increase in treatment level
Convert to AOSS	- Generally approved TL-2 or TL-3 system - Engineer-specified - Chesapeake Bay Watershed nutrient reduction req's

Permitting Pathways Used – Voluntary Upgrade



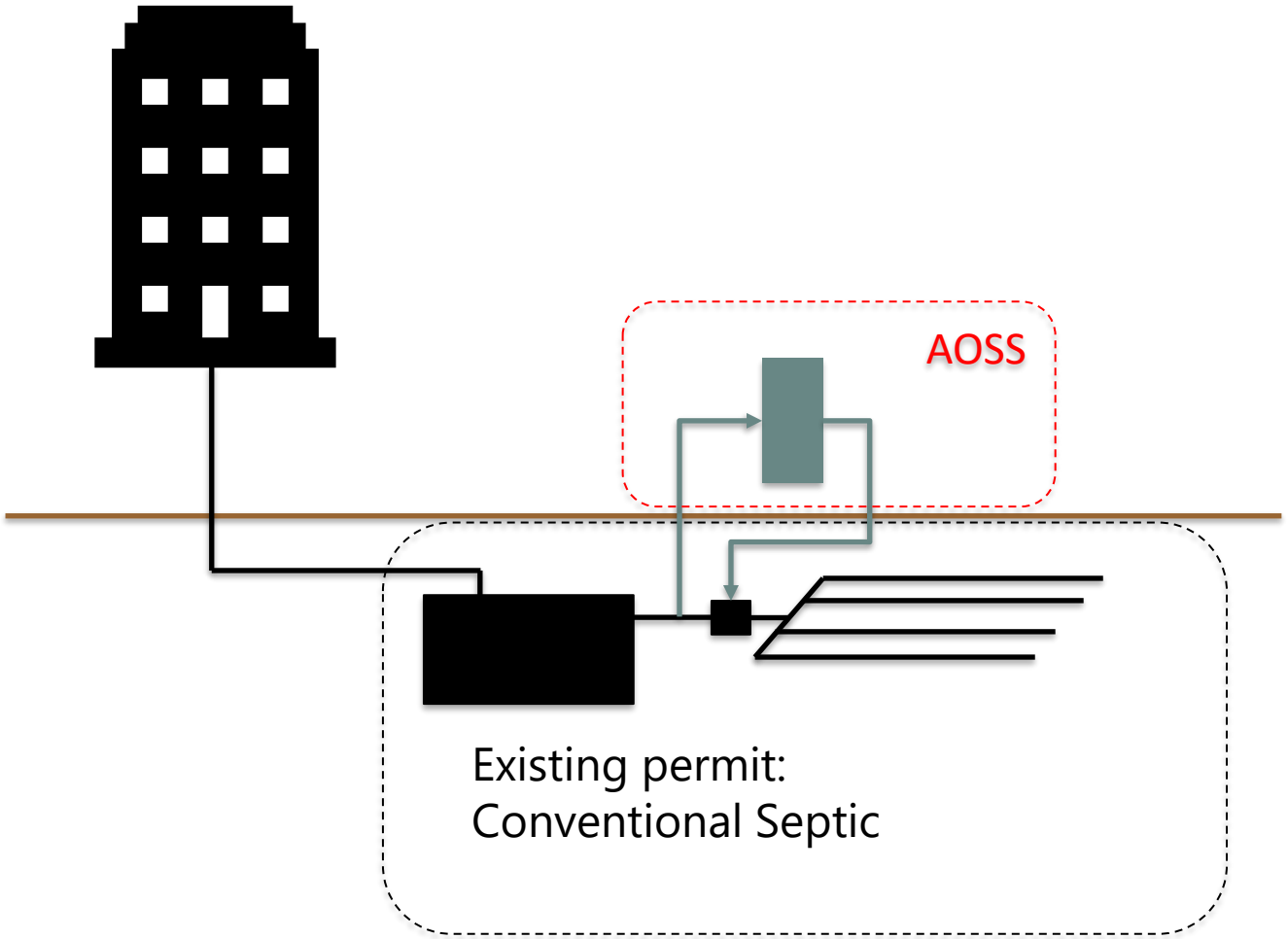
Permit application centered around Effluent Filter, which may or may not include pilot system

Permitting Pathways Used – AOSS amend



- Amended existing AOSS permit to include pilot system
- Included letter from AOSS manufacturer stating no negative impacts from pilot

