

Propelling Resilience

Town of Colonial Beach
Flood Resilience and Stormwater
Management Plan



2025

Acknowledgements

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PROPELLING RESILIENCE: INTEGRATING FLOOD AND STORMWATER MANAGEMENT IN COLONIAL BEACH

EXECUTIVE SUMMARY

Purpose

The Town of Colonial Beach, situated on Virginia's Northern Neck peninsula, faces increasing threats from climate change, including rising sea levels, frequent flooding, and inadequate stormwater infrastructure. To address these challenges, the town has developed a comprehensive two-part strategy: the **Flood Resilience Plan (Part I)** and the **Stormwater Management Plan (Part II)**. These efforts are designed to be an initial step to address stormwater infrastructure and enhance the community's resilience to evolving environmental conditions.

Key Findings

The **Flood Resilience Plan** focuses on identifying impacts of coastal and tidal flooding caused by sea-level rise, storm surges, and extreme weather events. Colonial Beach's low-lying geography and proximity to the Potomac River and Monroe Bay make it highly vulnerable to inundation. The plan highlights several high-risk areas, including the North Beach Area, including Virginia Ave, and Monroe Bay at Dennison Street, where recurring floods threaten homes, roads, and public spaces. Long-term projections from NOAA estimate a sea-level rise of up to six feet by 2100, underscoring the urgency of these measures. Additionally, FEMA floodplain designations and survey data pinpoint critical zones requiring immediate action. Key strategies to address flooding may include the implementation of storm surge barriers, raised roads, and nature-based solutions such as wetland restoration and vegetated dunes.

The **Stormwater Management Plan** complements the flood resilience efforts by addressing urban stormwater runoff and outdated drainage systems that exacerbate flooding. Since the Town's stormwater infrastructure has not yet been inventoried, the stormwater management plan had to limit the analysis to the prioritized project areas. These areas include Virginia Ave, Monroe Bay at Dennison Street and Potomac River Beach Outfalls, where undersized pipes, tidal backflows, and erosion contribute to prolonged water retention and infrastructure degradation. For the North Beach Area and similarly at Dennison Street, the plan proposes upgrading stormwater pipes and ditches, installing tidal gates, and constructing retention areas to

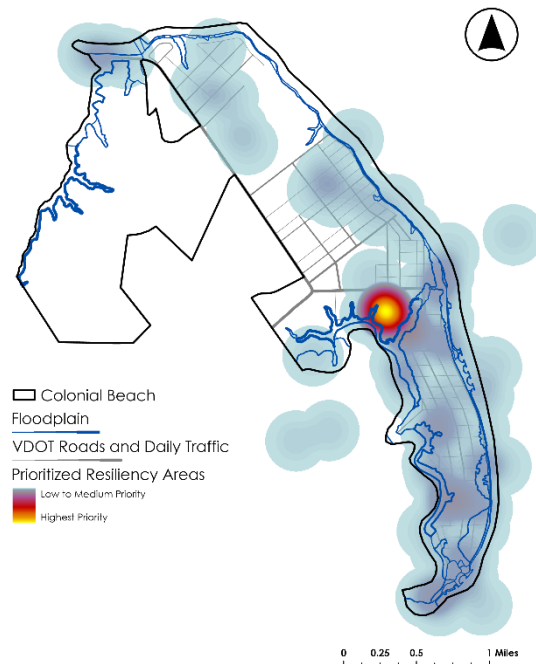


Figure 1: Flood-Prone Areas

reduce runoff and manage tidal influences. For the Potomac River Outfalls, recommended solutions include upsizing outfall pipes, adding vegetated dunes, and integrating green stormwater infrastructure (GSI) such as bioswales and rain gardens. These improvements not only mitigate flooding but also enhance water quality and natural habitat resilience.



Figure 2: Stormwater Priority Area Locations

Recommendations

Funding remains a critical component of the plans' success. Proposed mechanisms to increase funding include implementing stormwater fees, securing state and federal grants, and exploring development impact fees. High-level cost estimates indicate \$780,000 for improvements at Dennison Street, close to and over \$1,000,000 for upgrades to the North Beach Area and Potomac River Beach Outfalls. Funding is also needed for a full stormwater infrastructure inventory, in order for future modelling and analysis to be done. These investments are essential to maintaining Colonial Beach's appeal as a tourist destination while safeguarding residents and infrastructure.

Another recommendation is updating zoning and building codes to incorporate future climate projections, ensuring long-term resilience. Public outreach and education are prioritized to engage the community in sustainable practices, such as reducing impervious surfaces and incorporating green infrastructure on private properties.

By integrating flood resilience and stormwater management strategies, Colonial Beach is proactively addressing its vulnerabilities and preparing for a sustainable future. The

proposed solutions balance engineering innovation with ecological preservation, ensuring the town remains a safe, vibrant, and thriving coastal community.

Conclusion

The Town of Colonial Beach's comprehensive approach to flood resilience and stormwater management reflects a proactive commitment to safeguarding its community, infrastructure, and natural assets against the mounting challenges of climate change. By integrating the Flood Resilience Plan and the Stormwater Management Plan, the town has laid out a clear, actionable roadmap for mitigating flooding, improving drainage systems, and enhancing overall resilience. These plans prioritize not only infrastructure upgrades but also sustainable, nature-based solutions that preserve the town's ecological integrity and aesthetic appeal. With carefully targeted investments, policy updates, and community engagement, Colonial Beach is positioning itself to effectively manage current vulnerabilities while preparing for future climatic uncertainties. By implementing these strategies, the town ensures its continued vibrancy as a coastal community, supporting both residents and visitors in a safe and sustainable environment.

INTRODUCTION

Colonial Beach, Virginia is a charming waterfront town nestled between the Potomac River and Monroe Bay. Known for its scenic beauty and laid-back atmosphere, it offers a blend of history and modern amenities. With a population of around 3,500 residents, this small town boasts a welcoming community and a rich historical heritage.

The Town being situated as a peninsula between the Potomac River and Monroe Bay also expose it to significant risks from natural hazards, particularly flooding. This region, characterized by its low-lying topography and proximity to the Atlantic Ocean and major estuaries, faces frequent and severe flooding events, exacerbated by rising sea levels and climate change. These challenges necessitate a comprehensive and proactive approach to flood resilience to safeguard lives, properties, and the environment.

In order to address these challenging flood risk scenarios, *Propelling Resilience – The Town of Colonial Beach Flood Resilience Plan and Stormwater Management Plan* (the Plan) assesses the most commonly flooded areas, which populations and infrastructure are most vulnerable and offers potential solutions. In order to propose robust flood mitigation projects, and especially to address stormwater infrastructure, the Plan was developed in tandem with and incorporates the Stormwater Management Plan. The purpose of the Plan is not just to position the Town of Colonial Beach for resilience funds from the Community Flood Preparedness Fund (CFPF), but to provide a comprehensive, holistic look at flooding and stormwater infrastructure issues in a manner that is responsive to the needs of Town staff and residents. This ethos is captured in the mission statement, and objectives that were developed in tandem with Town staff and community stakeholders.

Mission Statement – Flood Resilience Plan

The Flood Resilience Plan will identify and position the Town to successfully secure funding for logistically and financially attainable projects that serve to protect all residents of the Town from increasingly severe flooding hazards which threaten property, human life, the built environment, the ecosystem, access to goods and services, ingress and egress to and from the Town, and the Town's the tax base, and overall limit the Town's ability to provide services and respond to future threats.

Objectives

The Resilience Plan will achieve the mission through the following:

- Collect data and information on existing plans, land uses, demographics, etc.;
- Analyze the current state of flooding issues in Colonial Beach with respect to the property, people, and public areas affected;
- Conduct outreach to affected residents, communities, businesses, and stakeholders, both to educate and to involve them in the planning process;
- Develop potential solutions to flooding issues, focusing on nature-based solutions;
- Prioritize projects to enhance protection from flooding with public input; and
- Assess the possibility of attaining NFIP Community Rating System status.

Through these goals, the Flood Resilience Plan creates robust and adaptable strategies that will protect the community, enhance its resilience to future flood events, and support sustainable development in the face of evolving environmental challenges.

Mission Statement – Stormwater Management Plan

The Stormwater Management Plan provides a high-level overview of the Town of Colonial Beach's existing stormwater infrastructure, with a prioritized list of stormwater infrastructure projects that focus on improving stormwater management by leveraging both gray/built and green/natural resources infrastructure, and will review and make recommendations regarding regulatory, administrative, operational, and educational practices in order to improve stormwater conditions within the Town, lessening flood impacts from increased rainfall and impacts from sea level rise due to climate change.

Objectives

The Stormwater Management Plan will achieve the mission through the following:

- Determine existing stormwater infrastructure condition level of service based upon the Town's existing design standards;
- Review state and national weather data to determine potential impacts of future and projected conditions related to climate change and sea level rise.
- Identify potential locations for stormwater best management practices in both public and private spaces;
- Provide a recommended prioritized list of potential projects, estimated costs, and potential project impact to aid in community resilience to reduce flooding;
- Review regulations to incorporate higher regulatory standards to increase resiliency, including incentives that encourage developers and property owners to incorporate physical measures rather than payments in-lieu;
- Assess a stormwater fee structure to support operations, maintenance, and/or capital improvements; and
- Determine opportunities for increased personal stormwater resiliency education.

This portion of the plan will include strategies like green infrastructure, detention basins, permeable surfaces, and improved drainage networks, which work together to protect properties, infrastructure, and ecosystems from flood damage. Ultimately, stormwater management helps communities adapt to increased rainfall and changing climate patterns, ensuring safer communities.

BUILDING ON PREVIOUS WORK

The Town of Colonial Beach is fortunate to have numerous coastal resilience related studies complete to date. The work involved several universities and government agencies working collaboratively with town staff and community stakeholders. It is imperative that this effort consider and build on the work that has been completed to

Town of Colonial Beach – Propelling Resilience

create a flood resilient community. The table below outlines the body of work in more detail.

Table 1: Existing Relevant Studies and Plans

PLAN OR STUDY NAME	AUTHORS	YEAR	PURPOSE	LINK/SOURCE
A FRAMEWORK FOR COASTAL FLOOD PLANNING	UVA SCHOOL OF ARCHITECTURE	2020	PROVIDES A WHOLISTIC COASTAL RESILIENCE STRATEGY	HTTPS://RAFT.IEN.VIRGINIA.EDU/SYSTEM/FILES/FRAMEWORK FOR COASTAL FLOODING_COLONIAL BEACH VA.PDF
THE RAFT – RESILIENCE ADAPTION FEASIBILITY TOOL	UVA, ODU, WILLIAM & MARY, VA CZM, NOAA	2020	COMMUNITY DRIVEN PROCESS TO ASSIST COASTAL LOCALITIES IN INCREASING RESILIENCE	HTTPS://RAFT.IEN.VIRGINIA.EDU/SYSTEM/FILES/COLONIALBEACH.SCO RECARDREPORT%28FINAL%29.PDF
TOWN OF COLONIAL BEACH COMPREHENSIVE PLAN 2020-2030	TOWN OF COLONIAL BEACH	2021	COMPREHENSIVE LAND USE PLAN	HTTPS://WWW.COLONIALBEACHVA.GOV/DOCUMENTCENTER/VIEW/1805/FY2020-2030-COMPREHENSIVE-PLAN
SHORELINE CHANGE ANALYSIS OF AN ESTUARINE RECREATIONAL BEACH, TOWN OF COLONIAL BEACH	ODU	2021	DETAILED SHORELINE CHANGE ANALYSIS OF THE NORTH BEACH AREA	HTTPS://RAFT.IEN.VIRGINIA.EDU/SYSTEM/FILES/SHORELINE%20CHANGE%20ANALYSIS%20OF%20AN%20ESTUARINE%20RECREATIONAL%20BEACH.PDF
VIRGINIA COASTAL RESILIENCE MASTERPLAN	VADCR	2021	STRATEGIC FRAMEWORK TO ADDRESS COASTAL RISK	HTTPS://WWW.DCR.VIRGINIA.GOV/CRMP/DOCUMENT/VIRGINIA COASTAL RESILIENCE MASTER PLAN.PDF
SHORELINE EROSION AND COASTAL DEFENSE STUDY	TOWN OF COLONIAL BEACH, VIMS	2022	SURVEY OF CENTRAL AND CASTLEWOOD BEACHES	HTTPS://WWW.COLONIALBEACHVA.GOV/DOCUMENTCENTER/VIEW/858/VIMS-COLONIAL-BEACH-SHORELINE-STUDY-PDF-
NORTHERN NECK REGIONAL HAZARD MITIGATION PLAN 2023 UPDATE	NORTHERN NECK PLANNING DISTRICT COMMISSION	2023	UPDATE TO FEMA APPROVED HAZARD MITIGATION PLAN	HTTPS://WWW.COLONIALBEACHVA.GOV/DOCUMENTCENTER/VIEW/859/2023-NORTHERN-NECK-REGIONAL-HAZARD-MITIGATION-PLAN-PDF-

TOWN OF COLONIAL BEACH INFLOW & INFILTRATION REPORT	DEWBERRY	2022	ANALYSIS OF THE OVERALL SANITARY SEWER SYSTEM IN THE TOWN TO IDENTIFY THE AREAS INDICATING THE HIGHEST POTENTIAL FOR I&I. OUTLINES THE ANALYSIS, FINDINGS, AND RECOMMENDED NEXT STEPS.	TOWN STAFF
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Existing Data Sources

Using up-to-date public datasets is especially important for flood resilience studies. Recent data on sea-level rise, precipitation patterns, and land development trends reflect evolving environmental conditions and human activity. Public datasets, such as those from FEMA, NOAA, USGS, and others allow assessment of the most recent floodplain maps, precipitation trends, and sea-level rise projections. The consequences of relying on outdated data could underestimate flood risks, potentially leading to inadequate flood defenses and increasing the town's vulnerability. Therefore, using the latest public datasets is key to ensuring effective resilience and long-term safety for Colonial Beach. It is also imperative that the Flood Resilience plan (Part 1) is updated regularly to incorporate new data sets. The data that was collected and analyzed for this effort can be found in Appendix C.

THE PLANNING PROCESS

Town of Colonial Beach staff and the Project Team, through the project kick-off meeting and subsequent coordination meetings, worked to create plan development objectives that would achieve the Flood Resilience Plan and Stormwater Management Plan goals. Each stage of the project incorporated feedback and adjustments to ensure the final product was tailored towards an actionable plan that reflects the needs of community members and can be feasibly implemented. The overall project timeline can be seen below.

The Planning Process

1



Direction Setting | February - March 23'

- Host Kick-off meeting
- Review of existing plans
- Development community engagement and education strategy

2



Analysis and Research | April '23 – May 24'

- Collect data
- Identify existing and emerging conditions
- Assess results of public engagement
- Conduct field assessments

3



Public Engagement | April '23 – March 24'

- Create and conduct public survey
- Host public forum
- Conduct stakeholder interviews

4



Plan Development | May – October 24'

- Present results of research and analysis
- Present findings from public engagement
- Finalize all renderings and schematics based on feedback.

5



Plan Adoption | October 24' – January 25'

- Review final document with Staff
- Develop final presentation
- Public comment period
- Final revisions after public comment
- Plan adoption

PUBLIC ENGAGEMENT PLAN

Public engagement is essential to this planning process because it ensures that the voices, concerns, and needs of the community are incorporated into decision-making. By involving residents, local businesses, and stakeholders, the plan reflects solutions that are not only technically sound but also aligned with the community's priorities and values. Engaged citizens are more likely to support and participate in the implementation of plans, making them more effective and sustainable. Additionally, public input can help identify local knowledge and innovative ideas, ultimately leading to more resilient and inclusive outcomes.

Stakeholders involve both those who have the influence to address problems in the community and those who will be most impacted by flooding. They represent a key demographic whose voices should be heard throughout the process.

It is important to impress upon Colonial Beach residents that not just those properties which are closest to the water are at risk from flooding impacts. A severe enough flood could restrict the roads into and out of the Town, which could strand all residents. Similarly, such a flood event could affect the ability for food, supplies, and fresh water to reach the Town in an emergency, either through transportation related issues or by impacting logistics and distribution centers directly, or even damage telecommunications or other critical infrastructure. Even properties which are not in the flood plain may see declining property values if there is disinvestment in flood resiliency measures, which will have obvious direct consequences but also indirectly make the Town less capable of addressing resident needs. Finally, residents will not be able to enjoy flood prone areas of the Town if they are consistently underwater.

The planning process involved the following engagement activities:

Stakeholder Interviews: The Berkley Group conducted four (4) interviews with identified stakeholder groups, focusing on resilience, flooding, stormwater management, shoreline management, and climate change. The goal is to identify objectives, recurring challenges, historically flooded areas, safety concerns, and community issues. The insights gained will help shape the Plan. Stakeholder Meetings were held with the following groups:

- Members of the Town's Planning Commission and Town Council
- Community Groups and Nonprofits
- Businesses and Development Community
- Town Staff, Researchers, and Consultants

Town Council Meeting: The Berkley Group conducted a project kickoff presentation to the Town Council.

Survey for Residents: The Berkley Group created a digital ArcGIS survey to gather input on flooding issues, priorities for projects, policy preferences, and demographic information.

Public Forums: One (1) in-person public forum was held during the plan development phase and a second public forum was held to review the developed plan.

Table 2: Public Engagement Schedule

Engagement Activity	Timeline
Introductory Town Council Meeting	April 5 th 2023
Distribution of Public Survey	April to July, 2023
Public Forum	June 13, 2023
Town Hall Survey Map Display	June to August 2023
Stakeholder Interviews	November 2023 to March 2024
Public Forum	November 2024
Planning Commission Presentation	December 2024

Town Adoption: The Berkley Group assisted in presenting the draft plans for consideration and adoption by the Town through public forums, Planning Commission meetings, and Town Council meetings, incorporating residents' feedback.

COMMUNITY OUTREACH

Kick-Off Meeting – February 7, 2023

At the Town of Colonial Beach's Resilience and Stormwater Management Plan kick-off meeting on February 7, 2023, participants discussed the mission, goals, and objectives of the plans. The Resilience Plan aims to secure funding for projects protecting vulnerable citizens from severe flooding, considering the whole community and regional coordination. Participants emphasized the need for projects to address hazard risks to human life and critical infrastructure and suggested incorporating public engagement and regional examples like water marks in Franklin. The Stormwater Management Plan's mission, crafted by TetraTech, focuses on evaluating the town's stormwater infrastructure to mitigate flood impacts from climate change and development. Key goals include project prioritization, integrating green infrastructure, and assessing community vulnerabilities. The meeting also addressed the importance of data collection, public education, and stakeholder engagement, with future tasks including public surveys and website and social media content development for ongoing updates and public engagement.

Public Forum – June 13, 2023

During the Town of Colonial Beach's Resilience and Stormwater Management (SWM) Plans Public Forum on June 13, 2023, several flood concerns were highlighted across various areas. Key issues include frequent flooding on Ridge Rd./McKinney Blvd., Locust and Mimosa Avenues, and problems with a culvert on 4th Street. Residents also reported major flooding incidents near 1st Street and the challenges posed by sea level rise affecting Garfield and Wilder Avenues. Issues with shoreline erosion along Monroe Bay and flooding due to deforestation near Hall's Supermarket were

noted. Participants suggested immediate financial aid for flood victims, the creation of emergency shelters, and the development of higher regulatory standards to address flooding concerns. They also recommended improving emergency response facilities, identifying vulnerable populations, and establishing emergency funds for disaster relief prior to FEMA assistance.

Town Staff Stakeholder Interview – November 28, 2023

Key areas of concern were mentioned during the interview included tidal flooding in low lying areas of Virginia Ave. and along the shore of Monroe Bay. High erosion around outfalls on the Potomac River beachfront are a concern, one pump station has been taken out of commission due to coastal impacts. Some public facilities have been impacted and are in need of repair (pier) or other solutions (EMS and fire rescue facilities). VDOT has raised some bridges, but the roads have not been addressed as still flood. The general lack of stormwater regulations for individual lots and developments is a concern that is only getting worse with increased development and infill pressures. Adequately sized pipes and infrastructure are on the list of items to be addressed in addition to the concerns surrounding the increased stormwater from wastewater treatment plant project.

Town Council and Planning Commission Stakeholder Interview – November 29, 2023

Town Council members highlighted some of their specific concerns during the discussion, which included several concerns surrounding flooding. Storms and high tides lead to issues with standing water. Infill lots are rapidly being developed in areas that were once wooded, now creating impervious spaces. The new construction often results in flooding on neighboring lots. Challenges with stormwater management are present in the numbered streets of the Classic Shores area. The Town has replaced a significant sewer line to tackle some Inflow and Infiltration (I&I) problems, which have contributed to stormwater challenges. The wooded region northwest of 12th Street and the Meadows (approximately between Dwight and Myers to the Potomac River) presents an opportunity for a river walk or a stormwater feature. Additionally, it serves as a habitat for bald eagles, potentially offering an opportunity for funding to support a project that combines habitat restoration, recreational opportunities, and addressing some stormwater concerns for the town.

Business and Development Stakeholder Interview – March 13, 2024

Stakeholders from the commercial business and development community in Colonial Beach identified several challenges related to stormwater management and flooding. One of the primary concerns was inadequate stormwater infrastructure to support new development, with developers often resorting to expensive on-site solutions due to the lack of municipal storm sewers to tie into. The high water table, approximately 2 feet below ground level, further complicates development and on-site mitigation, especially retention ponds. However, business owners did recognize there are legitimate flooding impacts to their bottom lines, including direct water intrusion and reduced available parking spaces during heavy rains and high tides. The interviewees agreed on the need for improved Town-owned infrastructure, particularly curbs, gutters, and outfalls, noting that while developers implement stormwater management measures in their projects, the Town's infrastructure often struggles to handle the discharge. This creates tension between the costs of on-site

management and the desire to connect to municipal systems. Ongoing maintenance of on-site solutions is also an issue.

The group identified downtown Colonial Beach and "the Point" as priority areas for stormwater infrastructure upgrades. Opinions on long-term flooding risks were mixed, with some anticipating more frequent flooding in the coming decade due to rising water levels, with others acknowledging a certain level of flooding is inevitable in a coastal town.

The stakeholders expressed openness to cost-sharing arrangements for infrastructure improvements and would like to see some education efforts on maintaining stormwater features. There was no strong opposition to implementing a stormwater fee or other regulations.

Recommendations included:

- prioritizing maintenance and upgrades of existing Town-owned infrastructure;
- providing clarity and consistency in stormwater policies;
- considering cost-sharing mechanisms;
- exploring "low-hanging fruit" solutions;
- investigating a stormwater fee;
- offering resources on green infrastructure maintenance; and
- adopting regulations based on DEQ suggestions for smaller sites.

Community Groups Stakeholder Interview – March 15, 2024

The meeting had representatives from the following Organizations/Affiliations: Colonial Beach Greenspace, Historical Society, Colonial Beach Community Foundation, Beach Art Mentoring Music (BAMM), local business owner, and Community Heart and Soul. The group discussed the topic of what impacts the community is facing including flooding concerns and current stormwater management. The group identified that water is lingering longer than expected as it has nowhere to go and is causing damage to property. The locality has one transportation access point, a major concern for the community during large impact events. Another large issue mentioned is that the wastewater treatment plant has issues to be addressed. Potential solutions were also discussed that included, stormwater district fees/taxes, analysis by experts of existing conditions, increased open space preservation, preserving the RPA buffer, and increasing vegetation along waterways in general.

TAKEAWAYS FROM THE PUBLIC SURVEY

The survey was completed on July 14, 2023, with responses from 192 participants, eighty-five percent (85%) being residents. More of the respondents answered that they have an active policy through the National Flood Insurance Program (NFIP) than answered they are in a Special Flood Hazard Area (SFHA), 29% vs. 16%, respectively. Common flooding events mentioned were hurricanes, drainage concerns from regular storm events, and severe tidal events. Common impacts from these events were yard

and beach erosion, inadequate community drainage systems, and overall standing water. A map of the identified flooding locations is found below. The top concern for flooding impacts was the potential damage to property, and the overall most suggested solution was regulatory options for development.

Figure 1: Public Survey Results

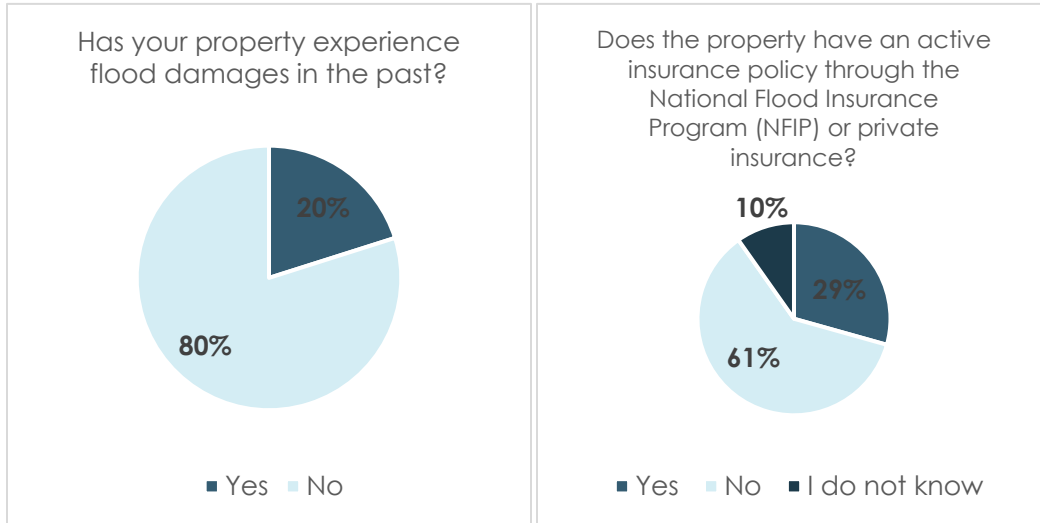
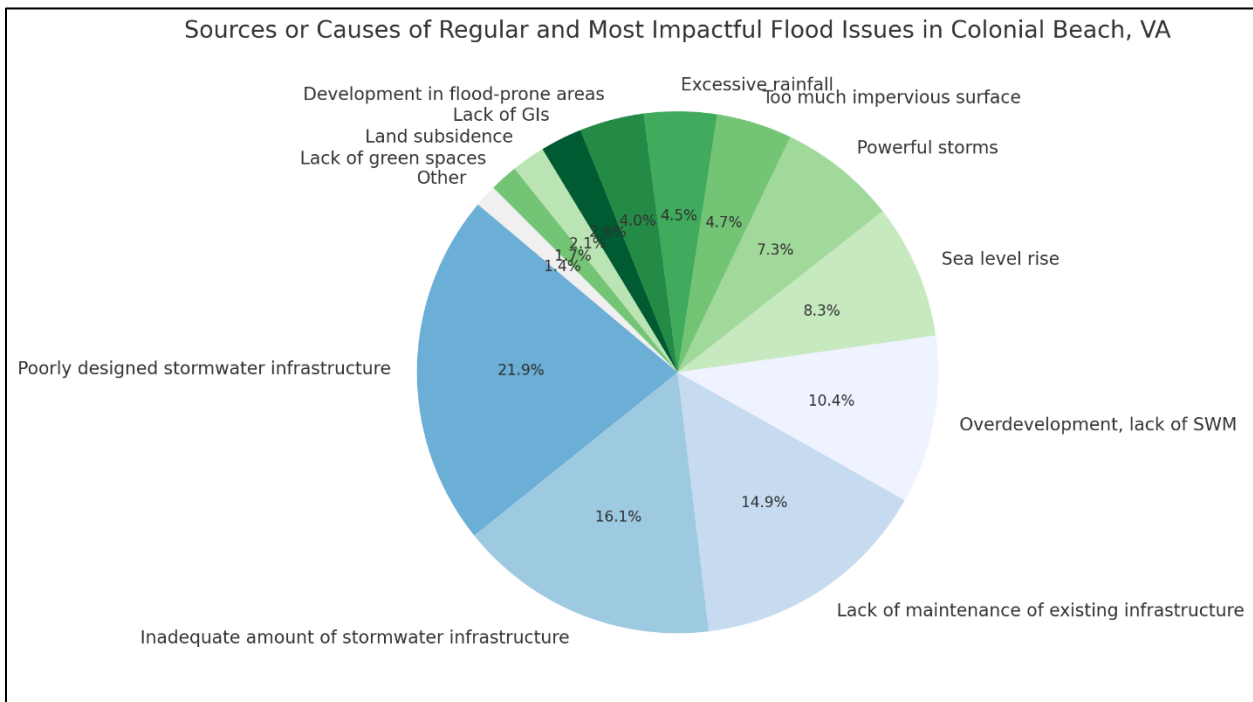


Figure 2: Public Survey Results



The Public Survey Report may be found in Appendix B.

