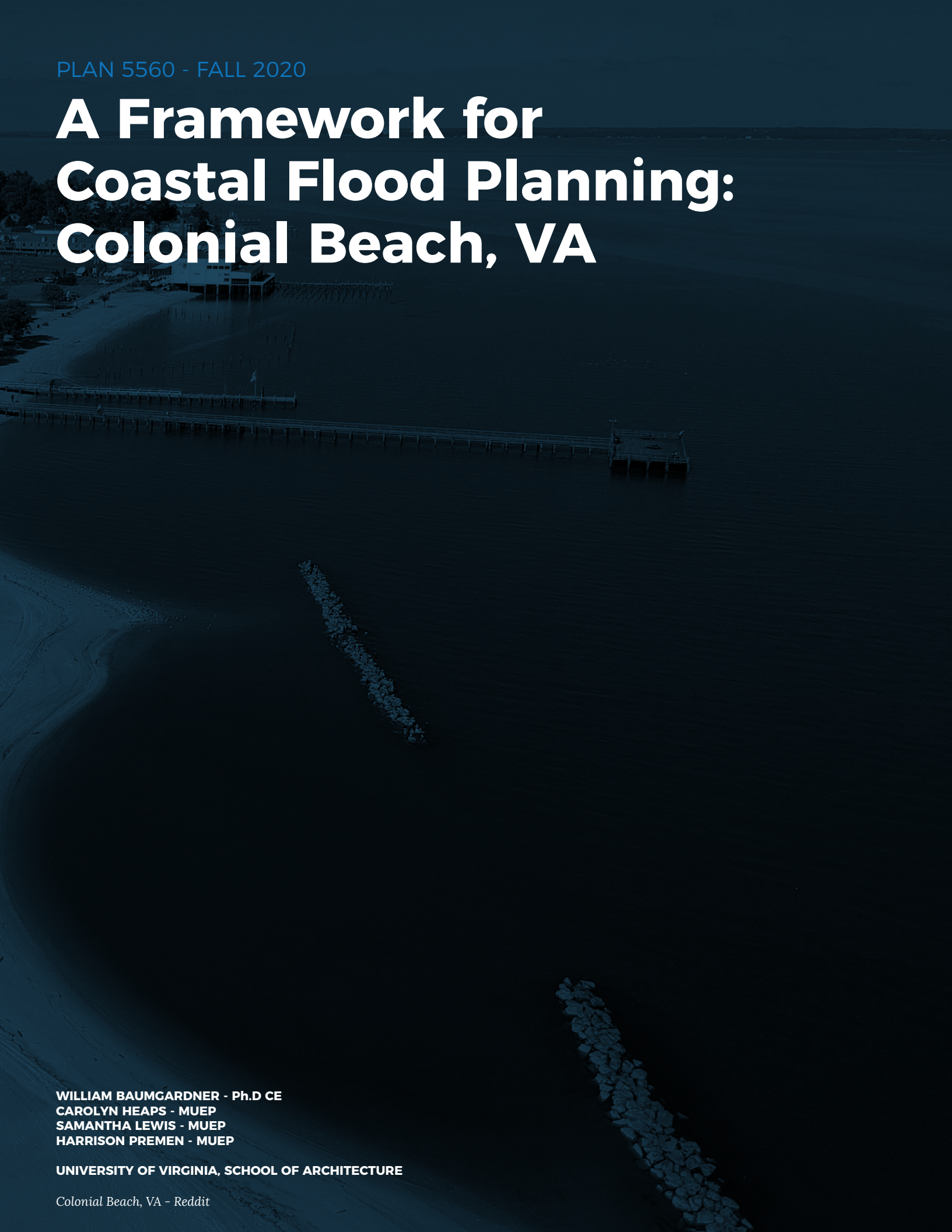
PLAN 5560 - FALL 2020

A Framework for Coastal Flood Planning: Colonial Beach, VA



WILLIAM BAUMGARDNER - Ph.D CE
CAROLYN HEAPS - MUEP
SAMANTHA LEWIS - MUEP
HARRISON PREMEN - MUEP

UNIVERSITY OF VIRGINIA, SCHOOL OF ARCHITECTURE

Colonial Beach, VA - Reddit

Contents

Acknowledgements

Honoring the Traditional Stewards of this Land

We acknowledge the Powtahan peoples as the traditional stewards of the land on which Colonial Beach was founded. Local indigenous communities continue to inhabit their ancestral lands in Virginia's tidewater region. Climate planning centered on equity should involve these tribal groups in building a holistic, reciprocal approach to creating an adapted future. An adapted future should center on building respect and appreciation for the land upon which we all rely.