Permitting Pathways Used – AOSS + Variance



- Adding pilot system converts conventional into AOSS
- AOSS req's nitrogen removal
- Requested variance from county

Other Challenges: Flood-Proofing

- Local FEMA req’t:
  - All electrical components must be 3′ above the base flood elevation

Road to home at high tide:

PROJECT STATUS

Support From:

Residential Pilot Site

Operational since March ’24

Septic tank effluent treatment

Interim Commercial Pilot Site

Installed Sep ‘24

- As of Oct 1, awaiting operation permit
- Testing with AOSS effluent
- Test until final Commercial Site is ready

Commercial Pilot Site

Dec ’24 Move-in

Operate for > 6 months

- 3 months greywater
- 3 months septic tank effluent

Performance vs. Targets

	Residential Avg. Results	**NSF 350** Non-potable Reuse	**Direct Discharge** Q10 Stream or Dry Ditch	**Reclaimed Water** (Level 1)	**AOSS** TL-3
BOD (mg/L)	9	10	10	10	10
TSS (mg/L)	0	10	10	10	10
Turbidity (NTU)	1.97	5	-	2	
E. coli (MPN/100 mL)	-	14	126	11	
pH	8.4	6-9	6-9	6-9	
Chlorine (mg/L)	1.0	0.5	-	1	

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pH	8.4	6-9	6-9	6-9	
Chlorine (mg/L)	1.0	0.5	-	1	
Nitrogen (% rem.)	39%	-	50%	-	50%
Other			No discharge in shellfish water	Continuous monitoring for tubidity, chlorine Weekly BOD/TSS sampling 3x/week *E. coli* sampling	

Next Steps

- Update design based on findings (figure below)
- Incorporate nitrogen solutions
- 3rd party certifications (e.g., NSF 350, NSF 245)

Recommendations

- More technical solutions are needed to improve climate resiliency of distributed water & wastewater
- Create pathways to pilot new technologies safely and efficiently
- New or updated regulations for onsite non-potable reuse

THANK YOU!

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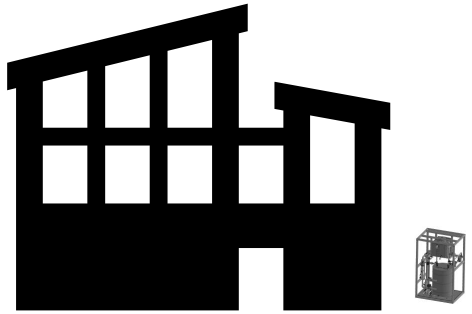
QUESTIONS?