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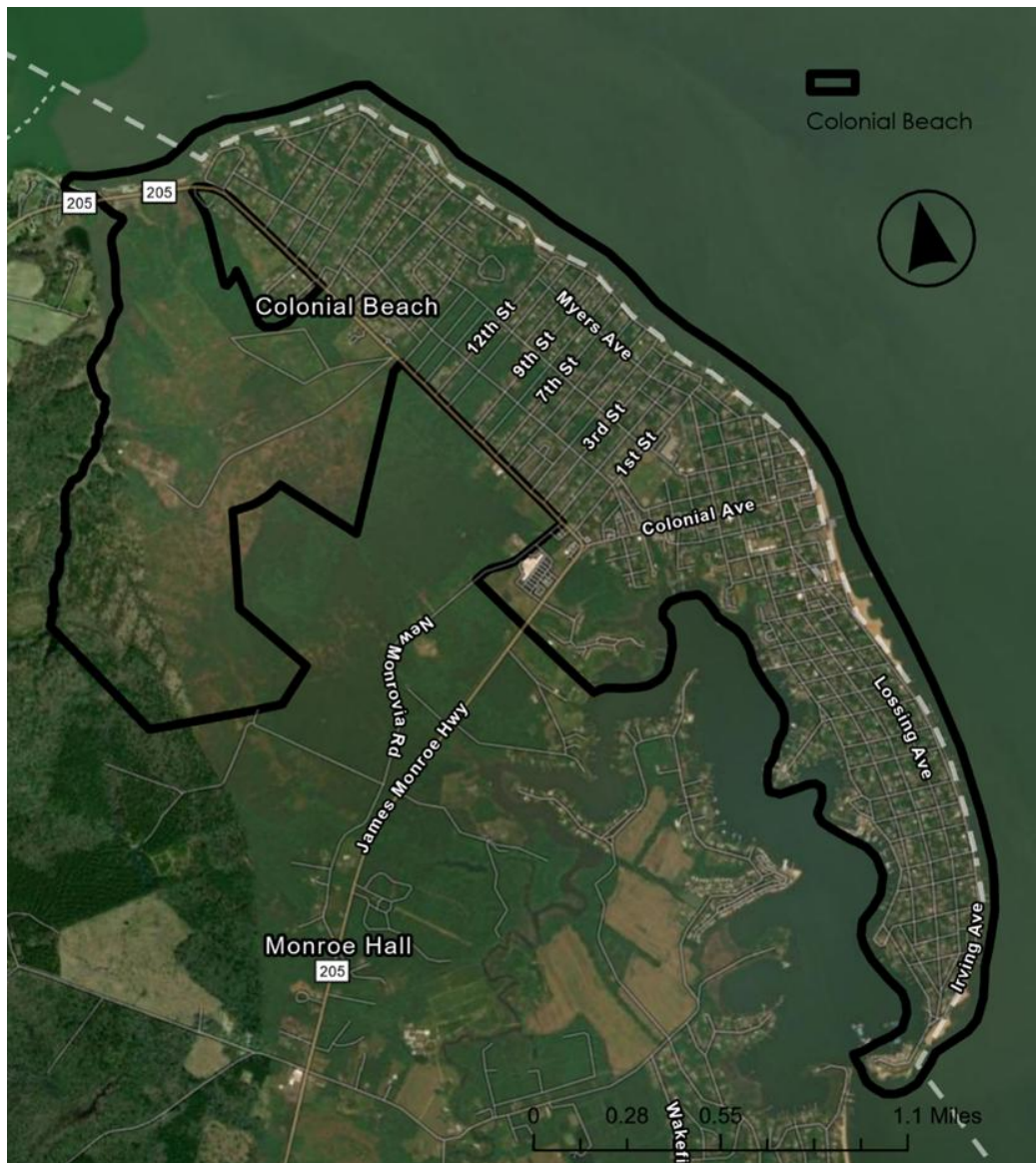
Resilience

PART I:
Town of Colonial Beach
Flood Resilience Plan

PART 1 – FLOOD RESILIENCE PLAN

Part I of the Plan, the Flood Resilience Plan component, addresses the increasing threats posed by flooding, which are exacerbated by rising sea levels, climate change, and the town's low-lying geography. This section focuses on high level flooding issues as heard through public engagement and analyzed through public data sources, and proposes a range of mitigation strategies, including infrastructure improvements, land use planning, and nature-based solutions, to enhance the town's ability to withstand and recover from flood events. The plan emphasizes adaptability to future conditions, promoting policies and practices that respond to the evolving challenges of climate change and rising water levels. The Flood Resilience Plan component aims to create a safer and more sustainable future for Colonial Beach, reducing the impact of future flooding while supporting long-term community resilience.

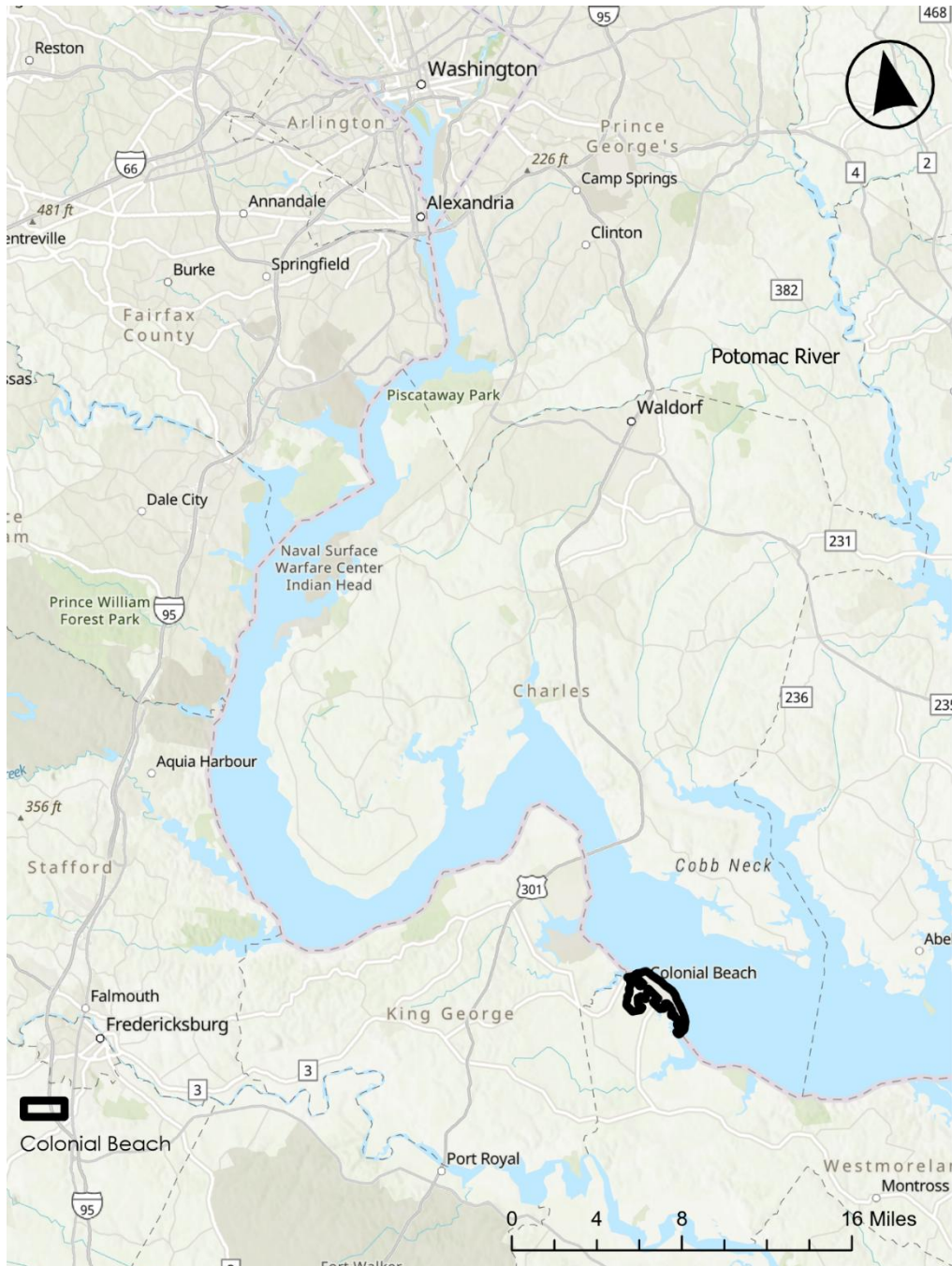
Figure 1-1: Town of Colonial Beach Boundary and Aerial Imagery



Town of Colonial Beach – Propelling Resilience

Colonial Beach is located in Westmoreland County, Virginia, and is bordered by Maryland across the Potomac River, King George County, and open rural areas, contributing to its serene environment. The economy of Colonial Beach is driven by its tourism, local businesses, and seasonal activities that cater to both residents and tourists alike. The main route into town is via James Monroe Hwy (SR 205) which is accessed from Kings Hwy (SR 3) from the South and U.S. Route from the North. These routes offer access to Maryland and Fredericksburg, VA, and I-95.

Figure 1-2: Town of Colonial Beach Regional Context



DEMOGRAPHICS

As of the most recent census data, the Town of Colonial Beach has a population of around 3,500 residents. The town has a predominantly White population, but there is also a mix of African American, Hispanic, and other racial and ethnic groups. The community is largely residential, with a significant proportion of retirees and vacation homeowners, due to its waterfront appeal. Colonial Beach's demographics also include a diverse age range, with both families and older adults, and the town has a slower-paced, small-town feel with a focus on tourism and local culture. The following demographic information is taken from the US Census Bureau.

Table 1-1: Colonial Beach Demographics and Change Over Time¹

Population	
Population, Census, April 1, 2020	3908
Population, Census, April 1, 2010	3542
Age and Sex	
Persons under 5 years, percent	5.57
Persons under 18 years, percent	18.48
Persons 65 years and over, percent	26.8
Female persons, percent	52.5
Race and Hispanic Origin	
White alone, percent	74.2
Black or African American alone, percent ^(a)	14.09
American Indian and Alaska Native alone, percent ^(a)	0.54
Asian alone, percent ^(a)	1.85
Native Hawaiian and Other Pacific Islander alone, percent ^(a)	.28
Two or More Races, percent	7.93
Hispanic or Latino, percent ^(b)	1.1
White alone, not Hispanic or Latino, percent	65.26

¹ Source: U.S. Census Quick-Facts:
<https://www.census.gov/quickfacts/fact/table/kinggeorgecountyvirginia/PST045223>

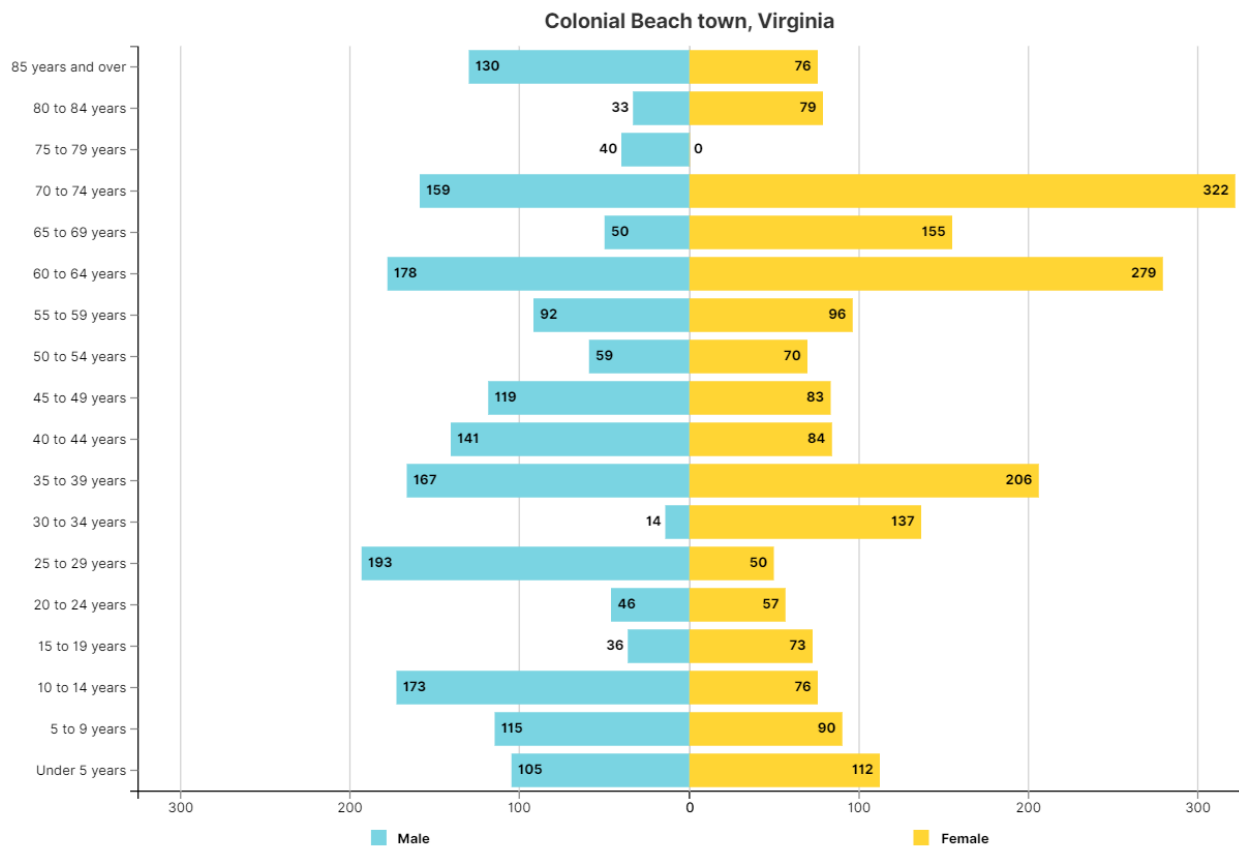
Population Characteristics (2018-2022)	
Veterans	11.12
Foreign born persons, percent	2.08
Families & Living Arrangements (2018-2022)	
Households	1865
Persons per household	2.05
Living in same house 1 year ago, percent of persons age 1 year+	3738
Language other than English spoken at home, percent of persons age 5 years+	3.9
Education (2018-2022)	
High school graduate or higher, percent of persons age 25 years+	32.4
Bachelor's degree or higher, percent of persons age 25 years+	15.6
Health (2018-2022)	
With a disability, under age 65 years, percent	69
Persons without health insurance, under age 65 years, percent	10.73
Economy (2018-2022)	
In civilian labor force, total, percent of population age 16 years+	32.58
In civilian labor force, female, percent of population age 16 years+	54.5
Income & Poverty (2018-2022)	
Median household income (in 2022 dollars)	\$55,731
Per capita income in past 12 months (in 2022 dollars)	\$36,187
Persons in poverty, percent	27.7
Geography	
Population per square mile, 2020	1,447
Population per square mile, 2010	1,311

(a) Includes people only reporting one race; (b) Hispanics may be of any race, included in applicable categories.

Table 1-2: Population Growth Change from 2010 to 2020

	2000 Census	2010 Census	2000–2010 % Change	2020 Census	2010–2020 % Change
Population	3219	3542	10.03%	3908	10.33

Figure 1-3: Colonial Beach Estimated Population Pyramid²



PHYSICAL PROFILE

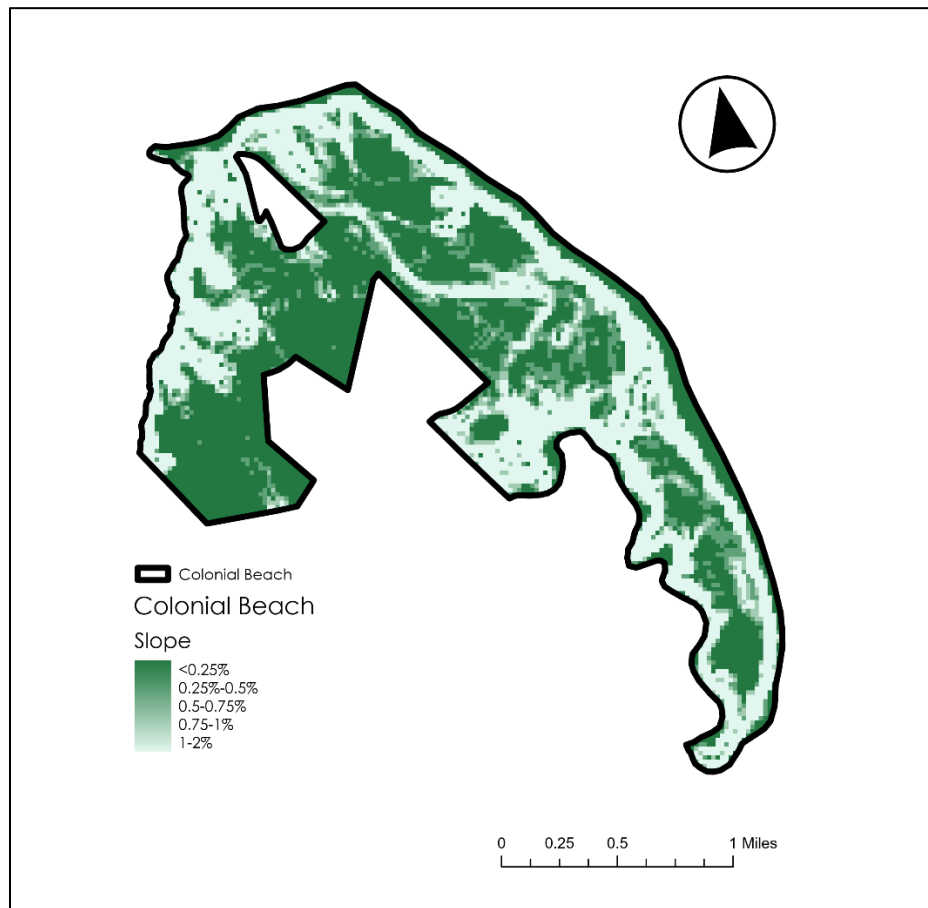
Flood-related datasets are often used to help communities understand what kind of threats are potentially present in their area. While other threats may exist, for the purposes of this plan only those threats relevant to flooding were included. The data shown in this plan range from periodic threats such as inundation from storm surge to more permanent characteristics such as the presence of low-lying areas. The plan also incorporates regionally specific threats, such as geologic stressors, which may impact a community's ability to survive or recover from flood events in the short and long term.

² Source: US Census

(<https://data.census.gov/vizwidget?g=160XX00US5118400&infoSection=Age%20and%20Sex>)

The Town's topography is characterized by flat, low-lying land with gentle elevations, the surrounding area features rolling hills and forested landscapes typical of the Northern Neck region of Virginia. The areas of low slope in the Town of Colonial Beach play an important role in the impact of storm surge from hurricanes or similar events. The following map identifies where water is more likely to collect on the landscape.

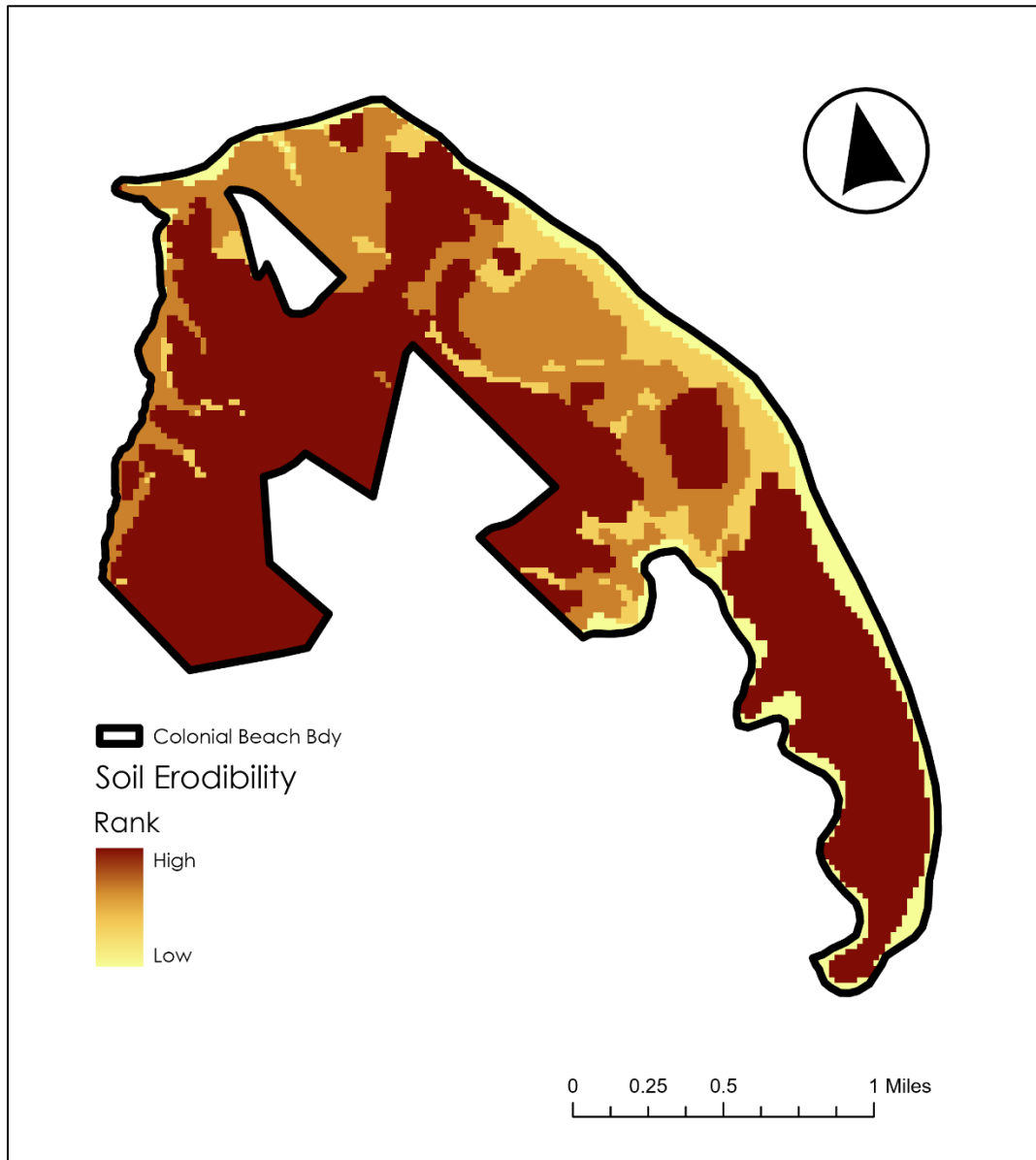
Figure 1-4: Percent Slope of Colonial Beach (and Immediate Shoreline)³



The geology of Colonial Beach is influenced by its location along the Potomac River and Monroe Bay, with sedimentary deposits playing a significant role in shaping the area's landscape. The underlying geology includes Quaternary sediments such as sand, silt, and clay, which have been deposited over time by river and coastal processes. The region also features some areas of fine-grained sedimentary rocks, including sandstone and shale, which are common in the broader Northern Neck region. The following map shows where, due to these soil conditions, land may be more likely to erode during floods.

³ Source: USGS National Elevation Dataset (NED) tiles, 30m resolution

Figure 1-5: Soil Erodibility Map⁴



Colonial Beach's primary water resource is its location along the Potomac River, a major Chesapeake Bay tributary. The Town's waterfront provides access to the river, which supports recreational activities such as boating, fishing, and swimming. The Potomac River is a significant ecological and economic asset for the Town. Additionally, there are smaller local water features, including Monroe Creek and Goldman Creek, which contribute to the area's water resources and support local wildlife habitats. The region relies on both surface water from the Potomac River and groundwater from local aquifers for its water supply.

⁴ Source: USDA-NRCS SSURGO database (<https://www.nrcs.usda.gov/resources/data-and-reports/ssurgo-portal/>)

Colonial Beach experiences a humid subtropical climate, characterized by hot, humid summers and mild to cool winters. The average annual temperature is around 57°F (14°C), with summer temperatures frequently reaching into the mid-80s to low 90s Fahrenheit (around 29-35°C). Winters are relatively mild, with average temperatures ranging from the upper 30s to mid-40s Fahrenheit (3-8°C). The town receives approximately 40-45 inches (1,000-1,200 mm) of precipitation annually, distributed fairly evenly throughout the year, with slightly wetter periods in the spring and summer. The climate supports a diverse range of vegetation and contributes to the town's appeal as a year-round destination.

The largest groundwater demands, according to the Virginia State Water Resources Plan 2022 published by DEQ, include several municipal facilities including the Town of Colonial Beach water treatment plant.

VULNERABLE POPULATIONS

This Flood Resilience Plan considers vulnerability and provides specific examples to align with the Virginia Department of Conservation and Recreation's Community Flood Preparedness Fund (CFPF) criteria. For the CFPF, "Low-income geographic area" means any locality, or community within a locality, which has a median household income that is not greater than 80 percent of the local median household income or any area in the Commonwealth designated as a qualified opportunity zone by the U.S. Secretary of the Treasury via his delegation of authority to the Internal Revenue Service. These areas are eligible to apply for CFPF funding with as little as 10% matching funds.

The chart below summarizes income data for the Town of Colonial Beach. For the purposes of this plan, and as expected by VA DCR, the "local" median household income metric is the state of VA.⁵ All areas within the Town boundaries are considered as a Low Income Geographic Community and therefore would be eligible for a reduced match amount for the purposed of the CFPF grant application.

⁵ US Census Bureau, 2022 American Community Survey 5-Year Estimates

Table 1-3. Comparative Income Data, US Census Bureau 2020

	Median Household Income State of VA	Locality Median Income	80% Median Household Income	Low-Income Geographic Community*
Town of Colonial Beach	\$85,873	\$52,119	\$68, 698	Yes
Westmoreland County	\$85,873	\$56,647	\$68, 698	Yes
<ul style="list-style-type: none"> • Per CFPF definition 				

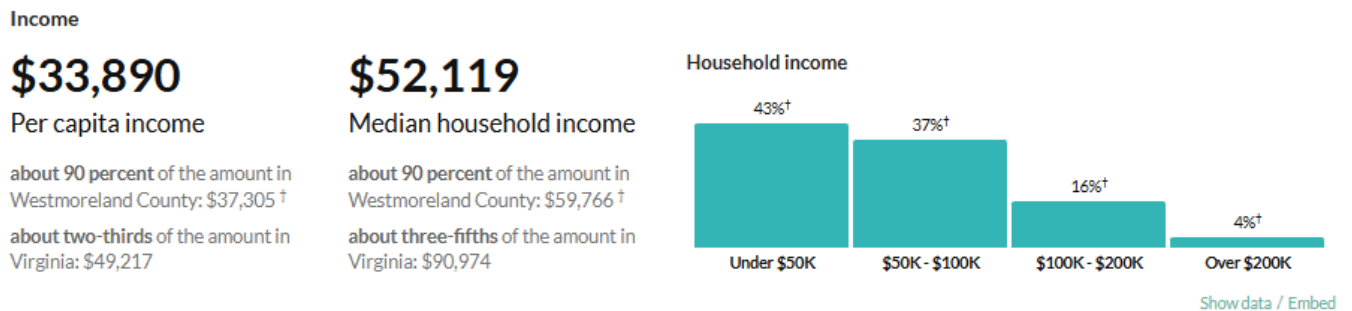


Figure 1-6: Town of Colonial Beach Income Data, US Census Bureau, 2020

Another factor in measuring vulnerability is the Social Vulnerability Index⁶. SVI indicates the relative vulnerability of every U.S. Census tract. Census tracts are subdivisions of counties for which the Census collects statistical data. SVI ranks the tracts on 15 social factors, including unemployment, minority status, and disability, and further groups them into four related themes. Thus, each tract receives a ranking for each Census variable and for each of the four themes, as well as an overall ranking. Projects and studies in areas with a higher SVI index score will receive prioritized rankings for CFPF funding. The Town of Colonial Beach has a Moderate Social Vulnerability Index Score.