This Framework was authored by students at the University of Virginia, who recognize the Monacan peoples as the original custodians of the land upon which the University now exists.

Introduction

INTRODUCTION

Colonial Beach is a small town with strong connections to the Potomac and Chesapeake that have shaped its history, and will continue to influence its culture and character into the future. The town's coastal geography brings both opportunities and challenges.

Among the challenges is coastal flooding, a risk which is being exacerbated by the reality of rising sea levels and more frequent storm events triggered by climate change. 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., above rates recorded both at nearby Sewell's Point and Gloucester Point.

The Town has already taken various measures to address shoreline erosion and flooding, particularly by installing shoreline management infrastructure, like seawalls and breakwaters. However, Colonial Beach has not yet created a holistic coastal resilience strategy to pair these measures with other green infrastructure, gray infrastructure, land use, and economic strategies. IN creating such a strategy alongside community members, the Town can more effectively prepare itself for coastal flooding before the worst impacts are realized.

This is an opportune moment for planning to begin. Colonial Beach is already building capacity and achieving priority resilience measures by participating in the Resilience Adaptation Feasibility Tool (RAFT), alongside other Counties and Towns in the Northern Neck. Further, Governor Northam released less than two months ago the Coastal Resilience Master Planning Framework, which aims to complete a Coastal Resilience Master Plan for the Commonwealth by the end of next year. Included in this is an expectation that coastal localities will conduct analyses of their resilience priorities to feed into the state-wide plan.

Goals

This document aims to support the Town in identifying, together with Town stakeholders, its coastal adaptation priorities predicated on climate science. It is a starting point which provides initial findings and a recommended framework by which future detailed, community-driven and locally-informed planning can occur. It is not intended to be a final plan, and does not comprehensively address all adaptation opportunities.

- Provide a framework for Colonial Beach to use in working toward a climate adaptive future.
- Equip the Town with potential climate adaptation strategies to employ to address coastal flooding vulnerabilities.
- Reflect ongoing initiatives at the Town and state levels to ensure entry points and connectivity for implementation.

EQUITY

Marginalized populations face the impacts of climate change at heightened and compounded rates. To ensure that climate adapted futures address, and do not exacerbate existing inequities, planning efforts must be inclusive of voices from many races, ethnicities, ages, and socioeconomic backgrounds, and must be accountable for equitable planning and action.

CO-CREATION

Any plan is most successful if developed in close coordination with the community at large, as opposed to by town staff and traditional subject matter experts alone. The local community offers valuable insights into current conditions, and also should drive the process of creating a vision for the future of the community at large.

AMBITION & ATTAINABILITY

Colonial Beach is a small town facing a daunting challenge. It is necessary that climate adaptation measures be ambitious enough to reflect the scale of sea level rise forecasted, while still reflecting the realities of the number of Town staff and the amount of funding available for coastal adaptation measures.

ACCOUNTABILITY

It is not enough to create a plan - it must also be implemented in order to be effective. This framework is premised on the idea that the Town must be responsible to its residents and business owners for achieving the objectives that are co-created as part of the planning process. Implementation must be transparent.

ADAPTIVE MANAGEMENT

As plans are implemented, the should be monitored to understand how impacts are being felt by the community, and the degree to which they are producing intended outcomes and reducing risk. Ongoing monitoring and evaluation should be coupled with a process of learning, in which findings are fed back into implementation of the plan. Adjustments should be made where monitoring identifies deficiencies.

SCIENTIFIC BASIS

There is a significant amount of scientific evidence documenting the observed and anticipated impacts of sea level rise across the nation as well as here in Virginia. To be most effective in preparing for future realities, adaptation priorities should be premised on a solid scientific basis, and should also be flexible enough to recognize that there is still much unknown about how climate change impacts will occur - dependent on the degree to which the global community can effectively curb greenhouse gas emissions - and as a result, multiple climate scenarios exist.

This framework examines climate change within the generally accepted 1.5C change in global temperatures by 2050. The data we used throughout the project comes from data and files sourced from a variety of federal and state agencies. Our sea level rise (SLR) data is sourced from metadata from the U.S. Geological Survey (USGS), NOAA, ESRI, National Flood Hazard Layer, National Flood Insurance Program, and the Federal Emergency Management Agency (FEMA). Storm surge is accounted for through similar sources like the USGS, NOAA, and FEMA. While this data is publicly accepted, there are always discrepancies with predictions. The data used and represented is to illustrate educated scenarios for Colonial Beach and real results may fluctuate. Localized monitoring will play an important role in adapting to coastal flooding as sea levels rise to observe and respond to impacts at the local level, including based on localized factors not captured in national-level analyses, like land subsidence rates.