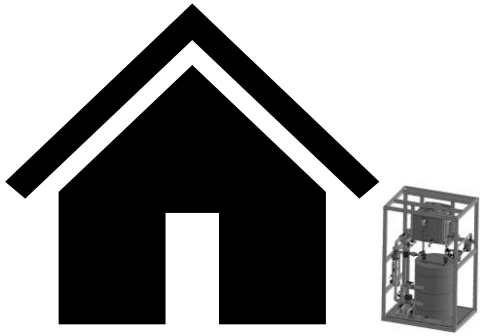
APPENDIX SLIDES

Potential Impacts

New commercial building



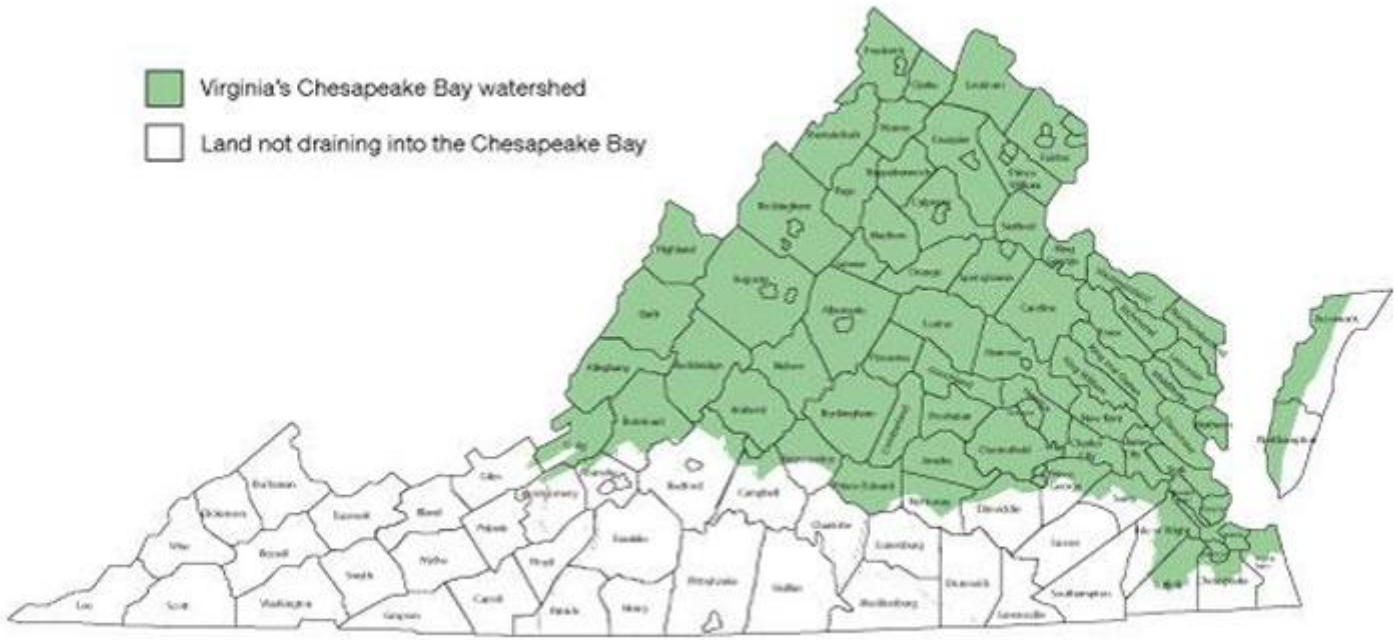
Existing home retrofit



Future Impacts:	Commercial		Residential	
	Septic Tank Effluent	Greywater	Septic Tank Effluent	Greywater
Drainfield reduction	100%	60-70%	100%	60-70%
Non-potable reuse	HVAC, Irrigation	HVAC, Irrigation, Toilet flushing	Irrigation	Irrigation, Toilet flushing, Laundry
Potable water use reduction	Up to 50%	Up to 90%	Up to 70%	Up to 85%

NOTE: Reuse is a future goal. These sites are for demonstration & data collection only.

Other Challenges: Nutrient removal



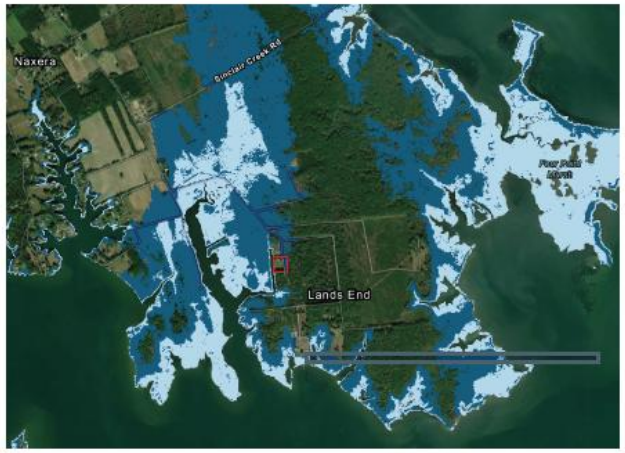
Source: DEQ

Require a 50% reduction of TN compared to a conventional gravity drainfield system:

- NSF 245
- TN < 20 mg/L prior to soil dispersal
- < 4.5 lb N per person per year at project boundary

Lands End High Tides

2030



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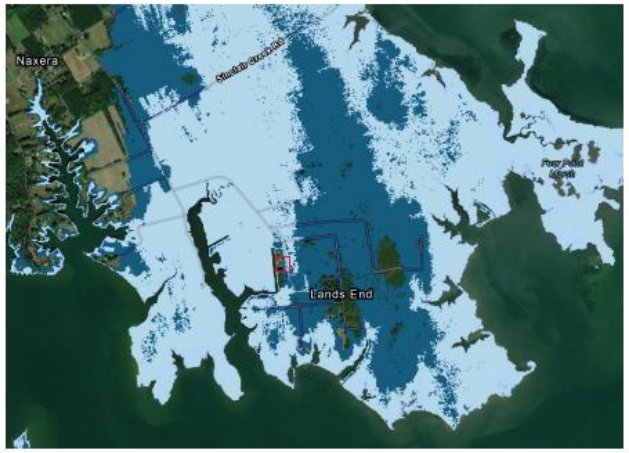

2070

0-6" WATER DEPTH*

6"-1' WATER DEPTH*

*WATER LEVELS DURING MEAN HIGH TIDE