⁶ Social Vulnerability Index, AdaptVA, <https://www.adaptva.org/docs/SocialVulnerabilityfactsheet.pdf>

Figure 1-7: Social Vulnerability Index Rankings for the Town of Colonial Beach, VA, Adapt VA



Social Vulnerability Index

Social Vulnerability Index Score

- Very Low Social Vulnerability
- Low Social Vulnerability
- Moderate Social Vulnerability
- High Social Vulnerability
- Very High Social Vulnerability
- Not included in the analysis

More than 1.5: Very High Social Vulnerability
1.0 to 1.5: High Social Vulnerability
0.0 to 1.0: Moderate Social Vulnerability
-1.0 to 0.0: Low Social Vulnerability
Less than -1: Very Low Social Vulnerability

Another important data set for evaluating economic and social vulnerability is ALICE, or 'Asset Limited, Income Constrained, Employed,' households that earn more than the Federal Poverty Level, but less than the basic cost of living for the county. While conditions have improved for some households, many continue to struggle, especially as wages fail to keep pace with the rising cost of household essentials (housing, childcare, food, transportation, health care, and a basic smartphone plan). Households below the ALICE Threshold — ALICE households plus those in poverty — cannot afford the essentials.⁷

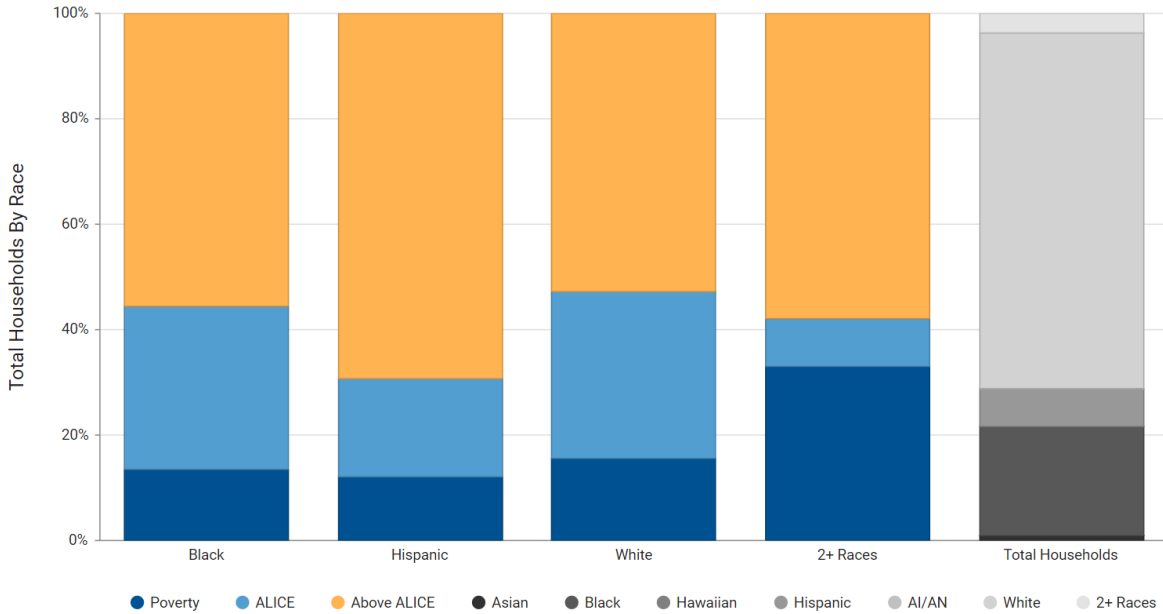
Table 1-4: Westmoreland County ALICE Parameters vs. Virginia Average

Parameter (2022 Data)	Westmoreland County	State Average
Population	18,480	-
# Households	7,832	-
Median Household Income	\$56,647	\$85,873
Labor Force Participation	51%	65%
ALICE Households	29%	29%

⁷ AdaptVA takes several factors into account, including income, minority status, elderly, single female head of households, educational attainment, and employment. For a complete breakdown of the methodology see: https://cmap2.vims.edu/SocialVulnerability/Documents/Metadata_descriptions_for_the_SV_viewer.pdf

Households in Poverty	17%	11%
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Figure 1-8: Households by Race/Ethnicity, Westmoreland County, VA 2022



ENVIRONMENTAL AND CULTURAL ASSETS

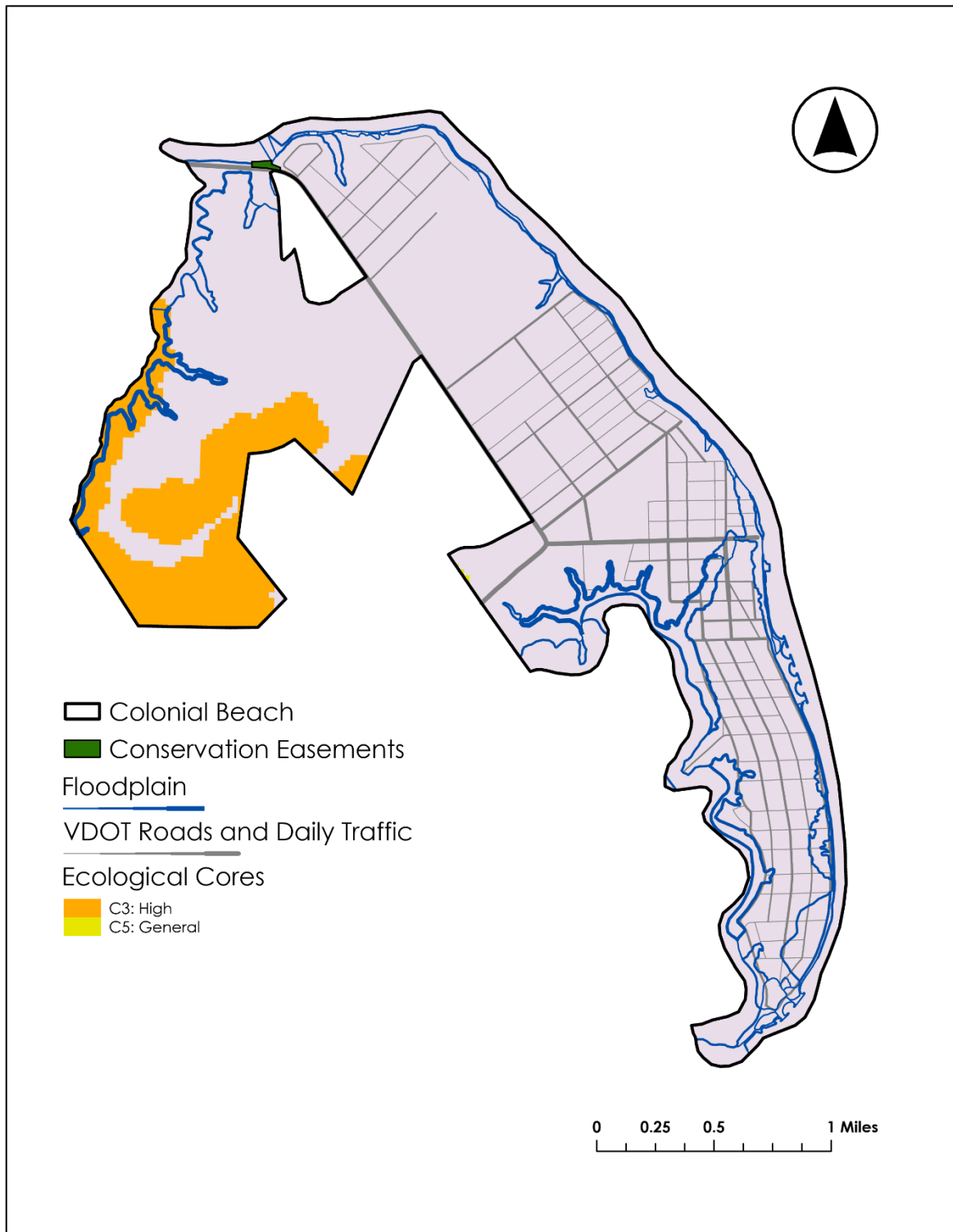
The Potomac River and Monroe Bay are central environmental assets for Colonial Beach. Its scenic waterfront provides recreational opportunities such as boating, fishing, and swimming. Colonial Beach boasts a sandy shoreline that is a key attraction for residents and visitors alike. The town has several parks that enhance its green space and recreational options including playgrounds, sports facilities, and walking trails. There are local initiatives that aim to preserve the health of the Potomac River, manage stormwater runoff, and protect the town's coastal and riparian environments. Colonial Beach has a rich historical heritage, with several preserved sites and landmarks. The Colonial Beach Historical Society plays a role in maintaining and interpreting the town's history. Key historical sites include old inns, Victorian-style homes, and structures from the town's early days as a resort destination. The Colonial Beach Commercial Historic District offers a wide variety of shops and restaurants while being a national historic landmark.

Ecological Cores

The Virginia Natural Landscape Assessment (VaNLA) is a landscape-scale GIS analysis that has identified, prioritized, and linked important lands to form natural land networks throughout Virginia. The cores layer shown in Figure 1-10 represents cores as polygons that are symbolized by Ecological Integrity scores, calculated from an Ecological Composite Model (ECM). Maintaining vital natural landscapes is essential for basic ecosystem services such as cleaning our air and filtering our water. Natural lands also

harbor thousands of species of animals and plants and contain libraries of genetic information from which we derive new foods, materials, and medicinal compounds. These parts of the landscape also provide us with recreational opportunities and open space resources. To assess their unique values, each core and habitat fragment has been assigned an Ecological Integrity score that rates the relative contribution of that area to ecosystem services such as wildlife and plant habitat, biodiversity conservation, open space, recreation, water resources protection, erosion control, sediment retention, protection from storm and flood damage, crop pollination, and carbon sequestration. In general, larger, more biologically diverse areas are given higher scores. Scores are enhanced if the core or habitat fragment is part of a larger complex of natural lands. Scores also are increased for those cores and habitat fragments that contribute to water quality enhancement. For more information, go to: <http://www.dcr.virginia.gov/natural-heritage/vaconvisvnlq>.

Figure 1-9: Ecological Cores Overlaid on the Regulatory Floodplain⁸



⁸ Source: DCR Natural Landscape Assessment (<https://www.dcr.virginia.gov/natural-heritage/vaconvisvnl>)

FLOODING

Flooding in The Town of Colonial Beach, like many coastal communities, can occur due to a variety of causative factors, including frequent and intense tropical storms, hurricanes, accelerated sea level rise (SLR)⁹, and related nuisance flooding. All types of flooding can have serious risks to human health and infrastructure.

The Floodplain

One of the most immediate sources of information in the United States for identifying areas at risk of flooding are FEMA's flood maps, officially known as Flood Insurance Rate Maps (FIRMs). The maps provide critical information for homeowners, businesses, and local governments to understand flood hazards and make informed decisions about building, insurance, and land use planning

The zones are as follows:

Zone A is the flood insurance rate zone that corresponds to the 1- percent annual chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE is the flood insurance rate zone that corresponds to the 1- percent annual chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Z

Zone AO is the flood insurance rate zone that corresponds to the areas of one percent annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

VE Zone the flood insurance rate zone that corresponds to the 1- percent annual chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2- percent annual chance floodplain, areas within the 0.2- percent annual chance

⁹ Science Direct, 2024, Sea Level Rise, <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/sea-level-rise>

floodplain, and to areas of 1- percent annual chance flooding where average depths are less than 1 foot, areas of 1- percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1- percent annual chance flood by levees.

Recently, FEMA unveiled Risk Rating 2.0, which no longer relies primarily on these flood zone designations to set rates. Instead, it uses a more granular approach that factors in:

1. **Property characteristics:** This includes information about the property, such as its elevation, the type of building, and the distance to the nearest body of water.
2. **Flood risk variables:** Risk Rating 2.0 incorporates local flood frequency, the potential for storm surge, rainfall, riverine flooding, and more, rather than just assigning zones.
3. **Individual risk:** This new system assesses the actual risk of flooding for each property individually, rather than relying heavily on the broad zone-based classification.

As a result, **flood insurance rates are now based on specific risk factors for each property** and are no longer directly tied to the community-wide flood zones that were established through engineering studies or Flood Insurance Studies (FIS).

Most portions of the town are currently not located in a FEMA flood zone, with small portions located in the “X” zone and other areas in the “AE” Zone. It is important to remember that structures located outside of a designated flood zone may still flood due to factors such as low natural topography, high groundwater levels, and increases in impervious surfaces due to development. See Figure 1-11 below for the Town’s NFIP effective floodplain areas.

Figure 1-10: FEMA NFIP Effective Flood Hazard Areas. 2024



In addition to regulating the floodplain, the National Flood Insurance Program (NFIP) provides flood insurance for properties that are vulnerable to flooding. This flood resilience plan builds on the flood risk assessment performed in the 2023 Northern Neck HMP update. Repetitive loss properties and severe repetitive loss properties as stated in the HMP: *“The Hazard Mitigation Assistance program defines Repetitive Loss as having incurred flood-related damage on two occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and, at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.”*¹⁰ As of 2024, there were 16 structures in the Town of Colonial

¹⁰ The 2023 Northern Neck HMP Update

Beach considered Repetitive Loss, with repetitive losses amounting to \$1,625,124.12 in damage payments.

The Town of Colonial Beach enforces Substantial Damage and Substantial Improvement regulations (Article 21 Flood Plain Overlay District) to reduce flood risks and ensure compliance with the National Flood Insurance Program (NFIP). These regulations require that when a building within a floodplain is substantially damaged (meaning repair costs exceed 50% of the building's pre-damage market value) or undergoes substantial improvement (where renovation or addition costs exceed 50% of its pre-improvement market value), it must be brought into full compliance with current floodplain management and building codes. This often involves elevating structures, retrofitting for flood resistance, or implementing other measures to reduce future flood damage. The goal is to protect property owners, minimize financial losses, and reduce the need for costly disaster relief, thereby fostering a more resilient community in Colonial Beach.

The Community Development and Zoning Department, specifically the Director of Community Development is responsible for determining whether a building project qualifies as a substantial improvement. This department evaluates permit applications, assesses project costs, and compares them to the structure's market value to ensure compliance with floodplain management regulations.

Hurricanes and Tropical Storms

Hurricanes, tropical storms, and typhoons are all cyclonic storms. In the northern hemisphere, these are characterized by counterclockwise rotational air movement around and into a low-pressure center. On average, about six storms per year reach hurricane intensity in this region. As recorded, about 69 tropical cyclones have been tracked directly across Virginia. Virginia averages about one storm per year. While some years are storm-free, others may witness multiple storms just days or weeks apart.

While the official hurricane season runs June 1 through November 30, the peak of the Atlantic hurricane season is typically from mid-August to late October, with September 10th being the climatological peak.

The Town of Colonial Beach is vulnerable to the impacts of hurricanes and tropical storms. The extent and magnitude of hurricane and tropical storm impacts can vary widely depending on the storm's characteristics, path, and speed of movement. Key factors include:

Wind: High winds can cause widespread damage to structures, down trees, and power lines, and create dangerous debris. While the region typically experiences reduced wind speeds compared to coastal areas, tropical storm-force winds (39-73 mph) and occasionally hurricane-force winds (74+ mph) can still occur.

Storm Surge: A rise in seawater level during a storm, caused primarily by the strong winds pushing water toward the shore; storm surges can result in

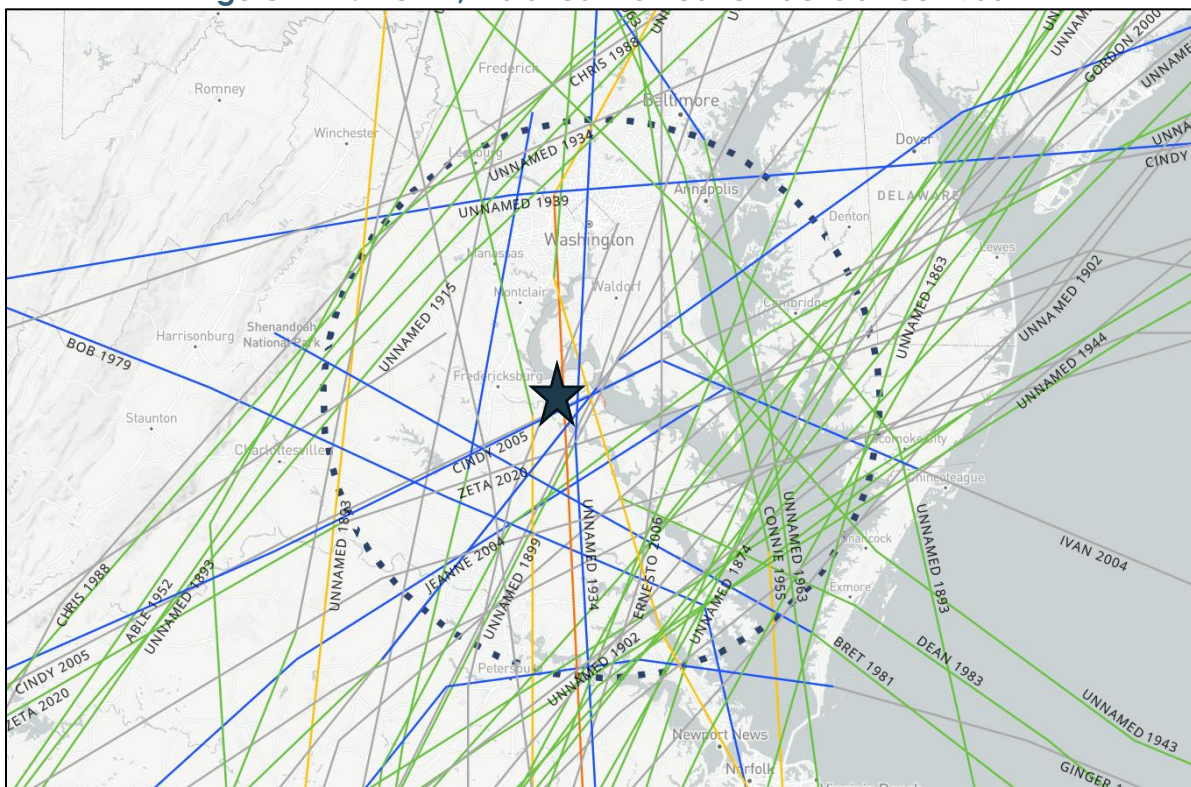
significant coastal flooding, particularly when they coincide with high tides, and are a major cause of damage and loss of life during hurricanes, cyclones, and other severe storms. The height of a storm surge can vary depending on the storm's intensity, speed, and direction, as well as the shape of the coastline and the underwater topography.

Rainfall: Tropical systems can produce extreme rainfall, leading to flash flooding and river flooding. The region's varied topography, including the eastern slopes of the Blue Ridge Mountains, can enhance rainfall in some areas.

Tornadoes: Hurricanes and tropical storms can spawn tornadoes, which may affect the region even when the storm center is hundreds of miles away.

Historical data provides insight into the region's hurricane risk. According to NOAA's Historical Hurricane Tracks tool, between 1851 and 2023, 57 tropical systems have passed within 50 nautical miles of the Town's center (approximate coordinates 38.25° N, 76.96° W):

Figure 1-11: NOAA, Historical Hurricane Tracks Since 1950



Notable storms that have impacted the region include:

Hurricane Isabel (2003): Made landfall in North Carolina as a Category 2 hurricane, causing significant wind damage and flooding in the region. Storm surge caused significant damage. Strong winds, heavy rainfall, and storm surge created considerable destruction in this small waterfront town.

Tropical Storm Lee (2011): Brought heavy rainfall and flooding to the area.

Hurricane Sandy (2012): Although it made landfall in New Jersey, its large size affected the region with high winds and heavy rainfall.

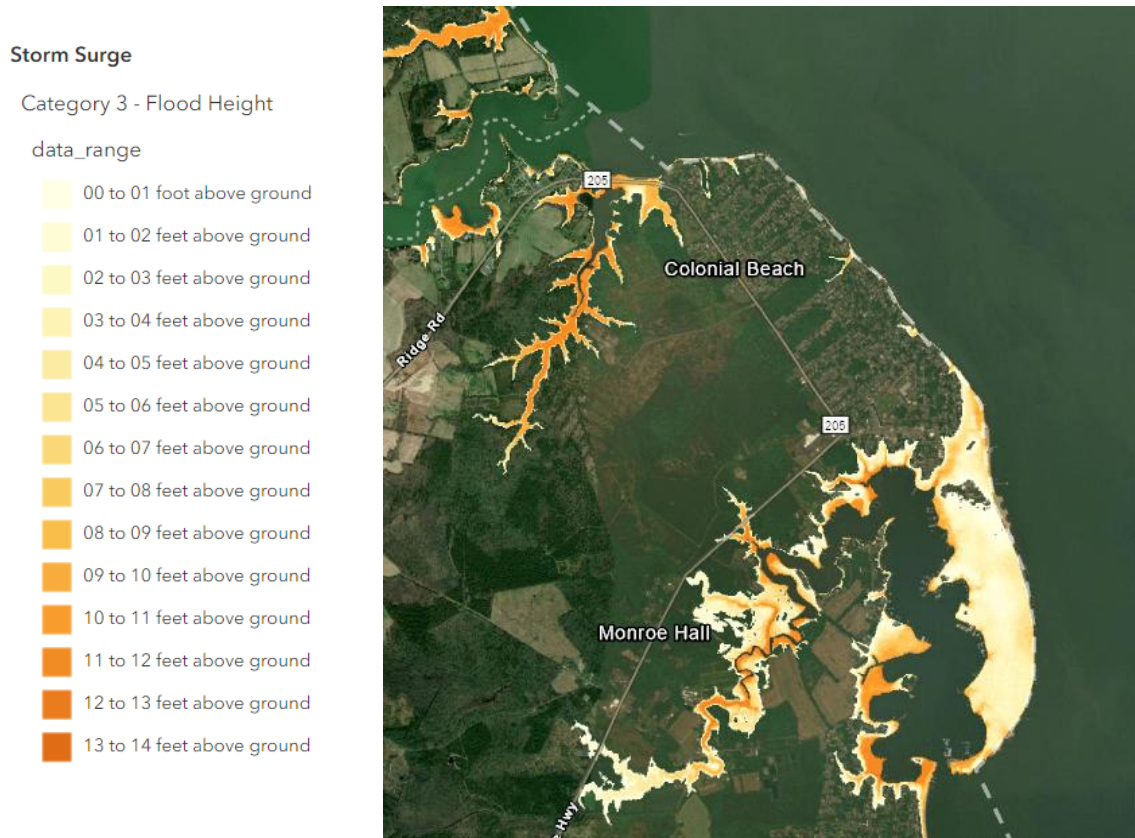
Hurricane Florence (2019): While the main impact of Florence was farther south, the storm's remnants caused minor flooding and high tides in the Colonial Beach area.

Tropical Storm Elsa (2021): Some wind impacts (due to gusts of 40-50 mph, with a couple gusts as high as 60 mph) were felt across eastern VA. Localized power outages occurred, and there were some significant flood/flash flood impacts (generally along and just to the left of the track).

Using publicly available data from the National Weather Service's SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model¹¹, it is possible to visualize the estimated impacts to the Town from hurricanes categories. Figure 1-13 below is a modelled visualization of a Category 3 hurricane, and storm surge heights within the Town of Colonial Beach.

¹¹ National Hurricane Center, National Storm Surge Risk Maps,

Figure 1-12: Storm Surge Heights from Category 3 Hurricane



Precipitation Events

According to the National Weather Service, on average, the United States sees 100,000 thunderstorms each year. Although thunderstorms generally affect only a small area, the extent of their impact is often enhanced by their ability to generate tornadoes, hailstorms, strong winds, damaging lightning, and flash floods. Thunderstorms occur in all regions of the United States and are common in the region where topographic and atmospheric conditions combine to create ideal circumstances for generating these powerful storms.

Thunderstorms can produce excessive amounts of rainfall which can produce riverine, coastal, and flash flooding. Riverine flooding results from excessive precipitation and high runoff volumes over a large area. In Virginia, riverine flooding often begins with widespread flash flooding of small streams. This may result from a series of small storms or the impact of larger systems including tropical storms, hurricanes, and northeasters. Snowmelt may also contribute to excessive runoff.

Flash floods, as the name suggests, strike quickly. Resulting from intense rainfall rates that quickly exceed surface absorption capacity, flash floods are often associated with slow-moving thunderstorms, hurricanes, and tropical storms. Streams, creeks, and drainage-ways quickly become raging torrents. More frequently occurring along

mountain streams, flash floods also affect highly urbanized areas where impervious surfaces offer no opportunity for infiltration. Rapidly moving walls of water and associated debris can uproot trees, roll boulders, destroy buildings, and obliterate bridges and roads. Flash floods also may result from the sudden release of water blocked by a shifting ice jam or the spontaneous failure of a dam or levee. The region's topography, with its mix of steep mountain slopes and broad river valleys, makes it particularly susceptible to these types of flooding events.

Coastal Flooding

Coastal flooding in the area refers to the inundation of normally dry, low-lying coastal areas with seawater. This type of flooding is often caused by a combination of factors, including storm surges from hurricanes or nor'easters, high tides, and rising sea levels. In the Mid-Atlantic region, which includes Virginia, coastal flooding is a significant concern due to the region's extensive coastline, dense population, and numerous estuaries and bays.

The impacts of coastal flooding in this region can be severe, leading to property damage, erosion, loss of habitat, and disruptions to transportation and infrastructure. The risk is exacerbated by climate change, which is causing sea levels to rise and storms to become more intense. The combination of these factors makes coastal flooding a persistent and growing threat.

Coastal flooding is most often associated with storm events that bring large amounts of rainfall to the area, swelling rivers and tributaries beyond their banks which in turn flood downstream areas. Topographical features, soils, and development patterns also play a part in flooding; and the interaction between these geophysical elements can affect how water moves through the landscape.

Flooding due to stormwater runoff is being evaluated for potential measures through Part 2 of this Plan, the Stormwater Management Plan, whereas flooding due to tidal influences is being evaluated for potential measures through the Town-wide Resilience Plan, being developed by The Berkely Group.

Known Flooding Issues

As previously mentioned, the Town of Colonial Beach has floodplain areas, where development is more at risk due to the proximity to coastlines and wetlands. Additionally, Colonial Beach contains topographical features that may contribute to standing water in certain areas during intense or prolonged storm events. Combining information received during community interviews, discussions with staff and elected officials, and the public survey has produced a list of the most common areas of known flooding in the Town:

Virginia State Road 205 near Wilkerson's Seafood: The road has a low spot that has ongoing flooding.

9th Street: The numbered streets between 7th Street and 12th Street have ongoing flooding problems.

North Beach Area (Virginia Avenue): The portion between Lincoln Avenue and Maryland Avenue and Washington Avenue and the beach has flooding that affects the homes along the road.

Dennison Street: Near Monroe Bay, the road has a low point that floods from storm and tidal events.

Santa Maria Avenue: The drainage network in this area has undersized pipes and ditches leading to flooding.

Irving Avenue: The road experiences beach erosion and flooding issues, especially during high tides.

Potomac River Beach Outfalls: Severe beach erosion is occurring at each of the outfalls located at the municipal pier, Wilder Avenue at the Riverboat, Colonial Avenue near the pump house, and Madison Street.

Undeveloped Area: The area to the west of the numbered streets is currently undeveloped but future development will add to stormwater management issues in this area and the numbered streets.

In addition to the above, the known areas of flooding (shown as points) from the public survey were placed by individuals to identify the location and source of known flooding. These points have been overlaid on layers depicting the average volume of daily traffic (according to VDOT) and outlines of the regulatory floodplain.

Figure 1-13: Flooding Locations Identified from Survey

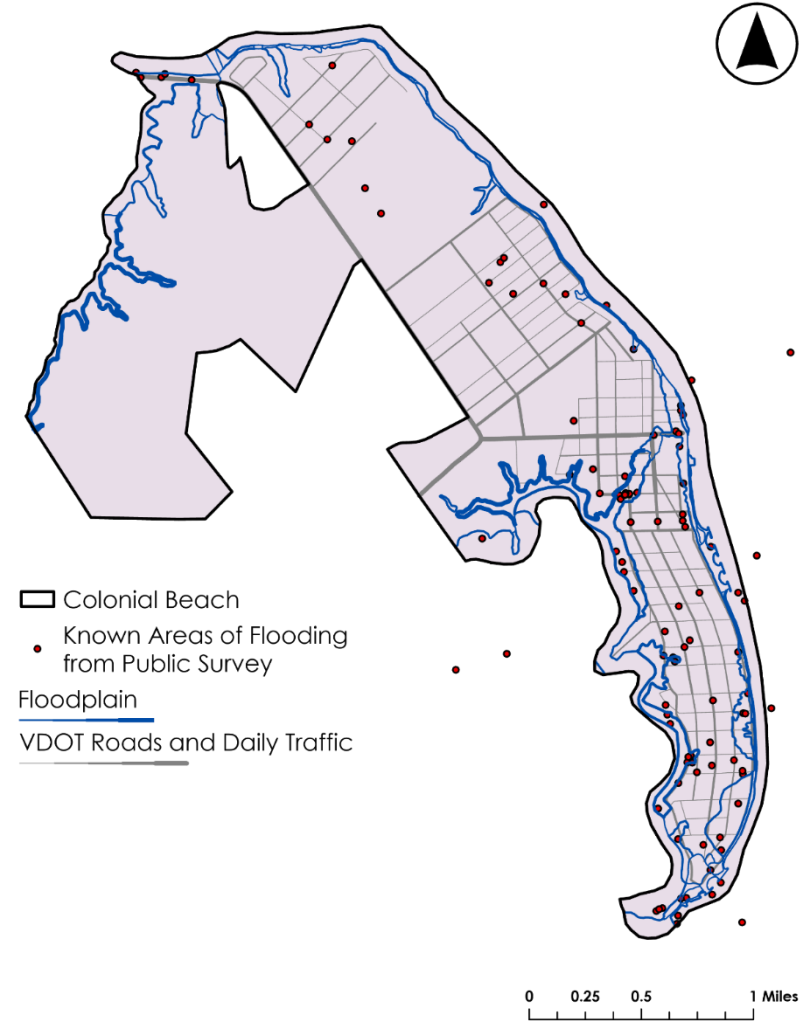
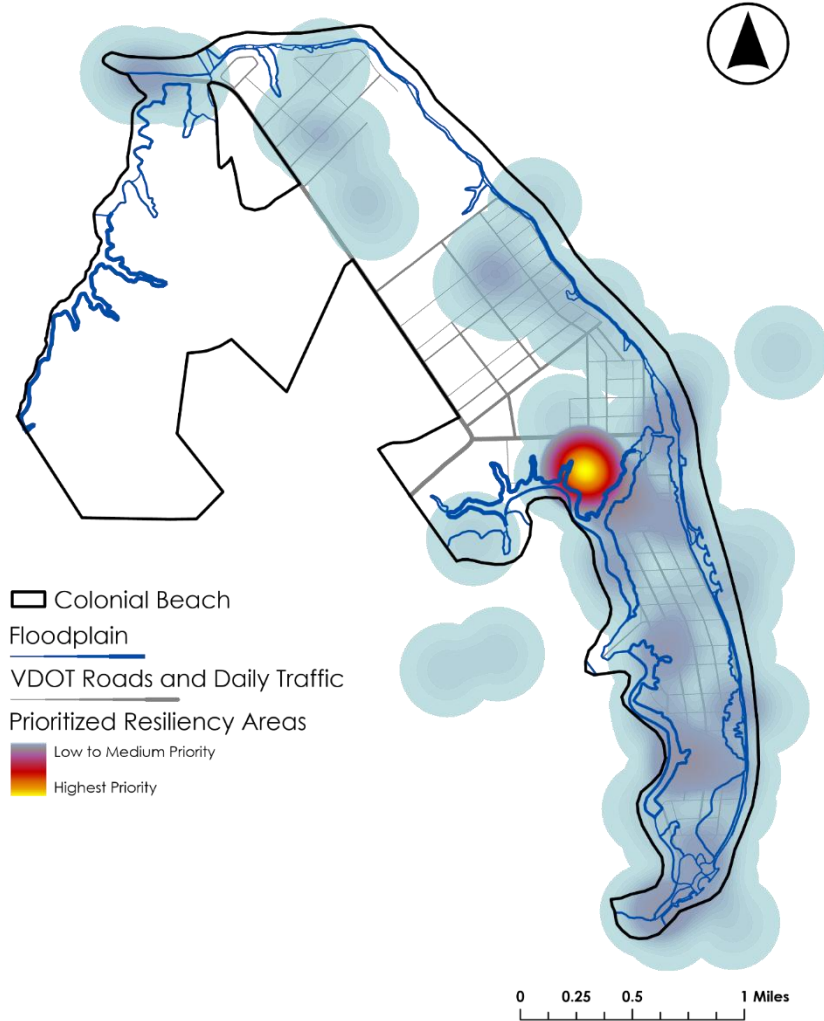