Background & Current Conditions

CURRENT CONDITION (2020)

The Town of Colonial Beach, Virginia is located in Westmoreland County, in the Northern Neck of the state along the Potomac River. It exists in proximity to both Washington, DC (located 65 miles to the north) and Richmond, VA (located 70 miles to the south). Home to approximately 3,500 residents, Colonial Beach takes pride in its history as a tourist destination, its connection to the Potomac, and its small-town charm.

CURRENT CONDITION (2020)

FLOOD RISK (10’ SLR)

BACKGROUND INFORMATION

History and Overview

Colonial Beach began to develop in 1878, when Henry Kintz purchased 650 acres of land on what is now known as The Point. Within the next five years, businesses had begun to imagine the town developing as a summer resort for Washington, DC residents. It was incorporated in 1892, and soon became a destination for thousands of visitors from DC, who arrived via steamboat on The Potomac.

Residents of the town have a long history of reliance on natural systems and resources for their livelihoods. The Potomac, in addition to being a tourist destination, fuelled the oyster industry, which was fraught with conflict between the states of Virginia and Maryland, as well as between harvesters and regulation enforcement. In 1959, Berkeley Muse, a Colonial Beach resident, was shot and killed in an incident which led to the creation of the Potomac River FIsheries Commission. River and bay oyster populations are slowly recovering from decimation that occurred in the 20th century from overharvesting, disease, and habitat loss.

Ongoing Adaptation Efforts

The Resilience Adaptation Feasibility Tool (RAFT)

Colonial Beach is currently engaging with The Resilience Adaptation Feasibility Tool (RAFT), implemented by a three-university partnership between the Institute for Engagement and Negotiation (IEN) at UVA, the Virginia Coastal Policy Center (VCPC) at William & Mary, and the Old Dominion University Resilience Collaborative in collaboration with the Northern Neck Planning District Commission. This process produced a coastal resilience scorecard, which rated the town as having an existing level of "moderate resilience". Based on this scorecard, Colonial Beach has established five resilience actions it will take in the next year to improve its coastal resilience: (1) Address shoreline erosion, (2) Improve stormwater management, (3) Integrate resiliency into the comprehensive plan, (4) Create a Colonial Beach resilience committee; (5) Develop a resilience communication strategy. Although the town has identified clear goals and strategies related to addressing coastal flooding through the RAFT process and in general, it does not have an existing coastal or climate vulnerability assessment nor a comprehensive coastal or climate adaptation plan. The RAFT looks at resilience broadly, but does not produce a holistic climate vulnerability assessment, nor a town-wide strategy for responding to climate-induced coastal threats.

The Virginia Coastal Resilience Master Plan

On October 22, 2020, Virginia Governor Northam and his administration released the Virginia Coastal Resilience Master Planning Framework, a document which outlines the Commonwealth's approach to increasing the resilience of coastal communities and economies. The Framework presents a roadmap for Virginia to develop and begin implementing a Coastal Resilience Master Plan by the end of 2021. The final plan will aim to improve Virginia's resilience and adaptive capacity to rising seas, increased nuisance flooding, and more frequent and intense storms resulting from climate change. It will be informed by localities' coastal resilience priorities, and aims to support the development of those priorities. Further, a key element of the state-level approach to coastal adaptation is the development of a Community Flood Preparedness Fund, which will be used to assist coastal localities affected by recurrent flooding, sea level rise, and flooding from severe weather events through grants and loans. The final guidelines for the fund are expected to be published by March 1, 2021, but the draft guidelines suggest that projects should align with localities' resilience plans[1].

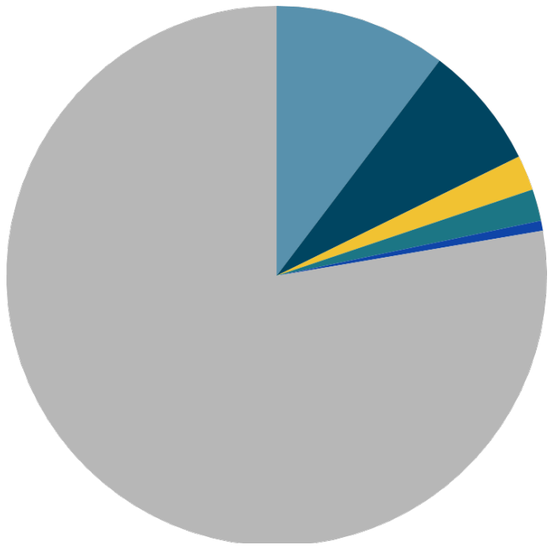
1. *Virginia Department of Conservation and Recreation, "Community Flood Preparedness Fund Draft Guidelines Priorities and Approach," Virginia Regulatory Town Hall, Accessed December 11, 2020, https://www.townhall.virginia.gov/l/GetFile.cfm?File=C:\Town-Hall\docroot\GuidanceDocs_Proposed\199\GDoc_DCR_4665_20201118.pdf.*