Figure 1-14: Heat Map of Flooding Locations Identified in Survey



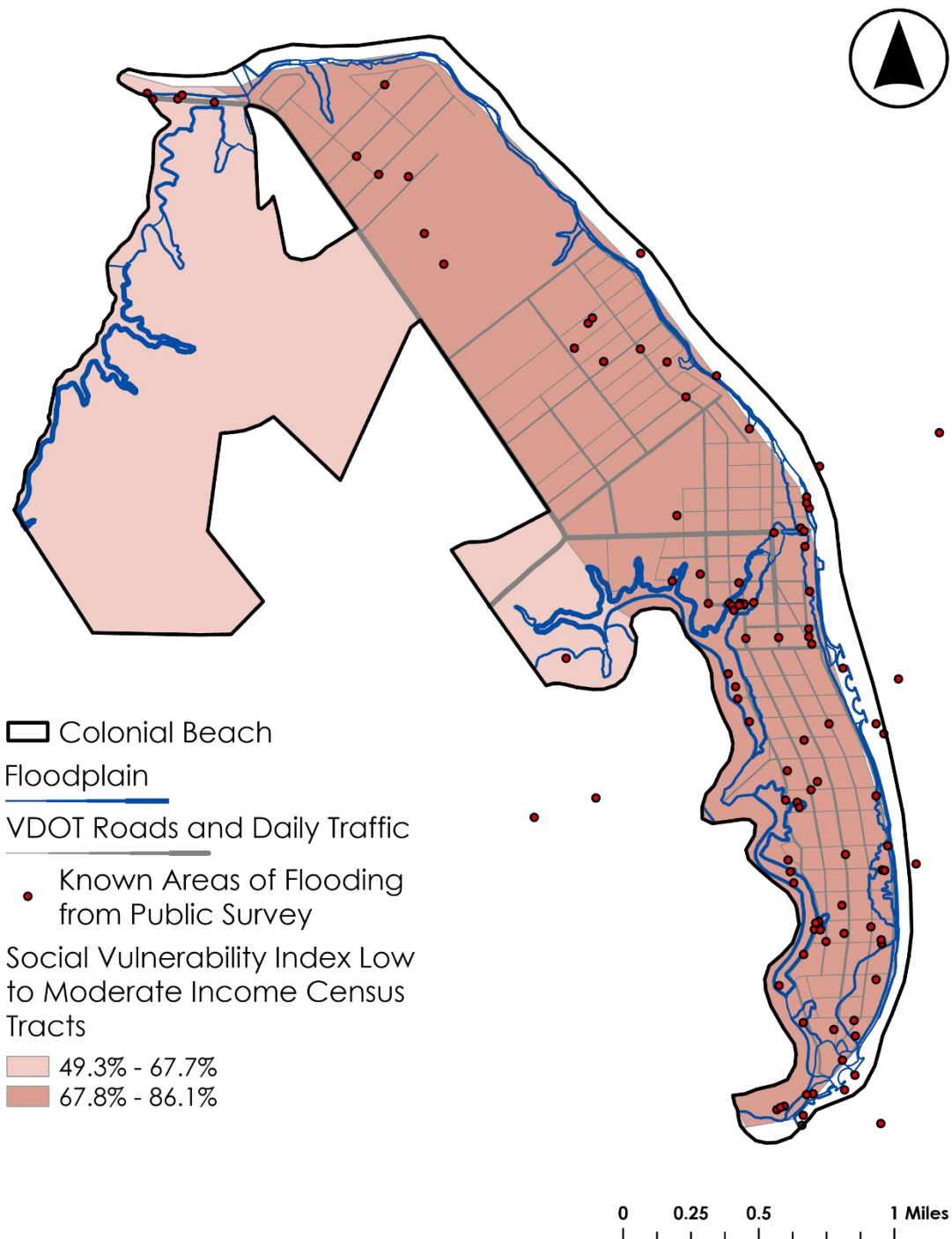
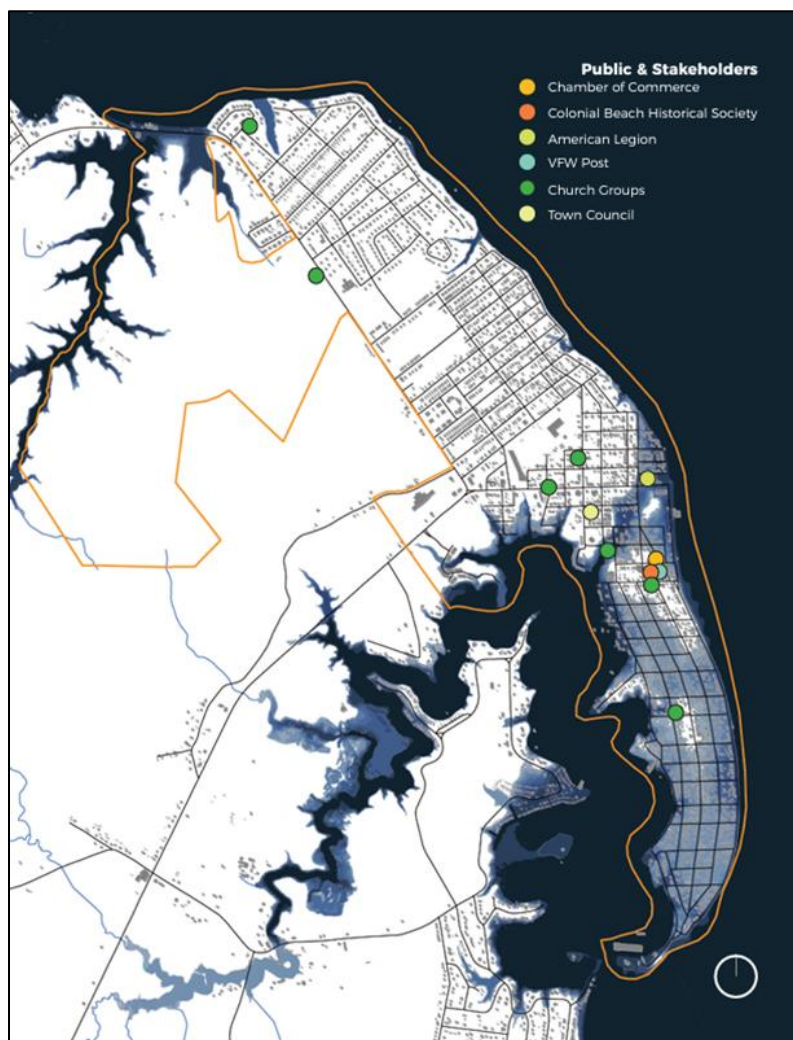


Figure 1-15: Map showing areas of flooding and percentage of low to moderate income census tracts.

Critical Facilities Threatened by Flooding

Different conclusions as to what constitutes “critical facilities” can be reached, which affects this analysis, but it is important to consider what infrastructure, government function buildings, major bridges and roadways, and social assets could be impacted by flooding and lead to compounding negative effects – for instance, a flooded road preventing fire and rescue from reaching imperiled portions of the County, or flooded and backed up sewage causing public health and humanitarian issues. The University of Virginia's Framework for Coastal Flooding Report¹² completed an analysis of assets throughout the town and their relative vulnerability to flood events. See Figure 1-16 below for mapped assets.

Figure 1-16: Mapped Assets and Vulnerability to Flooding with 10' of Sea Level Rise¹³



¹² A Framework for Coastal Flood Planning, Colonial Beach, VA, UVA School of Architecture, https://raft.ien.virginia.edu/system/files/Framework%20for%20Coastal%20Flooding_Colonial%20Beach%20VA.pdf

¹³ Source: UVA School of Architecture

STORMWATER MANAGEMENT

Stormwater management is critically important in the Town of Colonial Beach given its low-lying geography and proximity to water. The town is particularly susceptible to flooding from heavy rains, storm surges, and rising sea levels. Effective stormwater management is essential to reduce flooding risks, protect property, maintain water quality, and safeguard natural habitats. As identified in previous reports and studies, as the town continues to experience growth and development, implementing robust stormwater management practices will help mitigate the adverse impacts of urban runoff, prevent erosion, and enhance the resilience of this scenic coastal community to climate change and extreme weather events.

Stormwater management was identified as a priority and therefore an initial assessment was completed, in advance of a more detailed stormwater management plan. This assessment included Interviews with Town staff, Town Council, Planning Commission, and the public to identify areas of flooding. These areas were then prioritized to determine which should be a part of the Stormwater Management Plan, which is Part II to this report. Three priority areas were identified and will be discussed in more detail in Part II.

The prioritized areas to be further studied in Part II of this report are: (1) North Beach Area (Virginia Avenue), (2) Potomac River Beach Outfalls, and (3) Monroe Bay at Dennison Street.

As stated in Tetra Tech's memorandum dated March 17, 2024 which can be found in the Appendix, there are potential options to address flooding in the three priority areas. There are also several town wide strategies that could be implemented to help improve current stormwater management and reduce stormwater impacts from future development.

These measures include:

- Increasing maintenance to clean out ditches and inlets, repair broken pipes, and sweep the streets to maintain the capacity of the existing system.
- Adopting ordinances to guide future development to ensure that additional infrastructure is added to address the stormwater runoff from new development.
- Implementing an outreach and education campaign about what community members can do to help manage stormwater, such as reducing the impervious area on their properties, adding rain gardens, and using rain barrels.

Stormwater Infrastructure Funding

Currently, funding for dedicated stormwater initiatives in Colonial Beach comes only from the general fund allotted to the public utilities department, with additional grant funding added. The Town does have a dedicated utilities fund, a flat annual fee of \$366

for all residences, but this is used for upgrades to sewer and water delivery services. One common way to address funding for stormwater infrastructure is a stormwater fee applied to residents and businesses.

Stormwater Fees

A stormwater fee is a charge assessed on property owners to fund stormwater management programs. Unlike taxes, these fees are typically based on the amount of impervious surface on a property, which directly correlates to the amount of stormwater runoff generated. The fee structure encourages property owners to reduce impervious surfaces and implement stormwater management practices on their property.

There are several ways a stormwater fee can be structured:

Flat Fee: All properties pay the same fixed amount, regardless of size or land use.

Tiered Residential Rates: Single-family residential properties are grouped into tiers based on impervious surface area (e.g., small, medium, large), with a flat fee for each tier.

Proportional: directly proportional to the impervious surface area, or impervious surface area divided by a common unit (such as the average impervious area of a single-family residence, called an Equivalent Residential Unit).

Discounts for LID: low-impact development or green infrastructure that reduces stormwater can bring fees or tax rates down.

Combination: Any combination of these, including flat fees with variable rates.

Examples of Stormwater Fees in Virginia:

City of Richmond: Richmond implemented a stormwater utility fee in 2009. As of 2023, the fee is \$2.92 per month per 1,000 square feet of impervious area. Single-family residential properties are charged a flat rate based on five tiers of impervious surface area, with discounts for installed stormwater control measures.

City of Norfolk: Norfolk's stormwater fee is currently \$14.07 per month for a typical single-family residence (2,000 square feet of impervious area). Commercial properties pay based on their actual impervious area.

City of Charlottesville: As of 2023, Charlottesville's fee is \$1.20 per 500 square feet of impervious area per month.

City of Virginia Beach: Virginia Beach adopted a stormwater fee in 1992 used mostly for operations and maintenance of pump stations, ditches, lakes, dams, and pipes.

For Colonial Beach, a flat fee plus additional per-unit amounts for impervious cover over a certain amount could signal both that everyone in the Town has a responsibility for stormwater while bigger contributors to the issue pay more.

Other Potential Funding Sources

General Fund: this is the current method used by the Town and is dependent on tax revenues to fund stormwater projects, which can create a negative feedback loop if stormwater issues cause less tax revenue.

Special Assessment Districts: similar to a fee, create special districts where property owners within flood-prone areas pay an additional tax or assessment to fund specific stormwater projects benefiting that area. This would likely cover nearly all of Colonial Beach.

Bond Issuance: although debt should usually only be considered for emergencies or large necessary expenditures, it can spread the cost over many years.

State and Federal Grants: various grant programs are available for stormwater and flood mitigation projects; examples include:

- Virginia Community Flood Preparedness Fund (CFPF);
- FEMA's Building Resilient Infrastructure and Communities (BRIC) program; and
- EPA's Clean Water State Revolving Fund (CWSRF)

Development Impact Fees: Charge one-time fees to new developments to offset their impact on the stormwater system.

In-Lieu Fees: Allow developers to pay a fee instead of implementing on-site stormwater management practices, with the funds used for larger, regional stormwater projects that can serve the same purpose for an area.

CLIMATE CHANGE AND FUTURE FLOODING CONDITIONS

While future climate trends are variable in some areas of the United States, annual precipitation is expected to increase, presumably due to increased energy in the atmosphere. Simultaneously, other areas are expected to see less rainfall and prolonged droughts. Historical trends are variable and difficult to ascertain and extrapolate.

However, one shift in environmental conditions that can reasonably be determined is sea level rise. Sea level rise refers to the increase in average sea level over time,

primarily caused by the expansion of ocean waters due to the warming of the Earth's atmosphere and the melting of land-based ice.¹⁴ This analysis, in keeping with Commonwealth's Coastal Resilience Master Plan¹⁵, relies on the publicly available science and datasets for sea level rise projections.

Localized sea level rise rates in Colonial Beach have been recorded at 4.89 mm/year, which is the 11th highest rate of sea level rise in the entire U.S., and exceeds rates recorded both at other Virginia gauges at Sewell's Point and Gloucester¹⁶.

In the future, The US Army Corps of Engineers has estimated that water levels at the Colonial Beach Potomac River Gauge will rise up to 6 feet by 2100 in its highest rate scenario.¹⁷ The map on the next page illustrates the impacts to the town with a more moderate, Intermediate-High SLR scenario of 4.8 feet of sea level rise in 2100.¹⁸ The Town can expect dramatic impacts to infrastructure both private and public.

¹⁴ [Climate Change \(Third Edition\), 2021](#)

¹⁵ Virginia Coastal Resilience Master Plan, VADCR. 2021

¹⁶ NOAA, Tides and Currents, Colonial Beach, VA Station 8635150

¹⁷ US Army Corp of Engineers

¹⁸ NOAA, Intermediate High Sea Level Scenario, 2017

Figure 1-17: Water Depth for Intermediate-High Sea Level Rise Scenario, NOAA

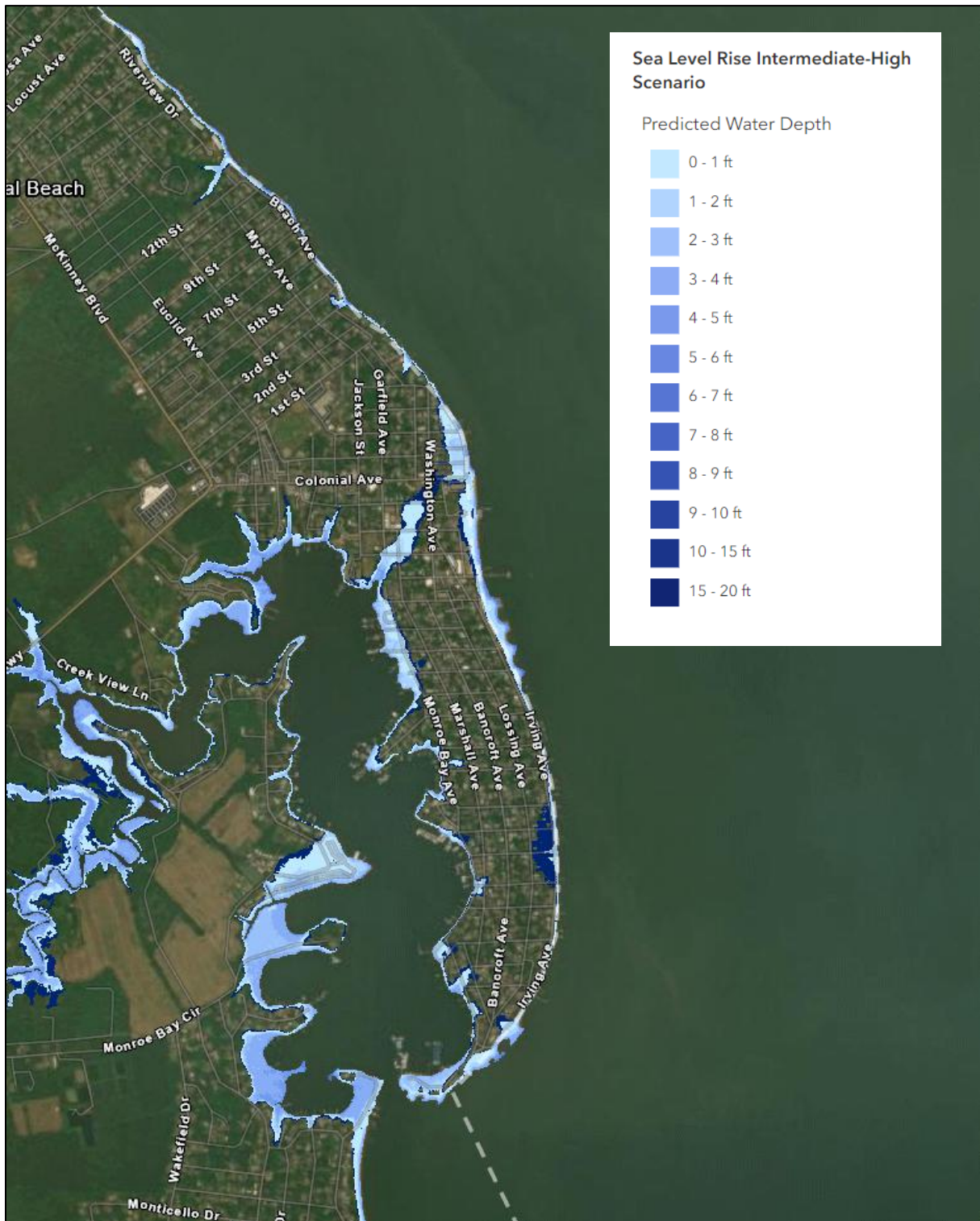


Figure 1-18: Structures at Risk of Sea Level Rise

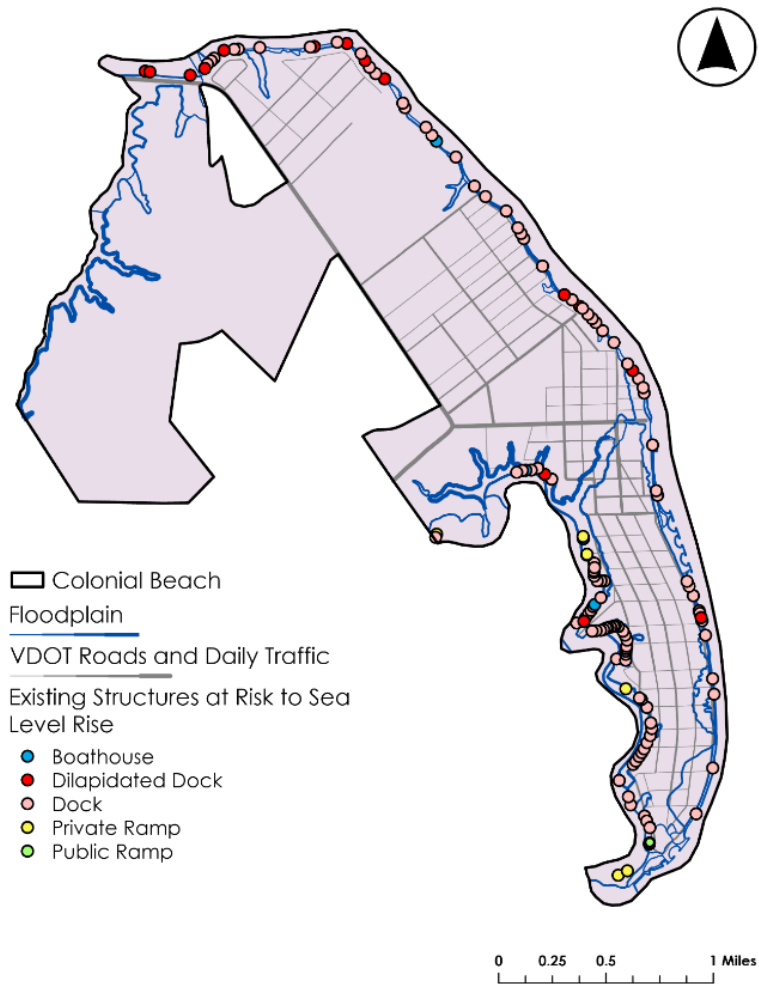
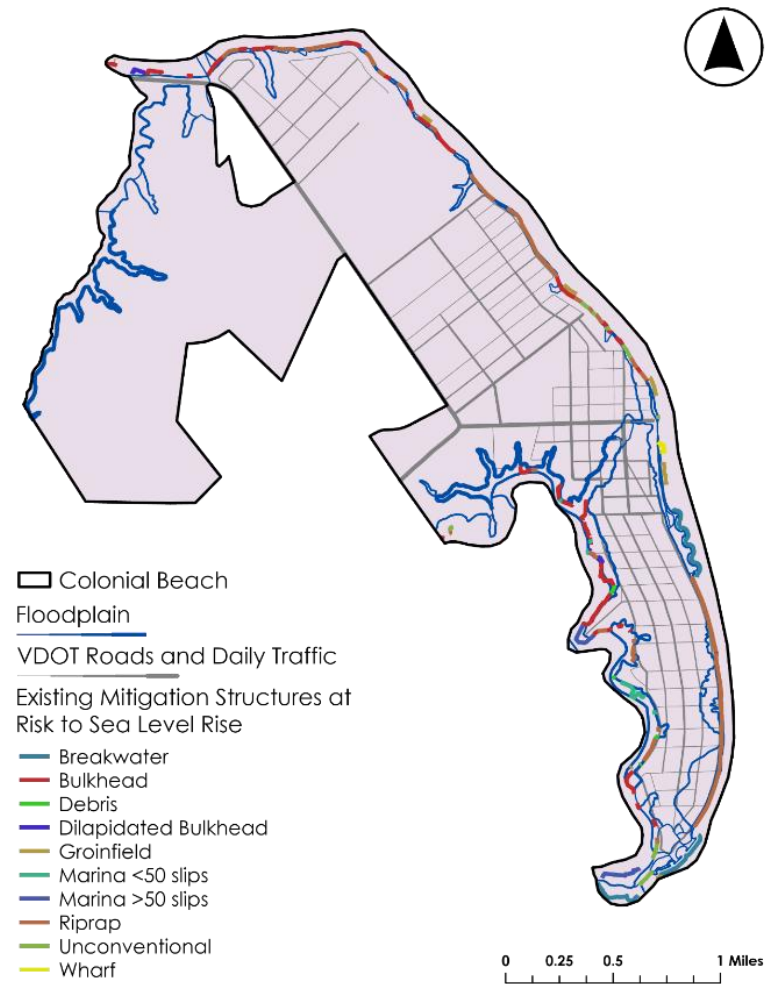


Figure 1-19: Existing Sea Level Rise Mitigation Structures



DEVELOPMENT TRENDS

Development in a coastal community can significantly exacerbate flooding by altering natural landscapes and increasing vulnerability to water-related hazards. One of the primary impacts is the reduction of natural buffers, such as wetlands, beaches, and dunes, which serve as critical barriers against floodwaters and storm surges. When these areas are cleared or filled for development, the ability of the environment to absorb and slow down water is greatly diminished, resulting in faster and more voluminous flooding. Furthermore, development typically involves the creation of impermeable surfaces like roads, parking lots, and buildings, which prevent water from soaking into the ground and lead to increased surface runoff during rainfall. This often overwhelms drainage systems, contributing to more severe flooding.

Additionally, construction in coastal areas frequently alters natural drainage patterns. Stormwater management systems, like culverts and ditches, may be poorly designed or inadequate for handling extreme weather events, leading to new flood-prone areas. In some regions, excessive groundwater extraction for development can cause land subsidence, further increasing vulnerability to flooding. The removal of vegetation for development also reduces the land's ability to absorb rainfall, leading to greater runoff and soil erosion. This erosion can cause sediment to build up in waterways, reducing their capacity to handle floodwater.

Moreover, the pressure on existing infrastructure grows with development, often overwhelming the capacity of drainage and stormwater management systems, especially during extreme weather. Raised structures and land elevation changes designed to protect individual properties can inadvertently direct water to lower-lying areas, exacerbating flooding for neighboring properties. Coastal development also places more buildings and infrastructure in areas vulnerable to storm surges, making it easier for surges to flood developed areas.

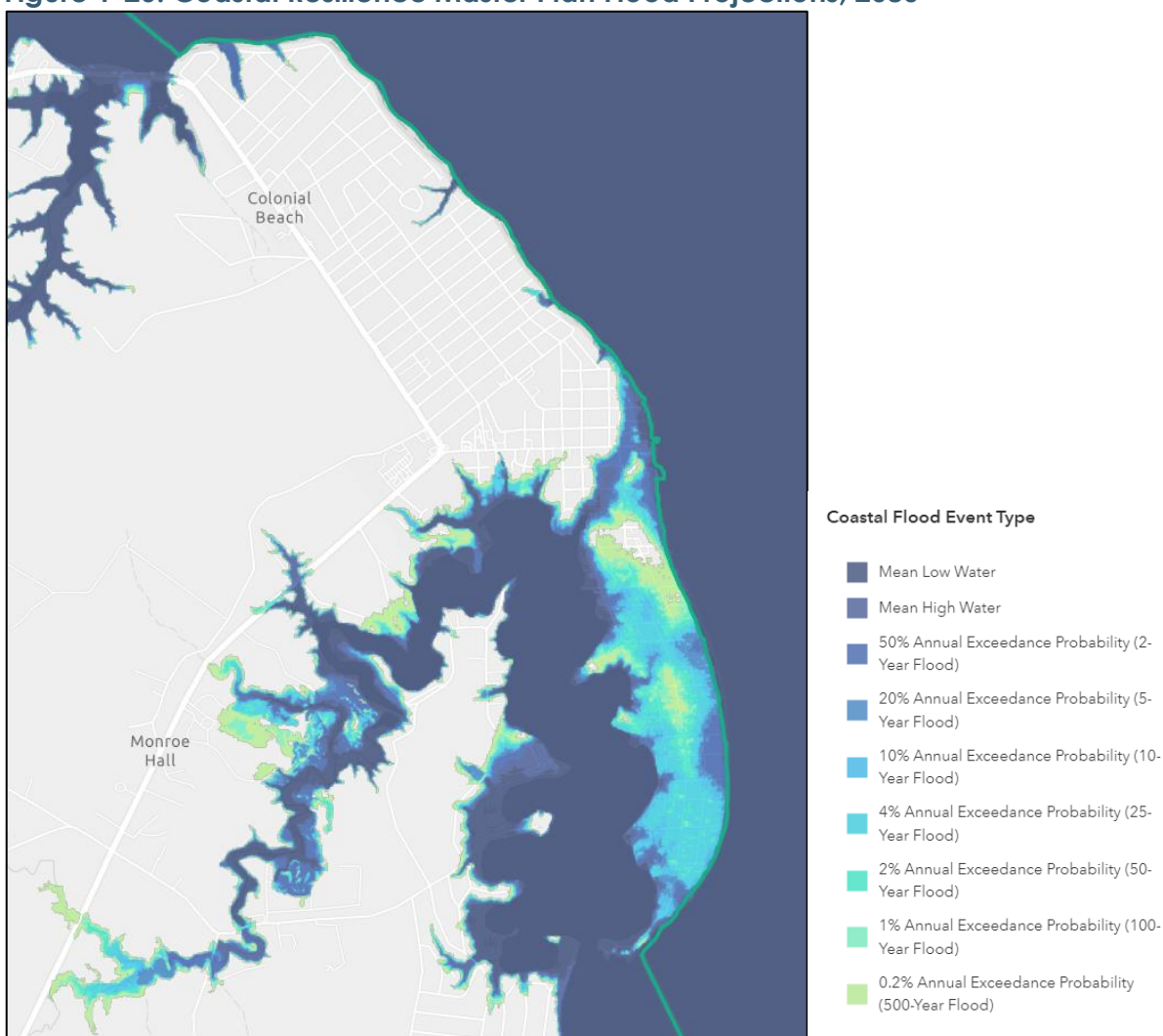
While there are fewer large areas of the Town of Colonial Beach that are undeveloped and most of the current development is in-fill development, there are opportunities to consider flood resilience in policies and regulations that will influence development patterns for redevelopment, retrofitting, and new development in yet undeveloped areas. Strategies to address future growth and development will be necessary in order to mitigate future flooding.

Colonial Beach has adopted certain typical standards for buildings lying in the floodplain, considered their Floodplain Overlay District, designated according to FEMA's typical lettering scheme: the A Zone (including AE, AH, AO, and the Coastal A Zone) where there is a 1% annual chance of flood, and the V and VE zones for Coastal High Hazard, which extends from the shore to the boundary of the primary dunes and describes areas expected to experience higher wave energy. The standards for these areas include freeboard requirements (per FEMA, "extra height above the Base Flood Elevation (BFE) that a structure is elevated to reduce the risk of flooding"), although these are lower than many other coastal areas require. For instance, Colonial Beach

requires 3 feet of freeboard for V, VE, and Coastal A zones, and only 1 foot of freeboard above grade or above base flood elevation for other flooding districts.