Demographics[1]

Colonial Beach has a population of approximately 3,500 residents. Among these individuals there is a high proportion of older residents. Thirty percent of the population is over the age of 65, and the median age is 48, which is higher than the median age in the United States as a whole by ten years. Twenty-three percent of the population is less than 18 years of age. There are more female than male residents in the town, skewed in part by the elderly population. Racially, the town is primarily White (approximately 78 percent). About 10 percent of residents identify as Black, and about 7.5 percent identify as two or more races. Additionally, approximately 7.5 percent of residents identify as hispanic or latino. Residents living with a disability make up 17.8 percent of the population More than fifteen percent of residents are veterans.

The median annual income in the Town of Colonial Beach is $47,367, and the mean annual income is $73,954. Poverty rates are at 15.6 percent, which is higher than the national poverty rate of 10.5 percent. Approximately 90 percent of residents are high school graduates, and about 25 percent hold a bachelor's degree.

Town Demographics



1. *The following data were obtained from 2018 5-year ACS data from the US Census Bureau. Notably, the town's small population leads to high margins of error in all categories. This should be kept in mind when reading the section.*

BACKGROUND INFORMATION

Land Use & Zoning

The Town of Colonial Beach is a low density riverside community that consists of mainly single family residential developments, a historic old town & tourist area, a small commercial corridor, and a select few multifamily developments. As of 2008, it was estimated that around 69% of the town consisted of residential and vacant/underdeveloped land, followed by roads & rights of way, then public/semi public, and finally commercial at 7%. Regarding how these uses are spread throughout the town, older resort-style homes can be found in the Southern peninsula of the Town, while the housing stock becomes progressively younger North and West of the town. Most of the public access land and beaches are located in the peninsula and in the center of town. Commercial uses are primarily concentrated in the along Colonial Avenue, the resort district, and at the Beachgate Shopping Center. A large portion of land in the NorthWest remains vacant with the potential for it to be a PUD. These uses and their concentrations can be seen in the map below[1].

The town is additionally divided into seven different planning areas, each with their own characteristics and planning objectives. Starting on the peninsula in the South, the districts are The Point, Central and Monroe Point to the West, Classic Shores, Riverside Meadows, and Bluff Point with Potomac Crossing to the West.

The Point consists of all land South of Boundary street. It is primarily a single family residential area, with public beaches along the Potomac and marinas surrounding Monroe Bay. It was one of the first areas developed in the town, thus making it, and many of its structures, historically significant. The most important concern of this planning area is with the preservation of its historical resources.

Central Area serves as the core of the town, where Colonial Avenue, and the Historic & Tourism Area are, as well as most municipal services. This area hosts some of the most diverse land uses in the town, and hosts multiple restaurants and tourist attractions. There are parcels of vacant land which are owned by the town[2].

Monroe Point serves as the gateway to Colonial beach connecting it to Westmoreland County. This is where the shopping center is located, in addition to a high density multifamily residential development.

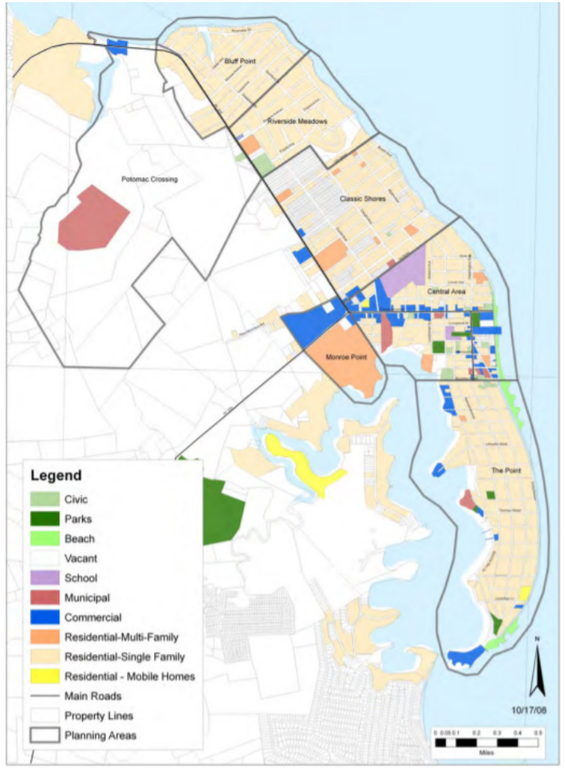
Classic Shores is just North of the Central Area, and is primarily a single family residential area with a few multifamily structures.