Not all of the Town of Colonial Beach is in a low-lying floodplain area, but these regulations do not apply consistently across the Town, do not account for other forms of flooding, and do not account for projected sea level rise. Significant portions of the Town which are currently outside of designated flood zones may be flooded entirely or much more consistently, if projections hold, by the year 2080. Figure 1-20 below shows the Coastal Resilience Master Plan projections for Colonial Beach by 2080, illustrating new mean low water that will essentially divide the Town in two.

Figure 1-20: Coastal Resilience Master Plan Flood Projections, 2080



All land in Colonial Beach is also subject to the provisions of the Chesapeake Bay Preservation Act, and thus wetlands, waterways, and 100 feet inland of each are designated as Resource Protection Areas (RPAs), with special rules governing construction and land disturbance according to State Code. All other areas of the Town that are not in the RPA have been designated Resource Management Areas

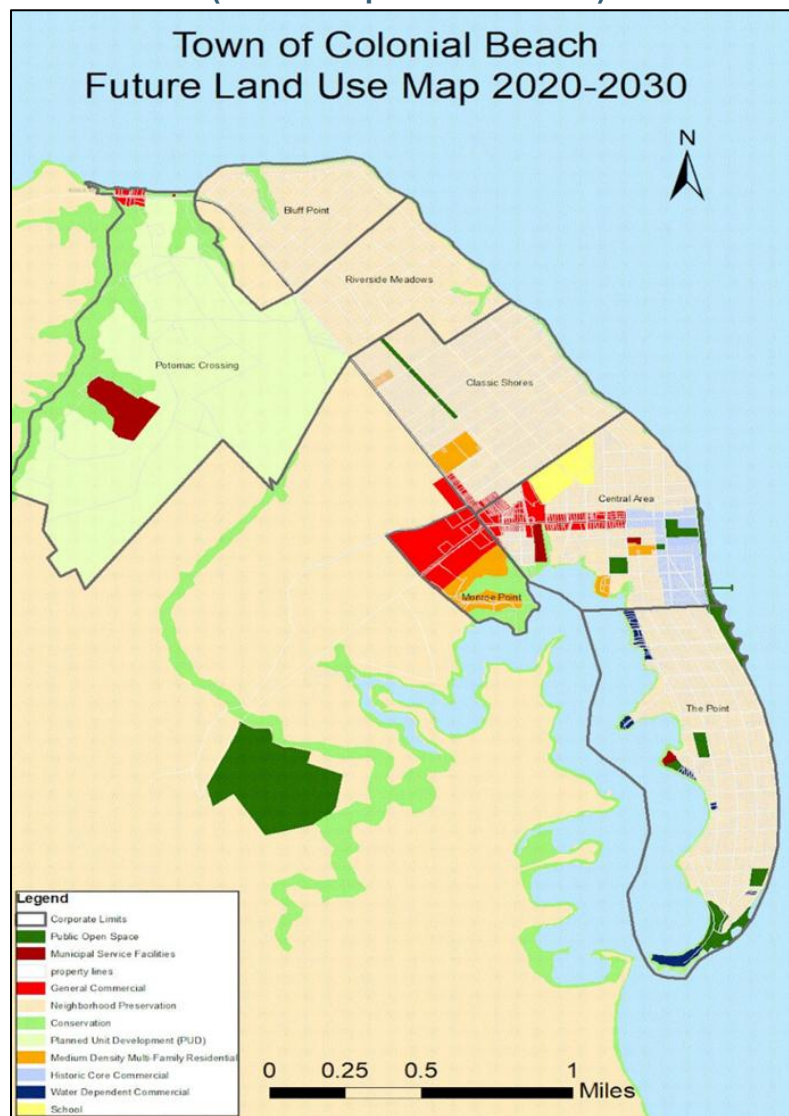
(RMAs), although there are no strict state or local regulations for RMAs except to provide for tree preservation and sufficient water quality benefits.

The most common types of development in Colonial Beach are commercial and single-family residential dwellings on individual lots. A common issue cited amongst those concerned about future flood-proofing is that, unless a home exceeds 36% impervious lot coverage, or development is over 2,500 square feet, there are little to no requirements to install stormwater mitigation measures. As written, even when triggered by disturbed area or lot coverage percent, it is unclear exactly how much stormwater mitigation is necessary. While it is generally the practice of the current Town staff that once those thresholds are met, no net stormwater or nutrient pollution may be generated, it is largely up to interpretation.

Commercial and mixed-use properties are also subject to the same stormwater management regulations. Being that they almost always hit the threshold, they are required to provide for on-site mitigation or to utilize the Town's stormwater system. Several commercial and real estate stakeholders expressed that they are willing to mitigate stormwater, but that requirements should be made clearer. These same parties would also appreciate consistent maintenance and expansion of the Town-operated system, and likely regulations designating easements for that purpose.

In all cases, increased development has the potential to worsen flood issues, and multi-pronged, precise, consistent resilience regulations ought to be considered both for future and current floodplain flooding risk and for expected increases in stormwater. The Colonial Beach future land-use map emphasizes residential preservation, along

**Figure 1-21: Future Land Use Map
(2030 Comprehensive Plan)**



with a core of commercial properties, a small number of medium-density residential developments, and one large subdivision on a large property abutting the Town's wastewater treatment plant. **Clarity in flood and stormwater regulations and minimum development standards that protect existing property in a manner that does not strain Town resources will be necessary for future growth. The RAFT effort conducted further analysis of the Town's regulations surrounding stormwater and has been referenced in the Relevant Environmental Database located in the appendix.**

Also, it is imperative when looking at existing regulations is the community's ability to implement such regulations. The following Capability Assessment is a part of the Northern Neck's Regional Hazard Mitigation Plan update in 2023.

Table 1-5: Town of Colonial Beach Capability Assessment, NNPDC HMP Update 2023¹⁹

Capability	Colonial Beach
Comprehensive Plan	Yes
Land Use Plan	Yes
Subdivision Ordinance	Yes
Zoning Ordinance	Yes
NFIP/FPM Ordinance	Yes
- Effective FIRM Date	05/17/2022
- Substantial Damage Language	Yes
- Certified Floodplain Manager	No
- # of Flood Prone Parcels	89
- # of NFIP Policies	134
- Additional Freeboard Requirements	36 inches
- Repetitive Loss Properties	16
CRS Rating	N/A
Stormwater Program	Yes
Building Code Version	VA USBC 2018
Full-time Building Official	Yes
- Conduct "As-built" Inspections	Yes
Local Emergency Operations Plan	Yes
Hazard Mitigation Plan	Yes
Warning Systems in Place	Poor

¹⁹ Source: Data provided from the Northern Neck Regional Hazard Mitigation Plan updated in 2023

- Storm Ready Certified	No
- Weather Radio Reception	Fair
- Outdoor Warning Sirens	No
- Emergency Notification (SMS Text)	Yes – Caroline Alert System
- Other? (e.g., cable over-ride)	No
GIS system	Yes
- Hazard Data	Yes
- Building footprints	Yes
- Tied to Assessor data	Yes
- Land Use designations	Yes
Structural Protection Projects	N/A
Property Owner Protection Projects	N/A
Critical Facilities Protected	Yes
Natural Resource Inventory	Yes
Cultural Resources Inventory	Yes
Erosion Control Procedures	Yes
Sediment Control Procedures	Yes
Public Information Program/Outlet	Yes
Environmental Education Program	Yes

POTENTIAL FLOOD RESILIENCE SOLUTIONS

While Part 2 will address specific stormwater management infrastructure improvements, solutions for flooding issues in the Town of Colonial Beach in general are addressed here. Solutions are categorized as Financial/Administrative, Organizational, Regulations and Ordinances, and Infrastructure.

These strategies were compiled and then assessed and prioritized through an action score. The prioritization matrix (detail of scoring) can be found in Appendix D, while the top actions that scored 13 or above are incorporated into action plan sheets, found at the end of this Part of the Plan.

POTENTIAL FLOOD RESILIENCE ADMINISTRATIVE, ORGANIZATIONAL, AND REGULATORY ACTIONS

The analysis of rising sea levels trends and increased flooding risk threatens both public and private infrastructure within Colonial Beach. Development exacerbates these issues by reducing natural buffers like wetlands and increasing impermeable surfaces, leading

to heightened runoff and overwhelmed drainage systems. Following the analysis, assessment, and evaluation of the impacts of flooding, development, and overall stormwater management on the Town, it is recommended to implement the following administrative, organizational, and regulatory solutions to mitigate future flooding concerns, improve flood resilience, protect infrastructure, and safeguard residents from the impacts of flooding. These measures will create a more robust and coordinated approach to managing flood risks and ensure the town's long-term sustainability and safety.

Financial/Administrative: Financial and administrative policies significantly influence a locality's overall flood resilience by shaping how resources are allocated, decisions are made, and flood mitigation strategies are implemented. Financial policies determine budget priorities, ensuring funds are available for critical infrastructure projects such as stormwater management, and emergency preparedness initiatives. Adequate financial planning also helps localities to access state and federal grants, such as FEMA funding, for large-scale resilience efforts. Furthermore, local policies that create dedicated revenue streams, like stormwater utility fees or special tax districts, enable consistent investment in flood mitigation projects without relying solely on external sources.

Administrative policies also play a vital role by embedding long-term flood resilience into the day-to-day operations of a government entity. From decisions on Town-owned property, to regular and clear communication with the public and elected officials, sound administrative policy ensures that the town is being managed appropriately. Ultimately, well-designed financial and administrative policies strengthen a local government's capacity to mitigate flood risks and safeguard its community from future disasters.

Organizational: Organizational policies are fundamental to enhancing flood resilience, as they establish the internal frameworks, processes, and standards that guide decision-making and operational efficiency in flood management. These policies ensure that government departments work cohesively toward common flood resilience goals, streamline communication, and define clear responsibilities during flood preparedness, response, and recovery phases.

Regulations and Ordinances: Regulations and ordinances play a crucial role in local flood resilience by establishing enforceable rules that govern land use, building practices, and floodplain management. These legal frameworks ensure that development and construction within a community are done in ways that minimize flood risks and protect both public safety and property.

One of the most impactful tools is floodplain management regulations, which control development in areas prone to flooding. These regulations often require that new construction in designated flood zones adhere to specific guidelines, such as elevating structures above the base flood elevation or restricting certain types of development altogether. By enforcing these standards, local governments can reduce the number of vulnerable properties in flood-prone areas and limit potential damage from future flood events.

Zoning ordinances also play a vital role in flood resilience by guiding land use decisions. These ordinances can designate certain areas as unsuitable for development due to their flood risk or require developers to include flood mitigation features in new projects. For example, zoning laws might mandate that new developments incorporate green infrastructure, such as permeable pavements or retention ponds, to manage stormwater and reduce flooding.

Building codes are another critical aspect of flood resilience regulations. Local building codes can be updated to require flood-resistant materials, stronger foundations, or designs that prevent water intrusion in homes and commercial buildings. These ordinances are especially important for communities looking to adapt to increasing flood risks due to climate change or more intense storm events.

Finally, local stormwater management ordinances can help control how water flows through developed areas. By regulating how stormwater is collected, stored, and discharged, these ordinances prevent local flooding caused by heavy rain or inadequate drainage systems. They often require that new developments manage stormwater on-site to prevent overwhelming public drainage systems, thus reducing the risk of flash floods.

Infrastructure: Potential infrastructure improvements are further discussed in Part II of Propelling Resilience. Upgrading existing stormwater management systems may include enhancing culverts, ditches, and retention basins to prevent overwhelm during extreme weather. The use of permeable materials could be promoted to increase water infiltration, reducing surface runoff, and easing pressure on existing drainage systems. Restoring and preserving natural buffers like wetlands and dunes can help absorb floodwater and protect against storm surges, while creating green spaces further aids in water absorption. Clear stormwater management regulations must be established for new developments to ensure that increases in impervious surfaces are offset by effective runoff management. Additionally, long-term community resilience planning should incorporate climate projections to guide infrastructure investments, and routine assessments of existing systems should be implemented to identify vulnerabilities and prioritize necessary upgrades.

The strategies listed below were identified and assessed through a prioritization matrix and assigned an action score. The scoring detail is outlined in the Action Plans at the end of Part 1. The comprehensive scoring matrix can be found in the appendices. The top four scoring strategies were further developed in the action plans below.

FINANCIAL/ADMINISTRATIVE

1. **Coordination with VDOT on maintaining and improving stormwater infrastructure on State roads.** Manage and enhance stormwater infrastructure along state roads to prevent flooding, reduce erosion, and maintain water quality while ensuring that transportation systems remain operational and safe.
2. **Targeted community outreach for predominately minority, low-income, or other vulnerable communities or communities that are not always included in the planning process.** To ensure equitable participation and representation in the planning process by engaging predominantly minority, low-income, and other vulnerable communities, ensuring their voices are heard and their needs are addressed.
3. **Coordinate with VDOT to install high water warning systems and signage along roadways informing that driving through standing water poses significant danger.** This action aims to enhance public safety by providing timely warnings and reducing the risk of accidents during flooding events. This data could also work to prioritize and improve the ability to implement actions taken to elevate roadways or other solutions to rising water on trafficked roadways which are prone to flooding.
4. **Conduct a vulnerability assessment of the Town's wastewater treatment plant and determine adaptation options to either retrofit the building or design and implement site strategies to mitigate flooding.** To enhance the facility's resilience, protect infrastructure, and ensure effective and sustainable wastewater management in the face of future challenges, conducting a vulnerability assessment of the Town's wastewater treatment plant involves evaluating risks related to flooding and other climate impacts, and exploring adaptation options such as building retrofits and site-specific strategies.
**In looking at the Wastewater System I&I report²⁰, Sewer and WWTP I&I can cause a reduced carrying capacity and WWTP permit limits. Action items should include camera and I&I testing to determine "hot spots" and remove I&I by replacing aging sewer infrastructure. These sewer actions will aid in removal of illicit discharges into recreational and drinking waters.* A complete stormwater inventory should be completed in order to accomplish this. (See #14)*
5. **Identify drainage improvement opportunities along the following roadways: Ridge Rd./McKinney Blvd (SR 205) along Wilkerson Creek, Locust and Mimosa Avenues, and problems with a culvert on 4th Street. Residents also reported**

²⁰ Town of Colonial Beach Infiltration and Inflow Report, Dewberry 2022

major flooding incidents near 1st Street and the challenges posed by sea level rise affecting Garfield and Wilder Avenues. By evaluating existing conditions, exploring targeted improvements, and planning for adaptation to sea level rise, the aim is to enhance drainage systems, reduce flood risks, and improve overall infrastructure resilience.

- 6. Join the Community Rating System program to reduce flood insurance premiums.** The Town should consider the CRS program; however, there can be increased administrative costs and demands associated with participation in the program, and the Town should therefore consider this as a mid-term action.
- 7. Install and maintain flood monitoring systems to provide real-time data on water levels and flood risks.** To install and maintain flood monitoring systems that provide real-time data on water levels and flood risks, thereby enhancing emergency response, supporting informed decision-making, and improving future project planning and evaluation.

ORGANIZATIONAL

- 8. Create a Resilience Advisory Committee, representative of the communities being served, to provide community engagement and input on current and future initiatives and projects.** Creating a Resiliency Advisory Committee involves assembling a diverse group of community representatives to provide input and guidance on resiliency initiatives and projects. This approach enhances community engagement, ensures that projects address local needs, and fosters collaborative decision-making to build a more resilient and inclusive community.
- 9. Identification of ecosystems, wetlands, and floodplains that are suitable for permanent protection or acquisition.** This process aims to ensure that these valuable areas are safeguarded from development and degradation, thereby contributing to long-term environmental and community benefits. Explore various protection methods and partnerships including conservation easements, land trusts, and regulatory protections (e.g., zoning laws, environmental regulations) to safeguard identified areas.
- 10. Partner with other agencies to incentivize shoreline stabilization best management practices.**
 - A. Promote the use of vegetative controls for shoreline stabilization projects where appropriate and continue to evaluate the use of structural controls based on eroding shoreline to ensure that the most appropriate shoreline management strategies will be used.** Promoting vegetative controls for shoreline stabilization involves advocating for the use of natural methods to enhance coastal resilience and reduce erosion. Simultaneously, evaluating and adapting structural controls ensures that the most effective and appropriate shoreline management strategies are employed. This integrated

approach aims to balance environmental benefits with practical needs, supporting sustainable shoreline management practices.

B. Discourage the use of structures that harden the shoreline and encourage alternative shoreline protection measures such as fringe marsh establishment in shoreline areas with less wave energy and light boat traffic. To reduce reliance on structures that harden shorelines, such as seawalls and bulkheads, and promote the use of alternative, green shoreline protection measures like fringe marsh establishment through partnering with other agencies to incentivize shoreline stabilization- best management practices.

11. Assess the vulnerability of roadways and identify priority projects to improve drainage through grey and green infrastructure upgrades. Upgrades will help with continuity of access to critical facilities and to physically isolated residents.

To evaluate the vulnerability of roadways to flooding and other drainage issues and to identify and prioritize projects that enhance drainage through both grey (traditional) and green infrastructure upgrades. These improvements aim to ensure continuous access to critical facilities and better connectivity for physically isolated residents.

12. Increase education on residential and private property green infrastructure projects. To enhance awareness and knowledge about green infrastructure projects on residential and private properties, promoting the adoption of environmentally friendly practices that improve stormwater management, enhance property value, and contribute to community sustainability.

13. Offer training for residents and businesses on flood resilience practices and how to best implement resilience plan actions. To provide comprehensive training for residents and businesses on flood resilience practices, focusing on effective implementation of resilience plan actions to mitigate flood risks, enhance preparedness, and improve community resilience. Engage experts in flood management, emergency response, and resilience planning to develop and deliver training materials. Through a combination of workshops, online courses, and printed materials, participants gain the knowledge and tools needed to implement effective resilience actions, thereby enhancing community preparedness, and reducing flood-related risks.

14. Inventory the Town of Colonial beach stormwater infrastructure to better understand flooding issues, stormwater system capacity, and stream conditions under future climate projections. Utilize the recently awarded CFPF grant to the Town to perform a stormwater asset inventory and assessment (AIA). Develop watershed and sub watershed hydrology and hydraulic (H&H) models along with groundwater modeling and river modeling to determine required carrying capacity for stormwater infrastructure. Using the model, create a priority action plan of flood mitigation actions and review the action plan annually as part of the development of the Town's budget and CIP.

REGULATIONS AND ORDINANCES

- 15. Develop a Debris Management strategy or plan for flood scenarios. This should include both ongoing maintenance of stormwater infrastructure and surrounding areas and flood event related debris cleanup.** In the event of a flood, specific and hazardous debris may be distributed and hinder the operation of public infrastructure, including stormwater assets. Advance planning and understanding of roles and responsibilities by Town staff and/or outside contractors/partners will be necessary for success.
- 16. Develop policies, incentives, and/or stormwater regulations and the use of green infrastructure in residential areas to improve Flood Mitigation.**
 - A. Policies that require or encourage on-site water retention and treatment for residences and businesses** can boost the Town's defense against nuisance flooding as it continues to grow and develop.
 - B. Examine the existing Planned Unit Development incentives for open space preservation** and address community concerns for stormwater management in large scale development proposals.
 - C. Evaluate that submittal materials for development proposals are addressing the solutions** within this plan and other supporting documents for the town.
- 17. Support the adoption and enforcement of flood-resistant building codes for new construction and renovations. This ensures that structures are designed to withstand future flood events.** Work with building code authorities and experts to review and enhance existing flood-resistant building codes. This may involve incorporating updated standards and practices based on recent flood risk assessments and technological advancements. Promote the adoption of model codes and guidelines, such as those provided by the International Building Code (IBC) or Federal Emergency Management Agency (FEMA), which include provisions for flood resistance.
- 18. Develop comprehensive stormwater management minimum development standards.** Work to implement incentives, such as reduced permit fees or tax benefits, for projects that incorporate additional resilience measures, and provide engineering standards for these best practices. By implementing incentives, developers and builders can be encouraged to integrate additional resilience measures into their projects. These measures may include flood-resistant designs, energy-efficient systems, and sustainable materials that mitigate environmental impacts and enhance durability. Through the promotion of best engineering practices for resilience in construction, it can streamline the process for stakeholders, ensuring that projects not only meet regulatory requirements but also contribute to a safer, more sustainable built environment.

- 19. Complete a shoreline management assessment and plan.** This potential assessment and plan will guide future actions to preserve coastal ecosystems and mitigate erosion while balancing recreational and developmental needs. Development of strategies for sustainable shoreline protection and enhancement are critical for the town, as outlined in the North Beach Erosion Project identified in the Virginia Coastal Resilience Master Plan, along with renewed coordination with the U.S. Corps of Engineers.

To prioritize the strategies outlined in this section, a matrix was created that used these evaluation factors and their associated criteria, metrics, and point scores summarized below in Prioritizing Resilience Projects. **See Appendix D.**

INFRASTRUCTURE

As noted, Part 2 will address specific stormwater management infrastructure improvements, general infrastructure solutions for flooding issues in Town of Colonial Beach are addressed here and will fall generally into three (3) categories: Green, Grey, and Hybrid.

- 20. Elevate critical infrastructure such as roads, bridges, and utilities to reduce vulnerability to flooding. This includes retrofitting existing structures to meet updated flood elevation standards.** Ensure that elevation and retrofitting efforts are aligned with local, state, and federal regulations and policies related to floodplain management and infrastructure resilience. Advocate for policies that support the elevation and retrofitting of critical infrastructure as part of broader state flood resilience and disaster preparedness strategies. For utilities, consider raising utility infrastructure above projected flood levels or relocating it to safer areas.

The following projects are highlighted in Part 2 of Propelling Resilience:

- A. Elevation of State Rd. 205 at Wilkerson's Seafood**
- B. North Beach Area (Virginia Avenue) retrofits to reduce flooding**

- 21. Implement Flood Mitigation and Water Quality Green Infrastructure.** Especially along roadways where flooding threatens transportation. Opportunities to connect ecological cores and other environmentally important areas, especially those already owned by the town or that include substantial easements, should be capitalized on. This can include everything from expanded vegetated ditches, created wetlands or other natural water detention, and riparian buffers.
- 22. Study the Hydrology of Monroe Bay and Potomac River to Determine Flood Risk.** Monroe Bay and Monroe Creek that lead to the Potomac River should be studied in order to manage flood risk to public and private property and infrastructure, with special attention paid to repetitive flooding areas. Additionally, preliminary studies and design to further the North Beach Erosion

Project identified in the Virginia Coastal Resilience Master Plan should be initiated, along with renewed coordination with the U.S. Corps of Engineers.

23. Add Flood Mitigation BMPs to Town Parks and Historic Resources. Colonial Beach has important assets in its history and preserves open spaces, and should be protected from flooding, with co-benefit opportunities to turn BMPs into beautification and educational opportunities for the public.

24. Develop a Parks and Open Space Master Plan to identify and plan for Potential Acquisitions. Creating an in-depth understanding of the towns' open space assets, especially in flood prone areas, will allow for opportunities to manage water volume through the development of green infrastructure on potential acquisitions.

A. Identification of ecosystems, wetlands, and floodplains that are suitable for permanent protection or acquisition. This process aims to ensure that these valuable areas are safeguarded from development and degradation, thereby contributing to long-term environmental and community benefits. Explore various protection methods and partnerships including conservation easements, land trusts, and regulatory protections (e.g., zoning laws, environmental regulations) to safeguard identified areas.

B. Consideration of areas like the wooded region northwest of 12th Street and the Meadows (approximately between Dwight and Myers to the Potomac River) presents an opportunity for a river walk project that combines habitat restoration, recreational opportunities, and addressing some stormwater concerns for the town. This strategy was voiced in the public outreach portion; as with any strategy outlined in this plan, this solution should be assessed for the equitable distribution of resources and access to this area.



Propelling Resilience



PART II:
Town of Colonial Beach
Stormwater Management Plan

Acronyms/Abbreviations

Definitions

BMP	best management practice
CIP	Capital Improvement Program
FY	Fiscal Year (July 1 - June 30)
GSI	green stormwater infrastructure
O&M	operations and maintenance
NBS	nature-based solution
Plan	Town of Colonial Beach Stormwater Management Plan
RSC	regenerative stormwater conveyance
Town	Town of Colonial Beach
VDOT	Virginia Department of Transportation



Example of constructed wetland

STORMWATER MANAGEMENT PLAN BACKGROUND AND NEED

The Town of Colonial Beach (Town) is in the northwestern part of Westmoreland County on Virginia's Northern Neck peninsula. It is bound by the Potomac River, Monroe Bay, and Monroe Creek, the confluence of which empties into Chesapeake Bay, 35 nautical miles downstream.

The Town is working to identify and correct deficiencies in its drainage system to prevent localized flooding. Most of the system is older and undersized for the current and future volume of stormwater from new development. Portions of the system were not formally designed and are not functioning properly. In addition, tidal influences from the Potomac River and Monroe Bay backflow into the system, affecting its capacity to convey stormwater.

As part of its 2020–2030 Comprehensive Plan, the Town identified the need to prepare a stormwater management plan “to address stormwater management with greater efficiency and economy.” The plan’s purpose would be to mitigate the impacts of new development and help remediate current erosion, flooding, and/or water quality problems. A stormwater management plan is a strategy designed to manage and control runoff from rainfall events, reduce flooding, prevent water pollution, and protect the environment. It often includes mapping drainage areas, identifying best management practices (BMPs), and ensuring compliance with regulations to minimize stormwater’s negative impacts on infrastructure and ecosystems.

To address this need for a stormwater management plan, the Town, with the assistance of a planning and civil and environmental engineering consultant team comprised of Berkley Group and Tetra Tech, developed the *Town of Colonial Beach, Virginia, Stormwater Management Plan* (Part 2 of Propelling Resilience – Town of Colonial Beach Flood Resilience and Stormwater Management Plan). The primary purposes of the stormwater management plan are to:

- (1) Identify and plan for incorporation of stormwater treatment and/or stabilization at multiple outfalls of existing open and closed stormwater conveyance systems;
- (2) Plan for incorporation of green stormwater infrastructure (GSI) within the developable properties, parks, and municipal properties;
- (3) Plan for the effective management of stormwater in developed areas where it is currently insufficiently managed;
- (4) Identify future costs for effective program implementation and administration; and
- (5) Identify, prioritize, and provide cost projections for projects.

This effort was developed in parallel with the Flood Resilience Plan (referred to as Part I). The two plans will work in coordination to identify projects, programs, and other actions the Town can implement to reduce flooding impacts and improve resilience for the community.

PLAN DEVELOPMENT PROCESS

At the start of the project, interviews were held with Town staff, the Town Council, the Planning Commission, and the public to identify areas subject to flooding. These areas were then evaluated using a set of criteria to determine which were the priority for this Plan. A site visit

was conducted to evaluate the top three priority areas for potential solutions to address the identified concerns. This Plan summarizes the results of the flooding area prioritization, provides concepts and high-level cost estimates for potential projects, and makes recommendations for Town-wide measures and modifications to current policies and ordinances to support better stormwater management.

EXISTING STORMWATER FLOODING CONCERNS IDENTIFIED

Based on the interviews and coordination with Town staff discussed in Part I of this Plan, the following areas were identified as having ongoing flooding concerns:

Virginia State Road 205 near Wilkerson's Seafood – The road has a low spot with ongoing flooding that causes access issues at the bridge. The Virginia Department of Transportation (VDOT) maintains the road, so any modifications to address this issue must be coordinated with them. Figure 2-2 shows this area in the red box in the northern portion along the water.

9th Street – The numbered streets between 7th Street and 12th Street have ongoing flooding problems. Homes in this area were developed a while ago, and the existing stormwater infrastructure is insufficient for the level of development. This area is noted by the pink box in the southeast corner of Figure 2-1.

North Beach Area (Virginia Avenue) – The portion between Lincoln Avenue and Maryland Avenue and Washington Avenue and the beach experiences flooding that affects the homes along the road. The flooding is caused by undersized stormwater infrastructure and inundation from the Potomac River. Sometimes the river rises onto the end of the street, pushing sand from the beach into the stormwater infrastructure and further limiting the system's capacity. This area is shown in the red box along the eastern side of Figure 2-3.

Monroe Bay at Dennison Street – The roads in this area slope downward and drainage collects in a low point on Dennison Street. This low point floods during storm and tidal events, and then water stands on the roads for several days before receding. The stormwater system along this road lacks the capacity for both stormwater runoff and tidal flooding from Monroe Bay. This area is shown in the red box on the western side of Figure 2-3.

Santa Maria Avenue – The drainage network in this area, from Locust Avenue, Mimosa Avenue, and Cedar Avenue to the beach, has undersized pipes and ditches, which leads to flooding. This area is shown in the pink box in the northern portion of Figure 2-1.

Irving Avenue – The road experiences beach erosion and flooding issues, especially during high tides because of the road's location along the coast. This area is shown in the orange box on the eastern side of Figure 2-4.

Potomac River Beach Outfalls – Severe beach erosion is occurring at each of the outfalls located at the municipal pier, Wilder Avenue at the Riverboat, Colonial Avenue near the pump house, and Madison Street. The beach is a key tourist attraction, and the erosion at

the outfalls is affecting the aesthetics of the beach. The outfalls are shown as green dots along the coast in Figure 2-3 and Figure 2-4.

Undeveloped Area – The area to the west of the numbered streets is currently undeveloped and consists of small lots that were platted decades ago. Development will occur here in the future, and the limited stormwater infrastructure in place will add to stormwater management issues in this area and the numbered streets. This area is shown in the yellow box in Figure 2-1.

Figure 2-1: Map of observed flooding – North



Figure 2-2: Map of observed flooding – North / East

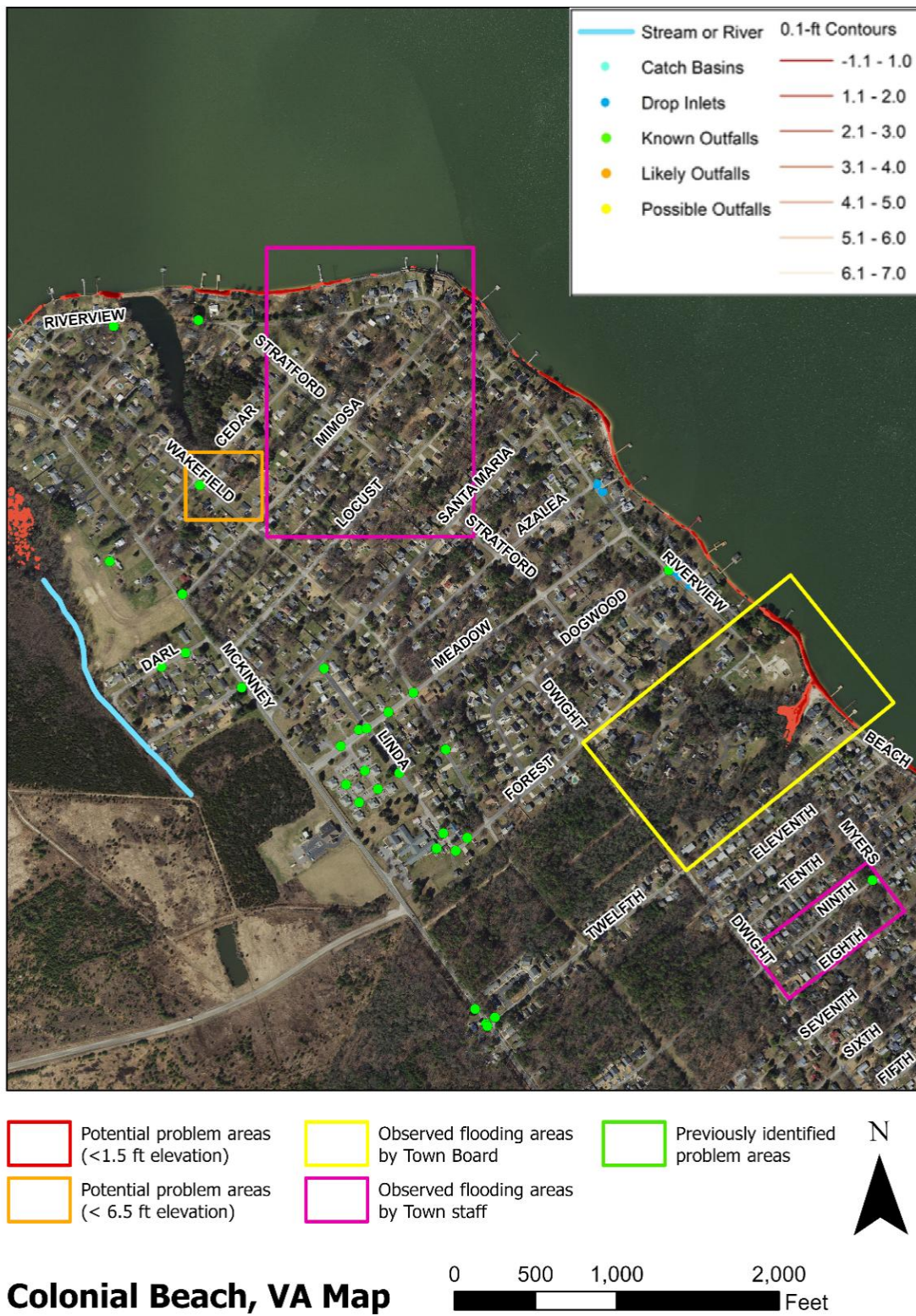


Figure 2-3: Map of observed flooding – Town Center

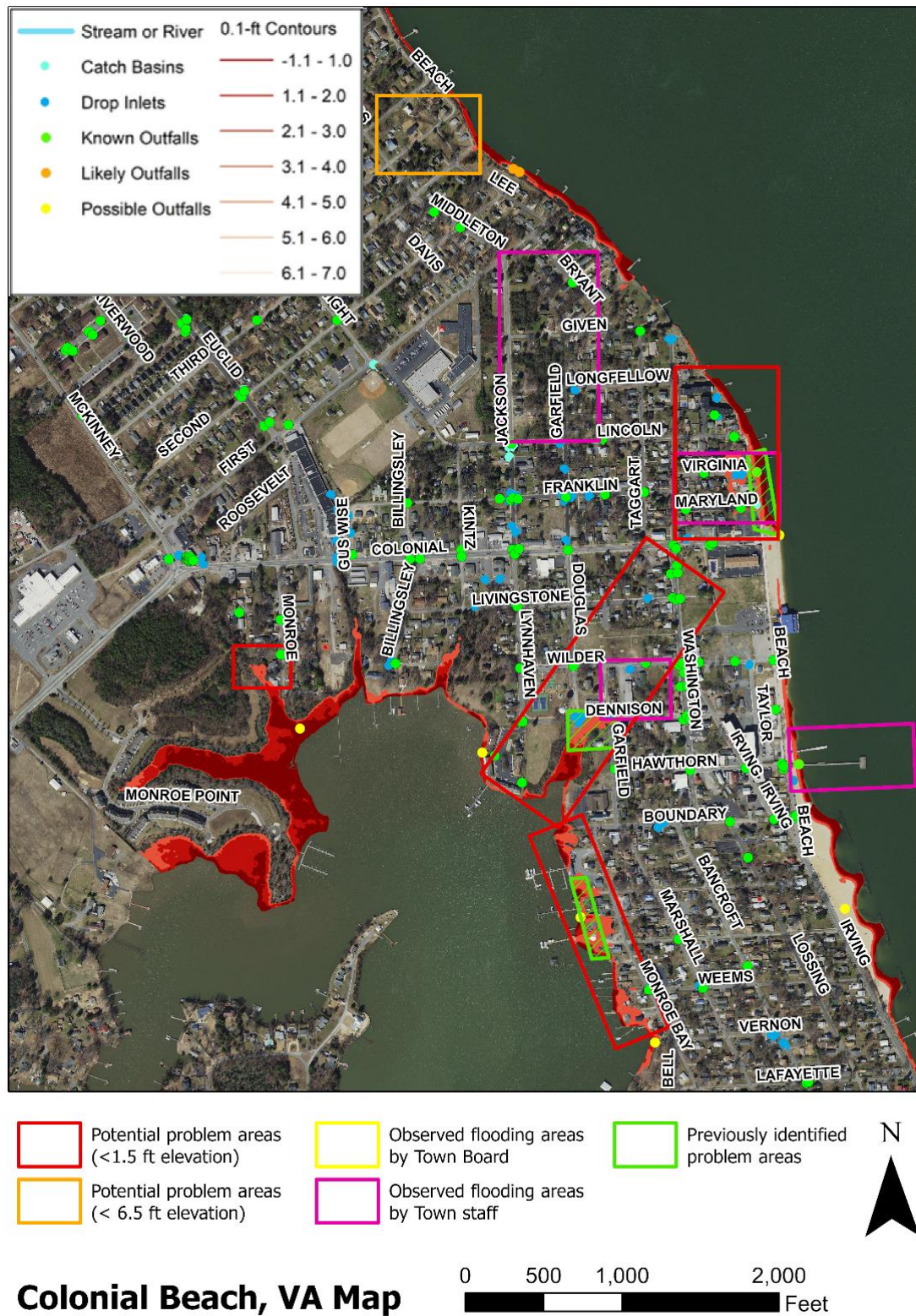


Figure 2-4: Map of observed flooding – South and the Point



CAPITAL IMPROVEMENT PROGRAM STORMWATER PROJECT ASSESSMENT AND ANALYSIS

The Town's Capital Improvement Program (CIP) accounts for all financial resources needed in the acquisition or construction of capital assets. Incorporating short- and long-term CIPs for stormwater improvement will be vital to decreasing stormwater runoff and flooding impacts for Colonial Beach. The Town identified multiple areas currently susceptible to flooding due to stormwater impacts. Many of these areas are in low-lying locations with little to no topography available to help drain the stormwater. Using stormwater BMPs in conjunction with an increased carrying capacity (increased stormwater inlet, pipe, and culvert sizes) will be vital to helping the Town manage stormwater volume with the added benefits of improving water quality.

INITIAL STORMWATER PROJECT IDENTIFICATION

Eight stormwater flooding areas were identified based on interviews with the Town and the public. These areas were further evaluated to determine which should be prioritized for this Plan. These areas were assessed against four risk categories: safety, flooding, economic, and equity. Each category included subcategories that were assigned a score based on the following likelihood of occurrence:

- 0 – 2: Very Low/Very Unlikely
- 3 – 4: Low/Low Likelihood
- 5 – 6: Medium/Likely
- 7 – 8: High/Highly Likely
- 9 – 10: Very High/Near Certain

Table 2-1 shows the matrix with the risk categories and subcategories. The subcategory scores for each area were totaled, and an overall ranking was assigned. The area with the highest number of points received the highest (number 1) ranking. Table 2-2 presents the scores and ranking results for the flooding areas.

Table 2-1: Ranking matrix to evaluate flooding areas.

Risk Category	Consequence Subcategory	Ranking and Score: Impact and Probability of Occurrence				
		Very Low/ Very Unlikely	Low/Low Likelihood	Medium/ Likely	High/ Highly Likely	Very High/ Near Certain
Safety	Loss of life	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Building flood impact (major, greater than 50% substantial damage, greater than 4 feet)	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Increased emergency response time	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Evacuation	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
Flooding	Yard flooding	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Building flood impact (minor, less than 50% substantial damage, less than 4 feet)	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Roadway flooding	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Ditch/inlet flooding	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
Economic	Negative impacts to Town's tourism areas (access, enjoyment, visibility)	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10

Town of Colonial Beach – Propelling Resilience

Risk Category	Consequence Subcategory	Ranking and Score: Impact and Probability of Occurrence				
		Very Low/ Very Unlikely	Low/Low Likelihood	Medium/ Likely	High/ Highly Likely	Very High/ Near Certain
	Increases Town infrastructure maintenance costs	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
	Negative impacts to natural features	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10
Equity	Negative impacts to disadvantaged communities (based on U.S. Environmental Protection Agency EJScreen metrics)	0 – 2	3 – 4	5 – 6	7 – 8	9 – 10

Table 2-1: Ranking results for priority flooding areas.

Risk Category	Consequence Subcategory	Project Location and Ranking								
		State Road 205 at Wilkerson's Seafood	9th Street Between 7th and 12th Streets	North Beach Area	Monroe Bay at Dennison Street	Santa Maria Avenue	Irving Avenue	Potomac River Beach Outfalls	Undeveloped Area (Current Conditions)	Undeveloped Area (Future Conditions)
Safety	Loss of life	8	3	10	5	3	5	5	3	3
	Building flood impact (major, greater than 50% substantial damage, greater than 4 feet)	10	3	10	5	3	5	5	1	3
	Increased emergency response time	8	8	10	8	5	5	5	4	8
	Evacuation	5	5	10	5	5	8	5	2	5
Flooding	Yard flooding	2	10	10	8	10	5	6	2	8
	Building flood impact (minor, less than 50% substantial damage, less than 4 feet)	10	10	10	8	8	8	6	2	8
	Roadway flooding	10	10	10	10	8	8	10	6	10
	Ditch/inlet flooding	8	10	10	10	8	6	10	6	10
Economic	Negative impacts to Town's tourism areas (access, enjoyment, visibility)	4	2	8	6	6	8	10	4	6
	Increases Town infrastructure maintenance costs	2	8	8	6	8	8	10	4	6
	Negative impacts to natural features	6	4	4	8	8	6	10	4	4
Equity	Negative impacts to disadvantaged communities (based on U.S. Environmental Protection Agency EJScreen metrics)	4	10	6	6	10	6	6	4	10
Calculated score		77	83	106	85	82	78	88	42	81
Stormwater Management Plan project ranking		N/A*	4	1	3	5	7	2	8	6

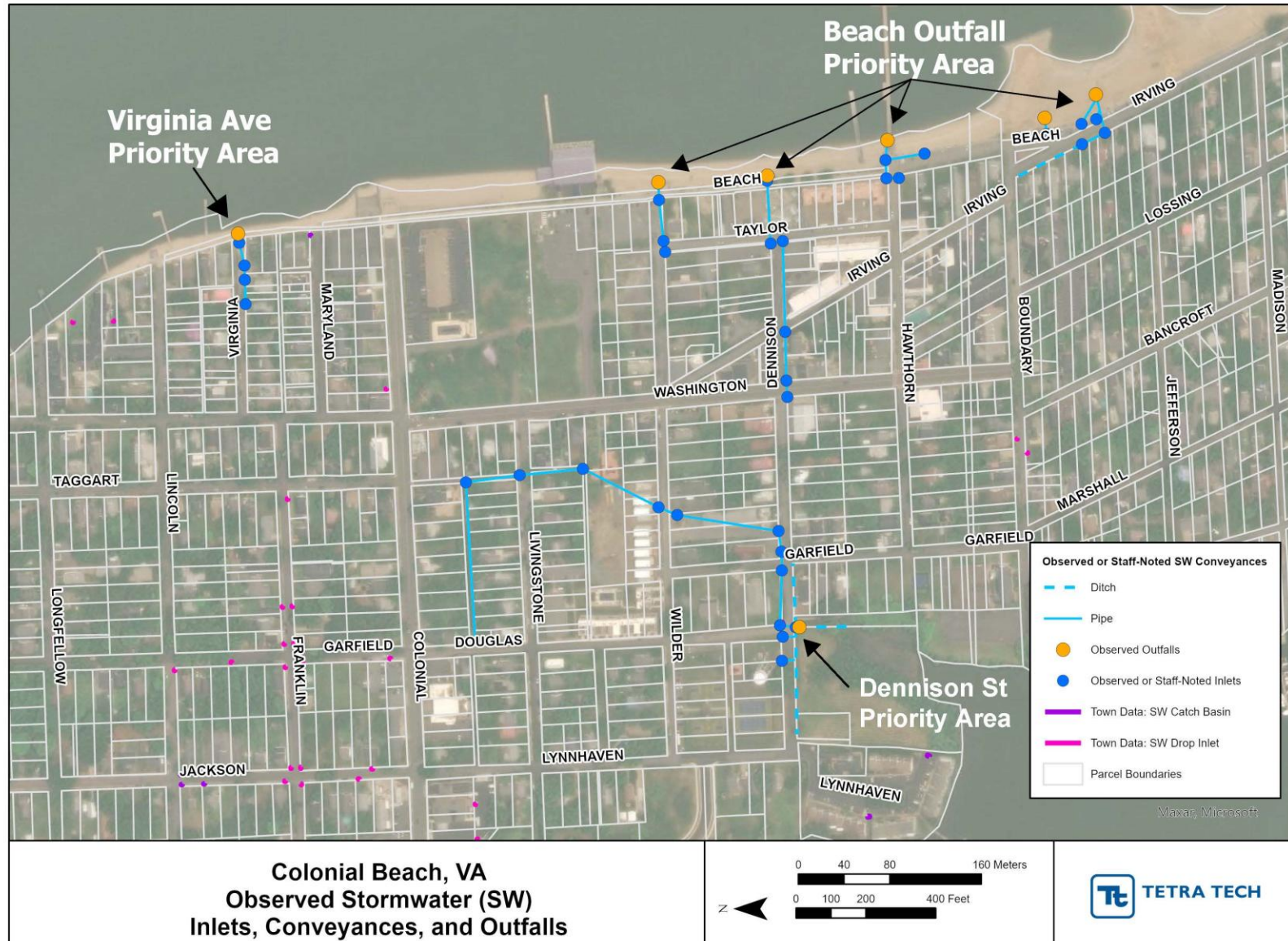
Notes: N/A = not applicable

* Flooding on State Road 205 is the responsibility of VDOT and outside of the Town's authority.

From this ranking, the areas selected for further investigation were: **(1) North Beach Area (Virginia Avenue), (2) Monroe Bay at Dennison Street, and (3) Potomac River Beach Outfalls**

(see Figure 2-1). Additional details about the issues in each of these areas are provided further below.

Figure 2-5: Locations of the selected priority areas



IDENTIFIED PRIORITY STORMWATER CIP PROJECTS

On February 1, 2024, Tetra Tech conducted a field visit to the three priority areas identified above in Figure 2-4 and met with Town staff to discuss the issues in these areas in more detail. Based on the additional assessment, the flooding issues in the North Beach Area (Virginia Avenue) were determined to be largely caused by tidal impacts. However, stormwater improvements may alleviate some flooding issues but should be considered in connection to the anticipated North Beach Resilience Project in the VA Coastal Resilience Master Plan.¹

The following sections describe the flooding concerns in the North Beach (Virginia Avenue) area, Monroe Bay at Dennison Street area, and the Potomac River Beach Outfalls priority areas and present potential projects that can be implemented to address the issues.

PRIORITY AREA #1: MONROE BAY AT DENNISON STREET

Dennison Street is a low point where stormwater runoff flows down the sides of the road in shallow ditches. The roadway sag (low point) near the intersection of Dennison Street with Douglas Avenue is prone to flooding due to the undefined ditches and undersized stormwater infrastructure. The stormwater runoff remains for a significant time after a rain event and is influenced by tidal fluctuations coming up the outlet pipe and ditches from Monroe Bay. The drainage area covers approximately 23 acres and originates north of Wilder Avenue and east of Washington Avenue. New development in the area is increasing the amount of impervious surface, which is compounding stormwater runoff volumes (Figure 2-2).

Figure 2-6: Examples of standing water in the Dennison Street area



PHASE 1: IMPROVE EXISTING STORMWATER SYSTEM

One option for this area is to improve the existing system to accommodate more runoff. The improvements could include increasing the ditch capacity by widening and/or deepening the ditches and adding vegetation and storage capacity to create bioswales. The stormwater

¹ Virginia Coastal Resilience Master Plan, Phase One 2021, Technical Appendix G: Project and Capacity Building and Planning Needs Schema, Suitability Matrix, Project #296

pipes can be increased in size, and tidal gates can be added to allow stormwater discharge into the bay while preventing bay water from entering the system during high tides. Continual maintenance should be considered in this area to ensure the stormwater system remains clean and operates properly. Examples of pipe modifications to reduce tidal influences are shown in Figure 2-3.

Figure 2-7: Examples of stormwater system pipe modifications that reduce tidal influence



PHASE 2: CONSTRUCTED WETLAND/FILTER MARSH

Another option is to add a constructed wetland on the property near the southwest corner of the road (Figure 2-4). This wetland would help slow tidal water coming up into the stormwater system from the bay during high tide, and it would detain stormwater runoff during rain events. These changes could lead to reduced stormwater flooding on the road. Examples of constructed wetlands are shown in Figure 2-5. The proposed property is privately owned, so the Town would need to determine whether purchasing a portion of the property is feasible.

Figure 2-8: Dennison Street at Monroe Bay: Potential location for constructed wetland



Figure 2-9: Examples of a constructed submerged gravel wetland (left) and a stormwater BMP constructed wetland pond (right) planted with native non-invasive plants



CONSTRUCTED WETLAND CONCEPTUAL PLAN AND ESTIMATED COST

An initial conceptual plan has been developed for the repairs and constructed wetland at Dennison Street (Figure 2-6). In addition, high-level cost estimates were determined as summarized in Table 2-2. The Monroe Bay at Dennison Street project would include improving the existing stormwater system by widening the ditches, converting portions of the ditches to bioretention cell swales as appropriate, and adding tidal gates at the ends of the pipes. A constructed wetland be added to the open parcel of land along Dennison Street to accept and detain stormwater runoff from the roadway and reduce tidal impacts from Monroe Bay.

Figure 2-10: Initial concept plan for Priority Area #1: Monroe Bay at Dennison Street



Table 2-2: Estimated costs for Priority Area #1: Monroe Bay at Dennison Street

Category	High-level Estimated Cost
Design	\$150,000
Acquisition/Right-of-Way (rough estimate)	\$100,000
Construction	\$400,000
<i>Subtotal</i>	<i>\$650,000</i>
Contingency (20%)	\$130,000
Total	\$780,000

PRIORITY AREA #2: POTOMAC RIVER BEACH OUTFALLS

There are four 12-inch outfalls to the beach, which discharge stormwater from a system that captures runoff from an area extending a couple of blocks back from the beach. As more development occurs in this area, stormwater from the additional impervious surfaces is tied into these outfalls, which leads to more damage at the outfalls. The outfall under the municipal pier is broken from excessive stormwater flows, and the pipe is now partially buried in the sand. In addition, stormwater exiting the outfalls is causing deep erosion on the beach. The Town has been continuously replacing the sand, only to have it washed out by the stormwater discharges. There are also obvious signs of scouring caused by stormwater running onto the beach from the road, concrete areas, and sidewalks (Figure 2-11 and 2-12).

Figure 2-11: Beach scouring at an outfall (left) and from pavement (right) along Beach Terrace/Irving Avenue (February 1, 2024)



Figure 2-12: Beach erosion from generator platform, bathhouse/bathroom, and parking/pavement (February 1, 2024)



OUTFALLS IMPROVEMENT

One option for improving the outfalls and reducing the scouring is to increase the size of all the outfall pipes leading into the Potomac River, which would accommodate additional stormwater and reduce the velocity at which discharges are occurring on the beach. Adding tidal gates to the outfalls would allow stormwater outflow to discharge to the beach but prevent river water from moving up the outfall into the stormwater system. The pipe under the municipal pier could be upsized as a concrete pipe to accommodate the high flows, and it could be extended further into the river under the pier to move the discharge off the beach. The other outfalls could be moved up the beach and closer to the road, and features such as rocks and vegetation could be added to help dissipate the discharge velocity (see Figure 2-9).

Figure 2-13: Stormwater outlet end treatment example: Regenerative stormwater control (RSC) measures



VEGETATED DUNES

Another option is to add low, vegetated dunes between the sidewalk or parking lot and the beach to help intercept stormwater runoff from the road and reduce erosion between the pavement and the beach (Figure 2-14). The dunes would help reduce the elevation difference from the pavement to the beach, which is causing scouring. Based on historical depictions of Colonial Beach, the beach previously had vegetation, so adding this feature will restore the historical look and provide an amenity for the community and visitors. Scattered trees could also be included to provide shade during the summer months. Local vegetation appropriate for a beach environment should be used to reduce maintenance requirements.

Figure 2-14: Shoreline erosion and walkway concept



Figure 2-15: Parking area bioswale concept



GREEN STORMWATER INFRASTRUCTURE/NATURE-BASED SOLUTIONS

A third option is to add GSI/nature-based solutions (NBS) dispersed along the roads and parking areas near the beach to capture stormwater before it reaches the beach and contributes to erosion. Potential GSI/NBS concepts include adding a bioswale along the boardwalk to the municipal pier, re-grading the existing roadside ditches to make them deeper and adding vegetation to create bioswales (Figure 2-16), adding a cistern and/or green roof on the bathroom building to capture rainfall (Figure 2-17), and adding pervious pavement (with wider spaces so that sand is not an issue) on the street parking. In addition, in the median with the War Memorial Cannon, the landscaping can be modified to include a bioswale and rain garden using local vegetation to capture stormwater (Figure 2-15). This would also provide a potential location for educational signage about GSI to inform the community and visitors.

Figure 2-16: Opportunity for bioretention swales and stormwater infrastructure upgrades on the west side of Irving Avenue (February 1, 2024)



Figure 2-17: Example of a roof leader cistern



Figure 2-18: Opportunity for small bioretention swales along the sides of the Cannon War Memorial and a bioretention pond/rain garden at the Point (February 1, 2024)



POTOMAC RIVER OUTFALLS CONCEPTUAL PLAN AND ESTIMATED COST

An initial conceptual plan has been developed for the improvements to the Potomac River Outfalls located along Beach Terrace and Irving Avenue, as shown in Figure 2-19. In addition, high-level cost estimates were determined, as summarized in Table 2-4. The Potomac River Outfalls project would include constructing a bioretention cell around the point of the Cannon War Memorial at the intersection of Beach Terrace and Irving Avenue (not disturbing the

memorial itself); adding bioretention cell swales on the riverside (east) of the sidewalk along Irving Avenue; adding a small berm/dune for detention on the backside of the bioretention swale; planting low-height native, non-invasive vegetation; and installing outfall energy dissipation (regenerative stormwater conveyance or similar measure) at the ends of each stormwater pipe outfall to reduce runoff velocities from eroding the beach.

Figure 2-19: Initial concept plan for Priority Area #2: Potomac River Outfalls



Table 2-3: Estimated costs for Priority Area #2: Potomac River Outfalls.

Category	High-level Estimated Cost
Design	\$300,000
Acquisition/Right-of-Way (rough estimate)	\$0
Construction	\$1,200,000
Subtotal	\$1,500,000
Contingency (20%)	\$300,000
Total	\$1,800,000

PRIORITY AREA #3: NORTH BEACH AREA (VIRGINIA AVENUE)

The terminus of Virginia Avenue is located at the beach and the Potomac River experiences flooding that moves up the road (west) and affects homes with low first floor elevations. The flooding is a result of a combination of storm events and tidal influences with major flooding occurring during compound stormwater and tidal events such as Hurricane Irene and the large storms in October and December 2023.

There is some stormwater infrastructure along the road, which ultimately connects to a 12-inch pipe that outfalls to the beach. The existing concrete pipe is old, and the end is buried under sand on the beach. The stormwater inlet at the end of the road also becomes buried under several feet of sand and small river pebbles the size of pea gravel/very coarse sand from the beach, which the Town has to remove to allow water to flow off the road and into the inlet (see Figure x). There is a concrete jersey barrier between the end of the road and beach to try and prevent tidal flooding. However, there are times when the tide is higher than the barrier so there is over washing, and the barrier has been moved by water flows. Historically, there was a boardwalk along this portion of the beach that was destroyed by tidal inundation and only pieces of concrete remain on the beach.

Due to the tidal flooding and erosion issues at the terminus of Virginia Ave, it is highly recommended that any stormwater improvements are considered as part of a larger shoreline project. This project has been included in the Virginia Coastal Resilience Master Plan, and grant funding is available through various federal and state programs. While tidal flooding is the major contributor in this area, a portion of the flooding is due to stormwater management and there may be some measures that can be implemented to help reduce the stormwater flooding if the larger shoreline project is not an immediate possibility.

Figure 2-20: Buried Outfall (left) and Buried Inlet (right) on Virginia Ave (February 1, 2024)



IMPROVE EXISTING STORMWATER SYSTEM

One potential measure is to improve the existing stormwater infrastructure to hold more water in the system. This could include upsizing the stormwater pipe and pipe outfall, modifying the outfall so that it is no longer buried on the beach side, modifying the inlet at the beach, and

adding a tidal gate at the end of the pipe to allow stormwater to flow out while preventing river water from going up into the stormwater system.

ENHANCE/EXPAND STORMWATER SYSTEM

In addition, options to expand the stormwater system could be investigated. The expansion could include adding bioswales on each side of the road to retain stormwater runoff and adding a detention area at the end of the street to capture stormwater runoff and potentially hold back some of the water during high tides to prevent flooding the road.

Table 2-4: Estimated costs for Priority Area #3: North Beach Area (Virginia Ave) Stormwater Improvement and Enhancement

Category	High-level Estimated Cost
Design	\$150,000
Acquisition/Right-of-Way (rough estimate)	\$100,000
Construction	\$550,000
<i>Subtotal</i>	<i>\$800,000</i>
Contingency (20%)	\$160,000
Total	\$960,000

EVALUATION OF POTENTIAL PROJECTS

To provide information to the Town for evaluation of the potential projects in the identified priority areas, Tetra Tech developed a ranking matrix that summarizes the construction cost, operation, and maintenance (O&M) cost, and flooding impact. Table 2- provides the results of this evaluation matrix by priority area and potential project. The resulting evaluation data shows that the Monroe Bay at Dennison Street project is more economically feasible overall with a medium-to-high stormwater flood reduction. The Potomac River Outfalls project will also reduce flooding at a medium-to-high level; however, due to its prime location along Irving Avenue, the initial construction costs will likely be higher due to phasing, the integration of overall aesthetics, compliance with Americans with Disabilities Act requirements, and visitor safety.

Table 2-5: Priority Project Evaluation Matrix

Priority Area	Priority Project	Construction Cost	O&M Cost	Flood Reduction
Monroe Bay at Dennison Street	Improve existing stormwater system	Medium	Medium	High
	Constructed wetland	Medium	Medium/Low	Medium
Potomac River Beach Outfalls, Phases 1, and 2	Outfalls improvement	Medium	Medium	High
	Vegetated dunes	High	Medium	High
	GSI/NBS	High	Medium	Medium/High

North Beach (Virginia Avenue) Stormwater & North Beach Shoreline Project*	Improve existing stormwater system	Medium	Low	Medium
	Enhance stormwater system	Medium	High	Medium
	*Breakwaters, Sand replenishment and shoreline structures	High	Medium	High

*** North Beach Shoreline Project (VACRMP)**

The matrix above uses the following categories for each of the criteria parameters:

- Initial construction cost parameters (not for budgeting purposes)
 - High: Initial cost estimates are over \$1,000,000
 - Medium: Initial cost estimates are between \$500,000 and \$1,000,000
 - Low: Initial cost estimates are under \$500,000
- O&M cost parameters
 - High: O&M cost estimates are over \$100,000/annually
 - Medium: O&M costs estimates are between \$50,000 and \$100,000/annually
 - Low: O&M cost estimates are under \$50,000/annually
- Flooding impact parameters
 - High: Addresses over 75% of the flooding issues (estimated)
 - Medium: Addresses between 50% and 75% of the flooding issues (estimated)
 - Low: Addresses under 25% of the flooding issues (estimated)

STORMWATER MANAGEMENT PROGRAM AND REGULATORY UPDATE RECOMMENDATIONS

In addition to stormwater infrastructure improvements, several program and regulatory measures could be implemented across the Town to help improve current stormwater management and reduce stormwater impacts from future development. These measures include:

- Adopting ordinances to guide future development to ensure that additional infrastructure is added to address the stormwater runoff from new development.
- Implementing an outreach and education campaign about what community members can do to help manage stormwater and flooding, such as reducing the impervious area on their properties, adding rain gardens, and using rain barrels.
- Developing a stormwater utility fee to create a dedicated funding source for project implementation.

- Participating in the Federal Emergency Management Agency National Flood Insurance Program and Community Rating System to allow for reduced flood insurance rates and grants.

These are discussed specifically in Part I of the Plan.

STORMWATER MANAGEMENT STRATEGIC ACTION PLANNING

The proposed projects within the prioritized stormwater problem areas are presented here in the revised priority order for implementation.

Table 2-6 provides estimated timelines for design and construction of CIP projects, as well as estimated costs. Additional field verification, data collection, and/or engineering will be required to verify feasibility and refine the projects, which may change the priority order. In addition, the Town will likely need to pursue outside funding to implement the projects (see Part I of this Plan for grant options); depending on the timing of funding, project priorities might need to be shifted.

Table 2-6: Stormwater CIP list

Revised Priority Area	Project	Stormwater Impact	Fiscal Year (FY)	Estimated Cost
1	Monroe Bay at Dennison Street	Upgrade ditches and pipes, purchase easement or portion of property, build constructed wetland, and add gate valves at end of pipes to reduce tidal/sunny day flooding.	FY26–29	\$780,000
2A	Potomac River Beach Outfalls Along Irving Avenue – Erosion and Detention	Beach erosion reduction and stormwater runoff reduction and detention.	FY27–30	\$1,800,000
2B	Potomac River Beach Outfalls Along Beach Terrace from Hawthorn Street – Repair and/or Replace Outlet	Replace high-density polyethylene pipe with larger capacity reinforced concrete Class IV pipe due to increased	FY26–27 (due to immediate need)	To be determined (TBD)

	Pipe Under Municipal Pier	impervious surface, sea level rise, and tidal action.		
3A	North Veach Area (Virginia Avenue) Stormwater Improvements & Enhancements	Upgrade pipe and outfall, purchase easement or portion of property, build street side swales and/or retention area , and add gate valve at end of pipe to reduce tidal/sunny day flooding	FY26-27	\$960,000
3B	North Beach Shoreline Project ²	Breakwaters, Sand replenishment and shoreline structures, site assessment and preliminary design	FY26-27	\$3,300,000

NEXT STEPS

In addition to the strategic action plan priority project areas listed in Section 0, the Town should complete two assessments to better understand the current stormwater management capacity and future needs. The first evaluation should be a stormwater asset inventory and assessment to identify the existing infrastructure locations, materials composition, sizes, and conditions. This information would then be used in a hydrologic and hydraulic model of all or parts of the stormwater system to evaluate the current stormwater carrying capacity and estimate the changing needs as development occurs. Additional details about these assessments are included in Table 2-7.

Table 2-7: Stormwater Assessment Projects

Focus Area	Stormwater Impact
Stormwater asset inventory and assessment	Obtain a detailed understanding of stormwater carrying capacity by evaluating public right-of-way stormwater infrastructure, including stormwater inlets, pipes, and ditches. Asset inventory includes location, size, materials composition, and condition assessment.
Townwide stormwater hydrologic and hydraulic	Model Townwide rainfall events and stormwater efficiency based on existing pipe carrying capacity, storm size (frequency and duration), future conditions, and stormwater infrastructure requirements

² North Beach Project, VA Coastal Resilience Master Plan, Technical Appendix G, Project # 296,

watershed modeling (HEC-RAS, HEC-HMS, or SWMM)

needed to carry the design storm. As new development occurs, require similar models as part of development design standards.

Based on the results of the two assessments noted above, this Plan should be revised once completed to include additional measures to address the remaining focus areas targeting reductions in community flooding related to stormwater runoff.

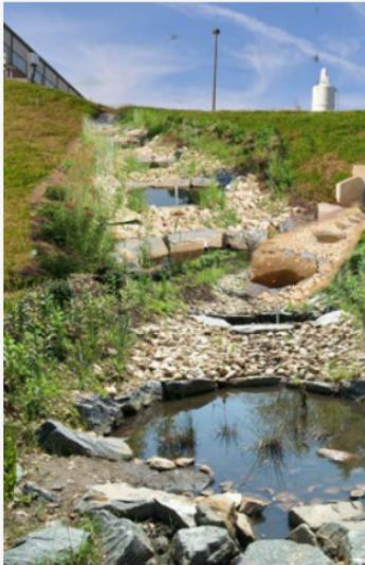
Table summarizes the additional stormwater focus areas and potential measures.

Table 2-8: Additional Stormwater Focus Areas

Focus Area	Stormwater Impact
9 th Street between 7 th and 12 th streets	Reduce flooding in ditches due to increased impervious surface from new construction/development. Consider stormwater ordinance maximum impervious surface limits on new development or require stormwater BMPs.
Santa Maria Avenue	Unbury the stream to reduce flooding and increase carrying capacity.
Undeveloped area (future conditions)	Consider adding stormwater ordinance maximum impervious surface limits on new development or require stormwater BMPs. Use modeling results to determine additional stormwater infrastructure needed to manage future runoff.
Irving Avenue	Shoreline erosion reduction needed to stabilize banks and reduce roadway infrastructure failure.
Undeveloped area (current conditions)	Consider adding stormwater ordinance maximum impervious surface limits on new development or require stormwater BMPs; conduct a drainage and flood study to determine pre-development conditions.
State Road 205 at Wilkerson's Seafood – bridge and sag elevation	Coordinate with VDOT on a second bridge at the low point in road or elevating the roadway to reduce flooding approximately 850 feet east of Wilkerson's.

Proposed Projects - Plant List

Beach Outfall



Low growing Native Grasses:

- Pink Muhly Grass,
- Autumn Bentgrass,
- Prairie Dropseed,
- American Beach Grass,
- Coastal Switchgrass

Low growing Flowering Perennials:

- Blazing Star Liastris,
- Purple Cone Flower,
- Lanceleaf Coreopsis,
- Lavender Hyssop,
- Butterfly Weed,
- Sky Blue Aster,
- Mistflower

Constructed Wetland



Sedges and Rushes:

- Common Rush,
- Tussock Sedge,
- Fox Sedge

Flowering Perennials:

- Cardinal Flower,
- Swamp Sunflower,
- Rose Mallow,
- Pickerel Weed,
- Turtlehead,
- Virginia Iris,
- Culver's Root

Small Trees and Shrubs with Seasonal Interest:

- Buttonbush,
- Elderberry,
- Northern Spicebush,
- Fringe Tree,
- Downy Serviceberry,
- Sweet Crabapple,
- American Snowbell

APPENDIX A

Minutes from Public Outreach Meetings

Meeting minutes begin on the following page.

Town of Colonial Beach Resilience and Stormwater Management Plan

Kick-off Meeting

Tuesday, February 7, 2023

1:00pm to 4:00pm

NOTES

Attendees (13)

In-Person

India Adams Jacobs, Town Manager, Colonial Beach

J.C. LaRiviere, Grants Manager and Town Person of Contact, Colonial Beach

Don Dooley, Director of Community Development & Zoning, Colonial Beach

Darla Orr, Zoning Manager, Colonial Beach

Diane Beyer, Director of Public Works, Colonial Beach

Kaylynn DeBernard, Town Planner, Colonial Beach

Michael Zehner, Director of Community Development and Planning, Berkley Group

Luke Peters, Environmental Planner, Berkley Group

Online

Holly Miller, NC Operations Manager WTR/Senior Planner, Tetra Tech

Marcy Frick, FL Water Operations Manager, Tetra Tech

Sarah Waickowski, Engineer, Tetra Tech

Lindsay Edwards, Environmental Planner, Berkley Group

Nadya Syazsa, Intern, Berkley Group

Team Introduction

Michael Zehner welcomed everyone to the meeting and reviewed the agenda of today's meeting. Mr. Zehner also coordinated introductions between Town staff and the consultant teams – the Berkley Group (BG) and Tetra Tech (TT).

Mission, Goals, and Objectives Workshop

Resilience Plan

Mission:

Luke Peters began the workshop to discuss the vision and goals of the Resilience and Stormwater Management Plans, building from the required elements of an approved

resilience plan for the Community Flood Preparedness Fund set by DCR and incorporating desired elements from the original RFP and the approved work order.

The following draft mission statement developed by the Berkley Group was sent to the group prior to the meeting:

"The mission of the Resilience Plan is to identify and secure funding for projects that serve to protect citizens most vulnerable to increasingly severe flooding hazards which threaten property, the built environment, human life, the ecosystem, and which will erode the tax base, limiting the Town's ability to provide services."

Kaylynn DeBernard, in her version of a possible mission statement, referenced that projects should be attainable, should include the whole community (as opposed to just those living on the water), and should be coordinated regionally.

J.C. LaRiviere suggested the mission statement and goals should include some additional Town priorities (e.g. prioritize projects, assigning a resiliency value) and agreed that the entire Town should be included. For instance, the Town is often landlocked during flood events due to the closing of the Town's evacuation routes. This led to a discussion regarding the facets of hazard risk, such as risk to human lives and critical infrastructure (including telecommunication facilities and logistics/distribution centers). This bookended the suggestion that all portions of the community should be considered because flooding affects everyone on some level.

Likewise, participants believe that public engagement should reach out to all residents, not only those more vulnerable to flood issues (e.g. waterfront property owners and residents). It will be important to impress upon the entire Town that flooding and stormwater are townwide issues that affect everyone. The group mentioned notable examples of whole-community flood awareness, such as the Town of Franklin which has established water marks to visualize historic flood and storm surges to the public.

Goals and Objectives:

Mr. Peters reminded meeting participants that DCR requires the Resilience Plan to :

- Be project-based, i.e. incorporate clearly articulated and actionable projects to resolve identified flooding issues on a community scale within a given timeframe;
- Use nature-based "green" infrastructure to the maximum extent possible;
- Include all parts of community regardless of economics or race, and to this end focuses on issues at the community level;
- Include coordination with other developed local and regional plans, such as comprehensive plans and hazard mitigation plans;
- Have a clearly articulated timeline for implementation; and
- Be based on the best available science, which in Virginia's case means incorporating climate change, using established storm surge estimates, and

relying on the NOAA intermediate-high scenario projections for sea level rise and mean high water.

Some ideas for the goals and objectives of the Plan include reviewing the impacts of existing and future development and to develop ordinances and regulatory tools to set expectations for and maintain consistency across developers. The Plan will also include an analysis of five (5) physical priority areas (i.e., geographic prioritization) to better understand impact of flooding and storm surge hazards. The eventual prioritized projects will focus on nature-based solutions.

Currently, the Town has one existing resiliency project, which consists of putting in place breakers in the north beach (in collaboration with USACE). There are currently disputes regarding public access in this area. Residents on the waterfront are against public access, even though there used to be a boardwalk with public access. Since the boardwalk had been destroyed from past weather events, public access has been restricted for the most part. The idea to improve public access can be structured into one of the Plan's goals – which the Town would benefit from socially and economically.

Other goals and objectives mentioned were to manage and leverage critical resources and protect public and cultural resources in the north and south beaches. There is also a need to evaluate shoreline changes over time (with the use of aerial imagery). There will also be a need to evaluate the success of the projects to ensure their purposes are served effectively and efficiently.

Stormwater Management Plan (SWMP)

Mission:

The following draft mission statement crafted by TetraTech for the Stormwater Management Plan was sent to staff prior to the meeting:

"The mission of the Stormwater Management Plan is to evaluate the Town's existing stormwater infrastructure for capacity analysis to lessen flood impacts from increased rainfall due to climate change and increased impervious areas from new development and redevelopment."

Holly Miller highlighted the importance of project prioritization – and noted that there may be overlap in goals between the SWM and Resilience Plans, which would be beneficial.

Town staff disliked the inclusion of "increased impervious surfaces" because, based on previous experiences, developers claim they would add pervious surfaces to their

projects, however this is not seen as much in the Town itself. The mentioned regulatory tools would be beneficial and should be highlighted in the Plans. With increased management and requirements to developers, the Town can protect its existing resources. Town staff believe new development should not be adding to the existing runoff issues.

Other key points in this discussion included:

- More regulation is needed to prevent the creation of more flooding issues
 - Possible example: In Norfolk, new development can either adhere to pre-set rules or earn points towards a Resilience Quotient to meet resiliency standards set by the City.
- Managing compliance and on-lot management – add no net stormwater to system
- Incentivize developers, but avoid pay-to-play
- Explore retrofitting options
- General education on stormwater (e.g., bioswales)

Goals and Objectives:

Ms. Miller stated for the purpose of the SMP data collection is the first step – to gain a better understanding where the ‘hot-spots’ are within the Town: areas most vulnerable to flood and stormwater runoff. This will be performed in coordination with BG, which would include noting and mapping the existing BMPs.

Then, a full assessment of the community will be performed, including staff interviews to learn of existing infrastructure that may need to be replaced/fixed. The assessment would then be compiled in a memo to be submitted to the Town.

Lastly, the Town would look into potential regulations and projects (as well as their costs), including larger development and smaller, yet still impactful ones. Then, a prioritization process would be utilized for these to understand which ones would be first to be implemented.

Some of these projects may include inventive solutions such as inserting green stormwater infrastructure in combination with existing grey infrastructure. In addition, there may be a need to leverage municipal land that is left in the Town. For funding purposes, it would be beneficial to have a range of projects with certain ones selected for the Community Flood Preparedness Fund (CFPF).

Town staff believe water quality does not seem to be much of a concern in Colonial Beach visually (i.e., brown water). The Town has a central sewer system, which does experience I&I issues and problems with grease.

Sarah Waickowski asked Town staff if they know any groups dedicated to environmental justice or other efforts. There are none within the Town itself, however, the Town has worked with some larger, regional groups such as Wetlands Watch.

Mr. Zehner then inquired Town staff about vulnerable groups in the Town, to which Ms. Miller added this could include lower-income areas as it could be applicable for FEMA's Justice40 Initiative that focuses on leveraging resilience for vulnerable populations. It is not known to Town staff, although Mr. LaRiviere pointed out that the Town has a Moderate Social Vulnerability status according to the State. Mr. Peters also mentioned ALICE (Asset Limited Income Constrained Employed) groups may be worth investigating.

It was noted that there is no county assistance for non-municipal projects at this time, and there are no existing projects in the Capital Improvement Plan (CIP) related to stormwater, except for the development of these Plans.

Project Administration Plan

Mr. Peters then presented a draft of the Gantt chart illustrating the Project Administration Plan in the process of developing the Resilience and Stormwater Management Plans.

Some of the components of the Administration Plan include:

- Roles and Responsibilities
 - Including estimates on Town staff support needed for each task; e.g., data collection, collaboration
- Identification of major stakeholders and venues
- Five (5) interview sessions – including community leaders, areas of multiple complaints
- Public education and engagement materials
 - 1st Community Meeting (tentatively in March/April)
 - 2nd Community Meeting (tentatively in June)
- Plans would be sent out to the Town staff, community, and DCR for review and comments – all of which will be incorporated into the final version of the Plan to submit to DCR

Input on Community Engagement and Education Plan

The group agreed that community education will be important, including educating homeowners on what can be done on their own properties such as rain gardens and planting native vegetation.

Town staff and Berkley Group brainstormed to identify major stakeholders and venues, which include the following:

- The Alliance
- Development community (e.g., builders, realtors)
- Nonprofits focused on environmental stewardship (e.g., FOR)
- Native plants group
- Community leaders – e.g., civic associations, religious institutions (church)
- Business owners
- County or PDC representatives; e.g., NNPDC
- Department of Historic Resources
- Consultants – for current Parks Stormwater project and HMP
- First response/emergency services
- DCR liaisons
- SWCDs

The group discussed methods of disseminating public education materials, which may require some marketing and branding strategies and could include the Town's current consultant. A brand for the entire undertaking may be helpful to raise public awareness. Consistent messaging would also be key in disseminating information.

The participants then discussed the use of a public survey. Survey123 was noted to be a good platform as it would help with GIS mapping to pinpoint areas of multiple complaints. The earlier the survey is started the better, and this information can be disseminated through social media, such as Facebook. For populations that may be more difficult to reach, there are ways to translate the survey as well, including Berkely Group's in-house Spanish translation.

Town staff asked if a website could be created to monitor the process as the plans are developing. While this is possible, BG would not be able to create it as it is beyond the scope of work, but would be able to assist with creating content for the website developed by the Town.

Lastly, to kick-off of the public engagement process, there would need to be some messaging that can be spread through social media. Town staff noted that they have a marketing consultant that may be able to assist on this matter.

Data Collection

In terms of data collection, BG has 45 days from the kick-off meeting to share any data collected on the Town's existing conditions to Tetra Tech.

For building records: The Town has a permitting software; however, it is fairly new and unfortunately does not have any historic records of permits (i.e., paper copies).

Town staff requested if possible to have a legacy platform where all data collected would be stored and can be looked back on for future uses.

Lindsay Edwards explained to the Town that the DropBox has been the most efficient and easiest data sharing platform. In addition, the following are some data that may be necessary for the Plans:

- Aerial imagery, including historic images
- Conservation easements
- Sea level rise and storm surge
- Database of map layers (GIS)

Other Business

Procedures and policies will be added as part of the objectives in the Plans. As there are also some mapping needs in Town, there may need a supplemental project focused solely on maps.

Mr. Peters advised the Town staff that in order to create an attractive value to DCR – think of vulnerable groups – LMI aspect, ALICE populations, and/or minority communities that may exist in the Town.

The meeting adjourned at approximately 3:00 pm.

APPENDIX B

Public Survey Summary Report

Report begins on the following page.

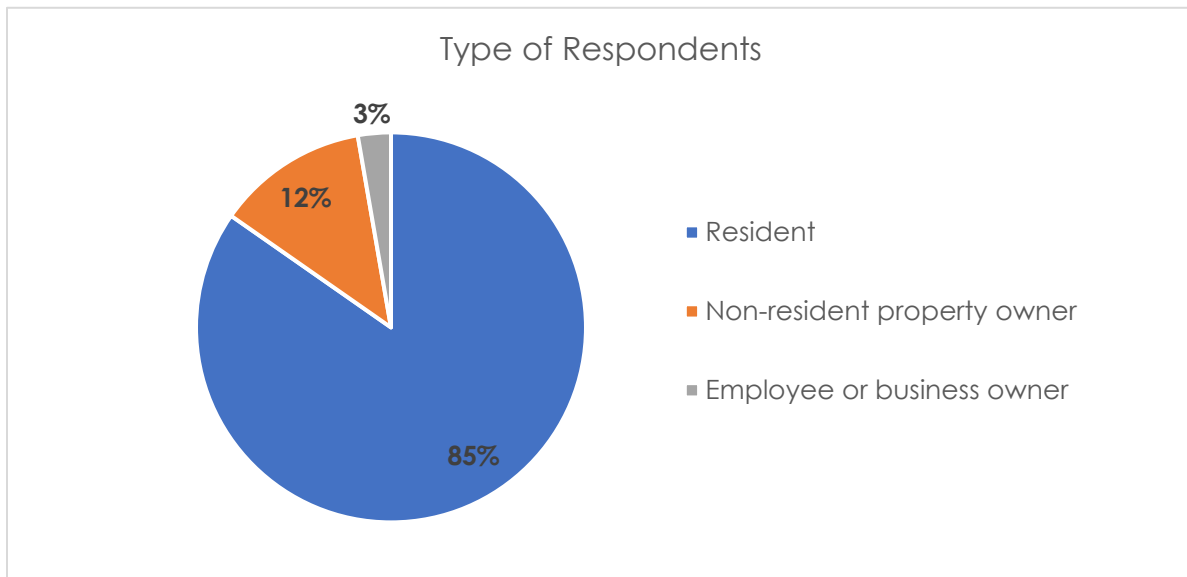
Town of Colonial Beach Resilience and Stormwater Management Plans Public Survey Summary Report

As of **July 14, 2023**, there is a record of **192 respondents** to the Public Survey for the development of the Resilience and Stormwater Management Plans.

General Information

- Residents vs. Non-Residents (Employees/Business Owners, Property Owners)*

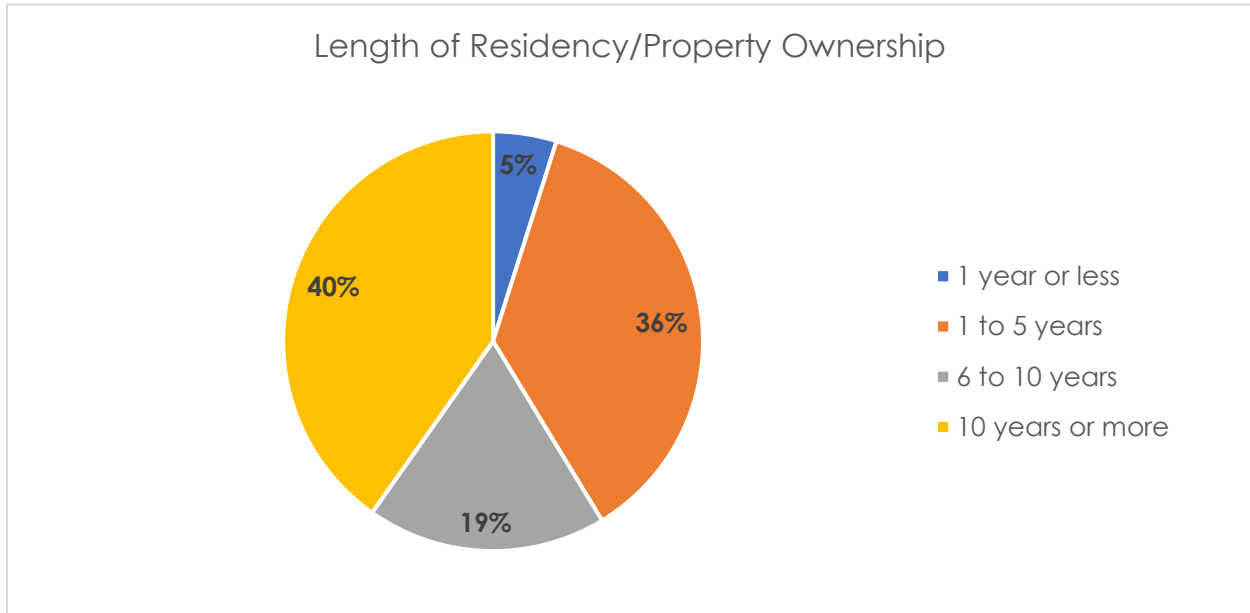
Answers	Count
Resident	162
Non-resident property owner	24
Employee or business owner	5
Other	1 (Resident of Westmoreland Co. at Ebb Tide)



- Length of residency/employment/ownership in the Town*

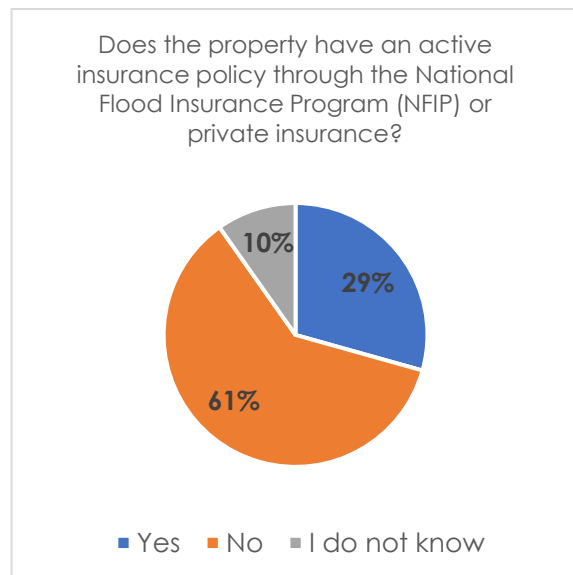
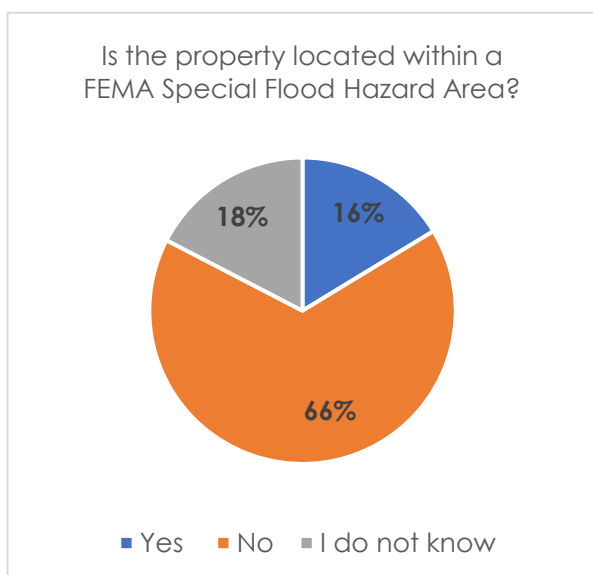
Answers	Count
1 year or less	10
1 to 5 years	72
6 to 10 years	34
10 years or more	76

**Town of Colonial Beach
Resilience and Stormwater Management Plans
Public Survey Summary Report**



- Property information

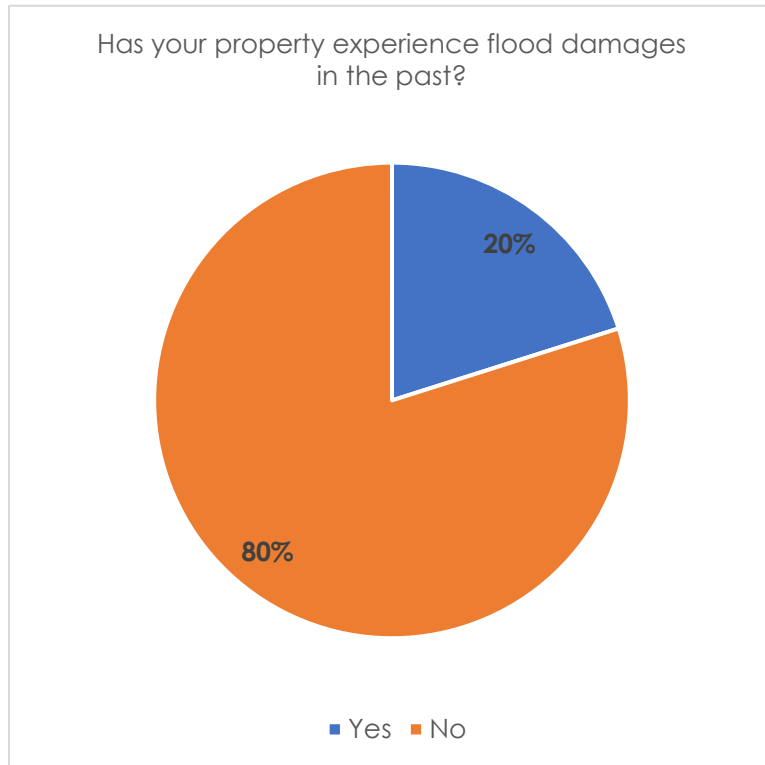
FEMA Special Flood Hazard Area?	
Yes	32
No	127
I do not know	33
Active NFIP or other Flood Insurance?	
Yes	58
No	116
I do not know	18



Flood Hazards:

- *Flood experiences (Y/N)*

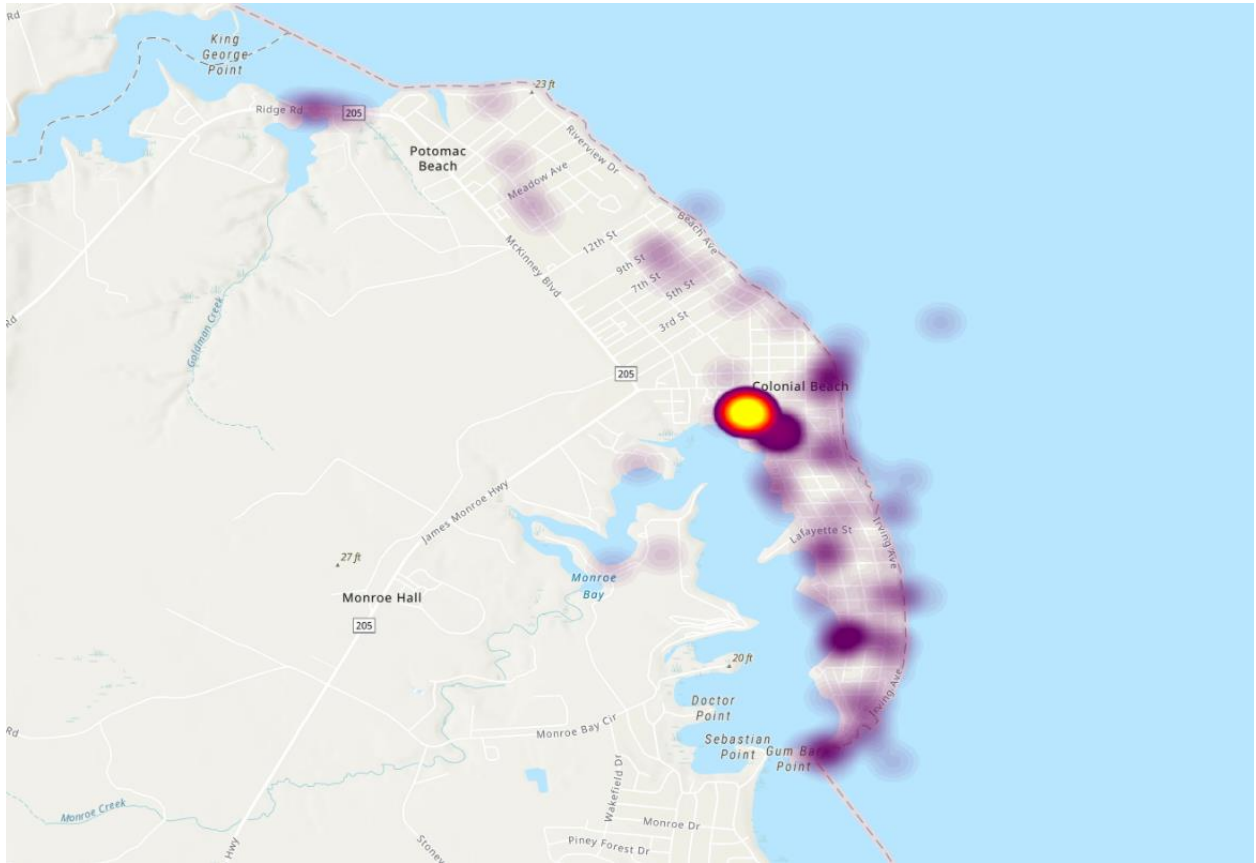
Yes	87
No	154



- Common issues described:
 - Mentioned events - Hurricane Isabel (2003) and numerous storm events in 2012, 2021, and 2022
 - Damages to structures (e.g., fence), buildings, crawl spaces, porches and piers
 - Flood occurring almost regularly with heavy rain, storm events, and high tides
 - Yard and beach erosion caused by tidal events
 - Inadequate community drainage (e.g., Town-owned culverts and drainpipes)
 - Standing water - in yards, parking lot, driveways; preventing access for residents, businesses, and property owners
 - Flood events range from 6 in. to 4 ft. depending on severity of rain, storm, and tidal events

**Town of Colonial Beach
Resilience and Stormwater Management Plans
Public Survey Summary Report**

- *Areas of flooding concern*



- *Measures of protection from flood and stormwater runoff issues*

Flood protection measures?	COUNT
Sump pumps	63
Elevated structures	52
NONE	51
Flood insurance	52
Drainage improvements	48
Other	21
Flood barriers	14
Water-resistant building materials retrofits	6
BMPs/Green Infrastructures	5
Installed flood vents	3

**Town of Colonial Beach
Resilience and Stormwater Management Plans
Public Survey Summary Report**

- *What sources/causes considered most impactful to flooding issues?*

Sources or causes of regular and most impactful flood issues in Town?	
Poorly designed stormwater infrastructure	126
Inadequate amount of stormwater infrastructure	93
Lack of maintenance of existing infrastructure	86
Overdevelopment, lack of SWM	60
Sea level rise	48
Powerful storms	42
Too much impervious surface	27
Excessive rainfall	26
Development in flood-prone areas	23
Lack of GIs	15
Land subsidence	12
Lack of green spaces	10
Other	8

- *What concerns you most about flooding impacts?*

Top concerns about flooding impacts?	
Damage to properties	142
Water quality deterioration	68
Outages	59
Disruption to transportation routes	46
Reduction to property values	40
Risk to human lives	23
Other	6

- *What resources would be considered most helpful?*

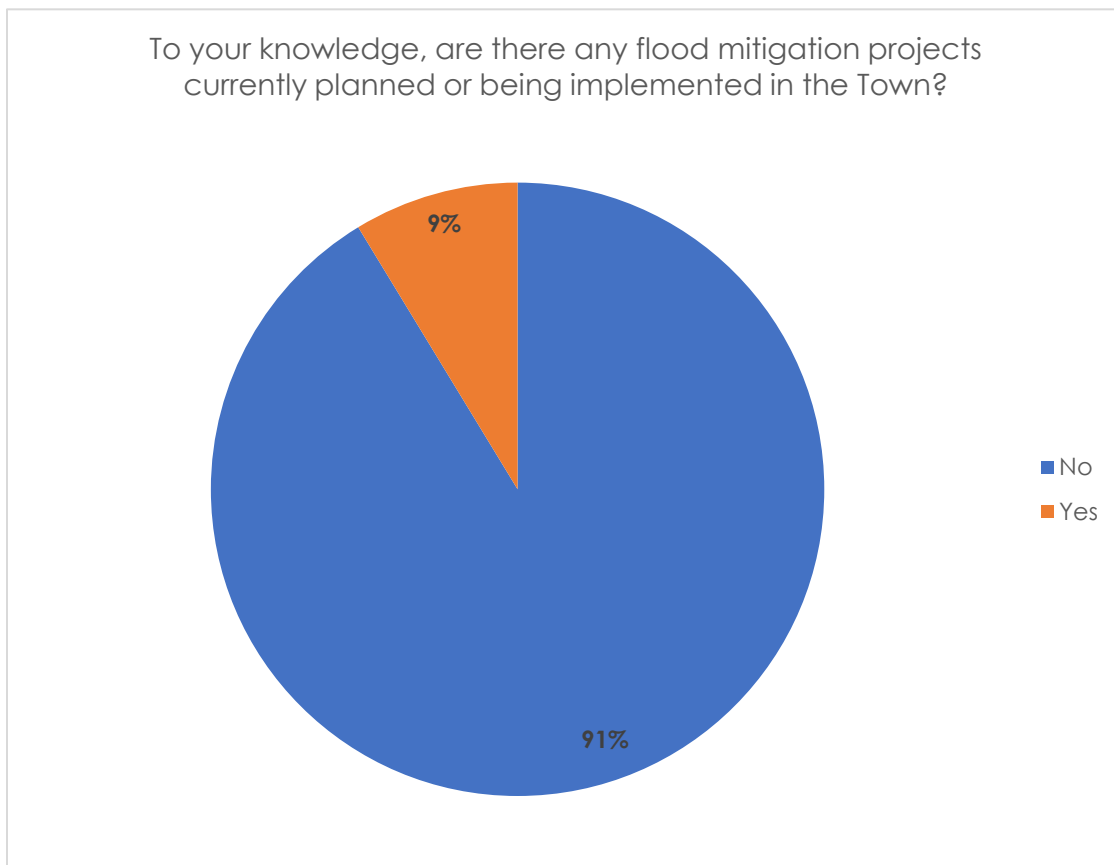
Resources to help improve flood resilience?	
New land development reg	134
Development regulatory tools	116
Info on where flood occurs	76
Dedicated flood manager	69
Town fee or fund dedicated to stormwater and flood	51
Flood gauges and warning signals	40
Other	40
Info on flood insurance	21
Info on repetitive loss properties	15
Info on Floodplain Buyout Program	14

**Town of Colonial Beach
Resilience and Stormwater Management Plans
Public Survey Summary Report**

- Any flood mitigation projects planned or being implemented in Town?

Any flood mitigation projects in Town?	
No	175
Yes	17

- Mentioned projects:
 - Beach restoration
 - High wall barriers
 - Central Drainage Area Project
 - Eleanor Park
 - Maintenance of beach sand and jetties
 - North Beach breakwater
 - Robin Grove living shoreline
 - Dwight Ave Extension
 - Improvements on runoff system
 - Washington Ave improvements
 - Many plans discussed, yet no actions taken by Town



**Town of Colonial Beach
Resilience and Stormwater Management Plans
Public Survey Summary Report**

- *Any type of projects or actions the Town could plan or implement to help reduce flood damages?*

Projects or actions the Town could do to reduce flooding?	
Retrofit existing SW infrastructure	165
Strengthen codes	97
Work on improving damage resistance of utilities	68
Assist vulnerable prop owners	58
Inform property owners of ways to mitigate flood damage	52
Enhance stream maintenance programs	32
Replace inadequate or vulnerable bridges and causeways	28
Improve access to information on flood risks	24
Reducing regulatory restrictions on properties to allow for property owners	20
Other	15
Retrofit and strengthen essential facilities	9

APPENDIX C

Relevant Environmental Database

Database begins on the following page.

Source	Use/Purpose	Link
Northern Neck Regional Hazard Mitigation Plan	<ol style="list-style-type: none"> 1. This Plan meets the requirements for a local hazard mitigation plan under regulations within 44 CFR 201.6, published by the Federal Emergency Management Agency (FEMA) in September 2009. 2. This Plan update allows jurisdictions within the Northern Neck Planning District Commission (NNPDC) to obtain all disaster assistance 	<p>HMP: https://raft.ien.virginia.edu/system/files/WESTMORELANDCo.ScorecardReport%28final%29.pdf </p>
Chesapeake Healthy Watersheds Assessment	<ol style="list-style-type: none"> 1. Support the Chesapeake Bay Program and its jurisdiction partners 2. Detect “signals of change” in the state-identified healthy watersheds 3. Provide information useful to support strategies to protect and maintain watershed health 4. Provide an “early warning” to identify factors that could cause future degradation 5. Allow for communication and management action 	<p>Map Viewer: https://gis.chesapeakebay.net/healthywatersheds/assessment/ </p> <p>Data Portal: https://data-hesbay.opendata.arcgis.com/ </p>

Virginia Natural Heritage Data Explorer	<p>ConserveVirginia:</p> <ol style="list-style-type: none"> 1. Agriculture & Forestry Category 2. Natural Habitat & Ecosystem Diversity Category 3. Floodplains & Flooding Resilience Category 4. Cultural & Historic Preservation Category 5. Scenic Preservation Category 6. Protected Landscapes Resilience Category 7. Water Quality Improvement Category 	<p><i>Map Viewer:</i></p> <p>https://vanhde.org/content/map</p> <p><i>Data Download:</i></p> <p>https://www.dcr.virginia.gov/natural-heritage/cldownload</p>
Virginia Coastal Geospatial and Educational Mapping System (GEMS)	<ol style="list-style-type: none"> 1. Impaired waterways (303D) 2. Threatened and endangered water species 3. Coastal wildlife concerns, conservation planning, sea level rise impacts 	<p>http://www.coastalgems.org/</p> <p>Data Download: <i>Source varies. Provided in information section for each layer within the map viewer.</i></p>
CCFR Recurrent Flooding Risk	<p>Provides Coastal Virginia Sea Level Rise and Flooding Predictions for 2040, 2060, and 2080. Includes: Flooded Streets, Impacted Structures, Areas Impacted by Moderate Flood Events, and Areas Permanently Flooded by Sea Level Rise</p>	<p>https://www.arcgis.com/home/webmap/viewer.html?webmap=36e758f7e2b544a980962faef1faaeb4&extent=-79.355,36.0917,-71.2415,39.4684</p>
Virginia Environmental Data Mapper	<p>Provides water quality assessments, brownfields, renewable energy, etc. layers</p>	<p><i>Link:</i></p> <p>https://geohub-vadeq.hub.arcgis.com/</p> <p><i>Download:</i></p> <p>https://geohub-vadeq.hub.arcgis.com/pages/f2d02039086b4a5c845152faa2f372e4</p>

Virginia Fish and Wildlife Information Service	<p>Provides a list of fish and wildlife for jurisdictions within Virginia. Provides in-depth information regarding specific species, habitat, distribution, etc.</p> <p>Can be useful to identify threatened and endangered species for CPDC jurisdictions.</p>	https://services.dwr.virginia.gov/fwis/?Menu=Home
Wildlife Environmental Review Map Service	<p><i>GIS shapefiles and Comprehensive datasets for conservation planning and assessing potential impacts to wildlife and recreational resources.</i></p>	https://dwr.virginia.gov/gis/werms/
Virginia Wildlife Action Plan	<p>Provides information on habitat conservation, local action plan summary for the CPDC region, and prioritization species</p>	<p>Link to report:</p> <p>http://bewildvirginia.org/wildlife-action-plan/</p>
Virginia threatened and Endangered Species	<p>Provides a comprehensive list of threatened and endangered species in VA</p>	<p>https://www.dgif.virginia.gov/wp-content/uploads/virginia-threatened-endangered-species.pdf</p>
Virginia Cultural Resources Information System	<p><i>VCRIS is the Department of Historic Resources' statewide electronic cultural resources GIS and database. It provides interactive views of information in the DHR Archives related to properties, historic districts, and archaeological sites, and presents evaluative information about the historic significance of resources.</i></p> <p><i>Note: More comprehensive datasets are available with a VCRIS License</i></p>	<p>https://www.dhr.virginia.gov/v-cris/</p>

Historic Registers, Virginia DHR	Listings of properties listed under the Virginia Landmarks Registers, and the National Register of Historic Places	https://www.dhr.virginia.gov/historic-registers/
DCR's Natural Heritage Website	Provides information on Natural Areas Preserves, Rare Species and Natural Communities, Native Plants, Invasive Plants, Caves/Karst, as well as site selection for Pollinator Smart Solar Sites	https://www.dcr.virginia.gov/natural-heritage/natural-area-preserves/
Virginia Natural Landscape Assessment (VaNLA)	A geospatial landscape analysis tool that can be used for identifying, prioritizing, and linking natural lands in Virginia. Provides data on Conserve Virginia priorities, agriculture, cultural resources, and other categories.	https://www.dcr.virginia.gov/natural-heritage/vaconvisvnla
DCR's Land Conservation Data Explorer Geographic Information System	Provides geospatial data on VA's conservation lands.	https://www.dcr.virginia.gov/natural-heritage/clinfo
VDOT's Scenic Byways Map	Provides maps of VDOT listed scenic byways throughout the State	http://www.vdot.virginia.gov/programs/prog-byways.asp
Virginia Estuarine and Coastal Observing System	Shows the results of water quality and meteorological data monitoring from the Chesapeake Bay and associated tributaries within Virginia.	http://vecos.vims.edu/Default.aspx
Chesapeake Bay Monitoring Cooperative – Chesapeake Data Explorer	A tool for storing and sharing data collected by a network of water quality. Contains data from multiple resources and monitoring sites throughout the CPDC region. Uses a GIS based map for displaying locations.	https://cmc.vims.edu/#/home

Chesapeake Bay Environmental Forecast System (CBEFS)	Uses a computer model to forecast the environmental conditions throughout Chesapeake Bay every day, including salinity and water temperature, along with dissolved oxygen and acidification. Low dissolved oxygen and changing acidification can have harmful impacts on the Chesapeake Bay ecosystem.	https://www.vims.edu/research/topics/dead_zones/forecasts/cbay/index.php
Adapt VA	Provides forecasting models regarding water levels, temperature, and precipitation. Also includes case studies for resilience planning for climate change, and data resources	http://adaptva.org/index.html
Sea Level Rise, NOAA	<ol style="list-style-type: none"> 1. Visualize potential impacts from sea level rise through maps and photos 2. Learn about data and methods through documentation 3. Share maps and links via email and social media 	https://coast.noaa.gov/digitalcoast/tools/slr.html
Coastal Flood Exposure Mapper, NOAA	Online visualization tool that supports localities in assessing their coastal hazard risks and vulnerabilities. Maps can be saved, downloaded, or shared to support communication of flood exposure and potential impacts.	https://coast.noaa.gov/digitalcoast/tools/flood-exposure.html
Wetland Condition Assessment Tool (WetCAT)	A spatially-specific, interactive, tool that provides water quality and habitat condition assessment for mapped non-tidal wetlands in Virginia.	https://www.vims.edu/ccrm/wetlands_mgmt/wetcat/index.php

EnviroAtlas, EPA	EnviroAtlas provides geospatial data, easy-to-use tools, and other resources related to ecosystem services, their chemical and non-chemical stressors, and human health.	https://www.epa.gov/enviroatlas
Chesapeake Bay and the Outer Coasts of Maryland and Virginia 2016 ESI FISH Polygons, Lines	This data set contains sensitive biological resource data for marine, estuarine, anadromous, and freshwater fish species in Chesapeake Bay and the Outer Coasts of Maryland and Virginia. Vector polygons in this data set represent fish distribution, concentration areas, spawning areas, nursery areas, and migration runs. Species specific abundance, seasonality, status, life history, and source information are stored in relational data tables (described below) designed to be used in conjunction with this spatial data layer. This data set comprises a portion of the ESI data for Chesapeake Bay and the Outer Coasts of Maryland and Virginia. ESI data characterize the marine and coastal environments and wildlife by their sensitivity to spilled oil. The ESI data includes information for three main components: shoreline habitats, sensitive biological resources, and human-use resources. See also the FISHL data layer, part of the larger Chesapeake Bay and the Outer Coasts of Maryland and Virginia ESI database, for additional fish information.	https://www.fisheries.noaa.gov/inport/item/55093
Virginia Vulnerability Viewer	Online mapping tool providing social and environmental vulnerability throughout Virginia	https://cmap2.vims.edu/SocialVulnerability/SocioVul_SS.html

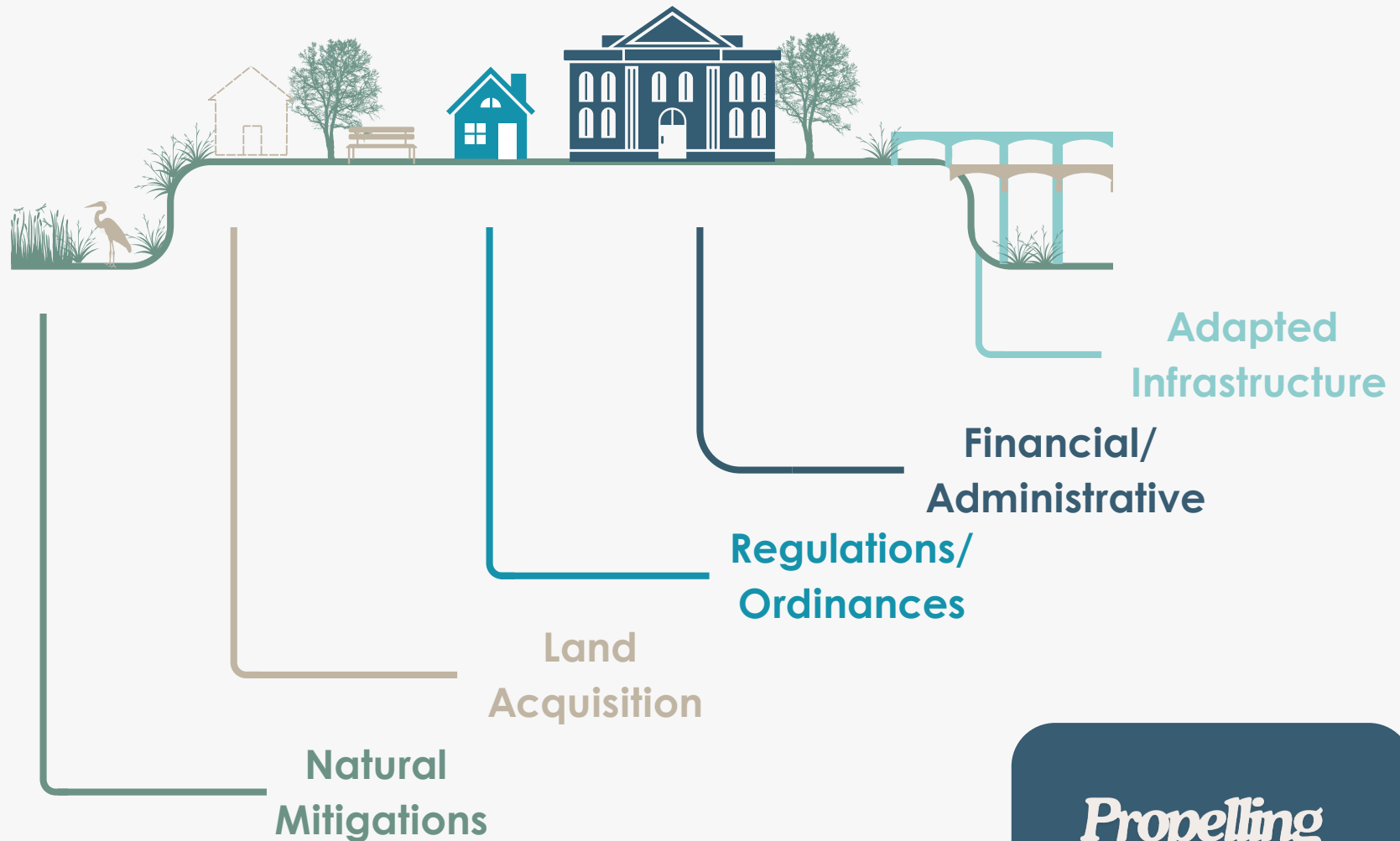
EJSCREEN: Environmental Justice Screening and Mapping Tool	<p>EJSCREEN is an environmental justice mapping and screening tool that provides EPA with a nationally consistent dataset and approach for combining environmental and demographic indicators. EJSCREEN users choose a geographic area; the tool then provides demographic and environmental information for that area. All of the EJSCREEN indicators are publicly available data. EJSCREEN simply provides a way to display this information and includes a method for combining environmental and demographic indicators into EJ indexes.</p>	<p><i>Link:</i></p> <p>https://www.epa.gov/ejscreen</p> <p><i>Limited English Proficiency Link:</i></p> <p>https://www.lep.gov</p> <p><i>Data Download:</i></p> <p>https://www.epa.gov/ejscreen/download-ejscreen-data</p>
VTrans Vulnerability Assessment	<p>Provides a screening level assessment of the vulnerability of Virginia's transportation system public roadways and VDOT-maintained structures, covered in the National Bridge Inventory (NBI), to projected sea level rise, storm surge, and inland/riverine flooding scenarios.</p>	<p>https://www.vtrans.org/long-term-planning/vulnerability</p>
VFRIS - Virginia Flood Risk Information System	<p>VFRIS is a Flood Tool map that provides data for general and CFPF grant applications including Social Vulnerability by Block groups, Dam Safety Layers in addition to Coastal Flooding Projections, NFHL Layers, and engineered models that include building footprints and elevation data.</p>	<p>https://casdsis.dcr.virginia.gov/VFRIS/?page=Map</p>

APPENDIX D

RESILIENCE PROJECT PRIORITIZATION MATRIX

Matrix begins on the following page.

Potential Flood Resilience Solutions



Potential Flood Resilience Solutions

Natural Mitigations

Natural features both in the water and on land can directly reduce the magnitude of flooding across the varying shorelines of Colonial Beach by reducing wave action, stabilizing landscapes, and absorbing excess floodwater.

Land Acquisitions

Land acquisitions can directly reduce the magnitude of flooding in areas of known flooding risk in Colonial Beach by absorbing excess floodwater, allowing for natural systems to reestablish while having the co-benefits of preserved open space, and lowering risk to flooding and other associated hazards.

Regulations / Ordinances

Beyond physical interventions, strengthening certain regulations and policy systems can help individuals prepare before a flood event, and improve the capacity of communities to recover after a flood.

Financial/ Administrative

Budgeting and financing to fund project planning and implementation using internal and external sources of capital.

Program and project management to allocate resources to oversee actions and achieve adaptation objectives.

Adaptive Infrastructure

Buildings and infrastructure systems can be sited, built, or retrofitted to withstand a certain magnitude of flooding event, helping to manage the residual risk that exists even behind protective infrastructure.

Action Score Rubric

Action Timeframe

Short 0-2 years

Medium 2-5 years

Long 5+ years



To enable ranking and comparison of projects, each metric is assigned a numerical score.

The Prioritization Approach is designed to allow metrics and methods for evaluating projects to be refined as better data becomes available.

5

Low Priority

10

20

Top Priority

RESILIENCE PROJECT PRIORITIZATION MATRIX

MITIGATION ACTIONS PRIORITY MATRIX Blank - N/A 0 - No 1-Maybe 2- Yes Action Score out of 22		Hazard Reduction Benefits				Co-Benefits				Factors for Implementation			ACTION SCORE	
		Water Retention	Coastal Flood Control	Shoreline Stabilization	Erosion Control	Aesthetics	Recreation	Action supports Socially Vulnerable populations	Education/ Outreach	Habitat Creation	Low Cost	Minimum Staff Time		Does not req. land acquisition
Financial/ Administrative														
1	Coordination with VDOT on maintaining and improving stormwater infrastructure on State roads.		1					2			0	1	2	6
2	Targeted community outreach for predominately minority, low-income, or other vulnerable communities or communities that are not always included in the planning process.							2	2		2	1	2	9
3	Coordinate with VDOT to install high water warning systems and signage along roadways informing that driving through standing water poses significant danger.								2		0	1	2	5
4	Conduct a vulnerability assessment of the Town's wastewater treatment plant and determine adaptation options to either retrofit the building or design and implement site strategies to mitigate flooding.		2					2			0			4
5	Identify drainage improvement opportunities along the following roadways: Ridge Rd./McKinney Blvd (SR 205) along Wilkerson Creek, Locust and Mimosa Avenues, and problems with a culvert on 4th Street. Residents also reported major flooding incidents near 1st Street and the challenges posed by sea level rise affecting Garfield and Wilder Avenues.		2					2			0	0	1	5
6	Join Community Rating System program to reduce flood insurance premiums		1					1	2		1	0	2	7
7	Install and maintain flood monitoring systems to provide real-time data on water levels and flood risks. This can help improve emergency response and inform future planning and Project Evaluation.							1	2		1	1	2	7

RESILIENCE PROJECT PRIORITIZATION MATRIX

MITIGATION ACTIONS PRIORITY MATRIX Blank - N/A 0 - No 1-Maybe 2- Yes Action Score out of 22		Hazard Reduction Benefits				Co-Benefits					Factors for Implementation			ACTION SCORE
		Water Retention	Coastal Flood Control	Shoreline Stabilization	Erosion Control	Aesthetics	Recreation	Action supports Socially Vulnerable populations	Education/ Outreach	Habitat Creation	Low Cost	Minimum Staff Time	Does not req. land acquisition	
Organizational														
8	Create a Resiliency Advisory Committee, representative of the communities being served, to provide community engagement and input on current and future initiatives and projects.							2	2		1	2	2	9
9	Identification of ecosystems, wetlands, and floodplains that are suitable for permanent protection or acquisition.	1	1	1	1	1	1	1		1	0	1	0	9
10	Partnering with other agencies to incentivize shoreline stabilization best management practices.	1	1	2	1	1		1			0	1	1	9
11	Assess the vulnerability of roadways and identify priority projects to improve drainage through grey and green infrastructure upgrades. Upgrades will help continuity of access to critical facilities and to physically isolated residents.		1					2			0	1	1	5
12	Increased education on residential and private property green infrastructure projects.	1	1	1	1	1		1	2	1	1	1	2	13
13	Offer training for residents and businesses on flood resilience practices and how to best implement resilience plan actions.	1	1	1	1	1		1	2	1	1	1	2	13
14	Inventory the Town of Colonial beach stormwater infrastructure to better understand flooding issues, stormwater system capacity, and stream conditions under future climate projections. Using the model, create a priority action plan of flood mitigation actions.	1	1	1	1	1	1	1	1	1	0	0	1	10

RESILIENCE PROJECT PRIORITIZATION MATRIX

MITIGATION ACTIONS PRIORITY MATRIX Blank - N/A 0 - No 1-Maybe 2- Yes Action Score out of 22		Hazard Reduction Benefits				Co-Benefits					Factors for Implementation			ACTION SCORE
		Water Retention	Coastal Flood Control	Shoreline Stabilization	Erosion Control	Aesthetics	Recreation	Action supports Socially Vulnerable populations	Education/ Outreach	Habitat Creation	Low Cost	Minimum Staff Time	Does not req. land acquisition	
Regulations and Ordinances														
15	Develop a debris management strategy or plan.								2		1	1	2	6
16	Incentivize and/or develop stormwater regulations and the use of green infrastructure in residential areas.	1	1	1	1	1		1	1		1	2	2	12
17	Support the adoption and enforcement of flood-resistant building codes for new construction and renovations. This ensures that structures are designed to withstand future flood events.	1	1	1	1	1		1	1		1	2	2	12
18	Develop comprehensive stormwater management minimum development standards	1	1	1	1	1		1	1	1	0	1	1	10
19	Complete a shoreline management assessment and plan.	1	2	2	2	1	1	1	1	1	0	1	0	13

RESILIENCE PROJECT PRIORITIZATION MATRIX

MITIGATION ACTIONS PRIORITY MATRIX Blank - N/A 0 - No 1-Maybe 2- Yes Action Score out of 22		Hazard Reduction Benefits				Co-Benefits					Factors for Implementation			ACTION SCORE
		Water Retention	Coastal Flood Control	Shoreline Stabilization	Erosion Control	Aesthetics	Recreation	Action supports Socially Vulnerable populations	Education/ Outreach	Habitat Creation	Low Cost	Minimum Staff Time	Does not req. land acquisition	
Infrastructure														
20	Elevate critical infrastructure such as roads, bridges, and utilities to reduce vulnerability to flooding. This includes retrofitting existing structures to meet updated flood elevation standards.		2	1	1			1			0	1	1	7
21	Implement Flood Mitigation and Water Quality Green Infrastructure.	1	1	1	1	1		1	1		1	2	2	12
22	Study the Hydrology of Monroe Bay and Potomac River to Determine Flood Risk.	1	1	1	1	1	1	1	1	1	0	0	1	10
23	Add Flood Mitigation BMPs to Town Parks and Historic Resources	2	2	1	1	1		1	1	1	1	1	1	13
24	Develop a Parks and Open Space Master Plan to identify and plan for Potential Acquisitions.	1	1	1	1	1	1	1	2	1	1	0	0	11
25	Identification of ecosystems, wetlands, and floodplains that are suitable for permanent protection or acquisition.	1	1	1	1	1	1	1	2	1	1	0	0	11