Riverside Meadows is further north and consists of newer housing stock on larger lots. Additionally, it is the site of the Mary Washington Health Care Center.

Bluff Point is the Northernmost point of the Town, with large single family lots.

Potomac Crossing is just West of Riverside Meadows and Bluff Point, serving as another entrance to the town. It is primarily undeveloped, serving as the location for the municipal water facility and wetlands. There are considerations of this area being a future PUD site.

1. *Town of Colonial Beach, "Town of Colonial Beach 2009 Comprehensive Plan: Chapter 2 Existing Conditions and Analysis," https://colonialbeachva.net/wp-content/uploads/2018/06/Chapter-2-Existing-Conditions-and-Analysis.pdf*
2. *Town of Colonial Beach, "Town of Colonial Beach Incomplete Comprehensive Plan 2020: Chapter 2 Existing Conditions and Analysis,"*



Districts & Zones

Colonial Beach has a multitude of zoning designations that regulate the development of the town. How these ordinances shape development also shape how exposed, sensitive, and adaptive the community is to coastal flooding.

For residential zoning, the municipality has five distinct classifications. These classifications are Residential Limited (R1), Residential General (R2 & R2a), Residential (R3), and Residential High Density (R4). Out of these five classifications, only R4 allows for multifamily developments, with the other classifications regulating how dense single family developments can be. Additionally, only the latter three classifications,R2a, R3, and R4 have provisions for non-residential uses. The R2a zone is the most restrictive out of the three, stating that only certain types of services that revolve around public needs, recreation, or education can apply for a conditional use permit. The R3 and R4 zones address commercial uses, with the R3 being the more restrictive, requiring blending in with the urban form. Finally, there are two mobile home zones within the area.

Regarding commercial zoning, the town has four different classifications. These are the Commercial Residential (CR), Commercial General (C1), Heavy Commercial (C2), Maritime Commercial (MC), and Resort Commercial (RC). Only the CR district accommodates for residential uses, focusing on the "transitional mixture of uses," dulling the contrast between the zones and allowing for mixed use structures. Both the C1 and C2 districts provide for average commercial developments, with the c2 classification specifically for heavier uses such as shopping centers. The MC district is located along Monroe Bay south of Boundary Street for waterfront/ dependant businesses. Finally, the RC district is located around the Central District and is for the development of tourism in the town.

There are four other classifications that cover a wide range of uses. The agricultural district (A1) is primarily for farming and light residential uses. The municipality allows for the zoning of manufactured home parks (MHP) as well. It also allows for a small degree of industrial development in its Light Industrial District (I1) where uses include "light manufacturing, fabrication, warehousing, and wholesale distribution." Finally, Colonial Beach has a Planned Unit Development district to shape future development[1].

1. *Town of Colonial Beach, "Colonial Beach Zoning Ordinance: Article 3 Districts And Zoning Map Description," https://colonialbeachva.net/wp-content/uploads/2018/07/Article-3-Districts-and-Zoning-Map-Description-Updated-October-2012.pdf*

Left: Colonial Beach Existing Land Use Map, Colonial Beach 2009 Comprehensive Plan

Below: Colonial Beach Future Land Use Map (2009-2029), Colonial Beach 2009 Comprehensive Plan

BACKGROUND INFORMATION

Zoning Overlays

There are currently two major overlays in the Town of Colonial Beach that are codified in the zoning ordinance, both of which revolve around environmental regulation. The first of these two overlays is the Floodplain Overlay District, which regulates the interaction between land use, building codes, and flood zones. The Floodplain Overlay creates zones that add an additional layer of regulation to mitigate damages from flooding. These zones are the Floodway District (which is within an AE zone), the AE or AH Zones, the A Zone, the AO Zone, the Coastal A Zone, and the VE or V Zones. Each of these zones carry additional regulations on land use and building.

The Floodway District is an overlay where, "certain areas within the floodplain must be capable of carrying the waters of the one percent annual chance flood without increasing the water surface elevation of that flood more than one (1) foot at any point." There are none in the town.

- The AE or AH Zones are areas where "one-percent annual chance of flood elevations have been provided and the floodway has not been delineated."
- The A Zone is for "areas for which no detailed flood profiles or elevations are provided, but the one percent annual chance floodplain boundary has been approximated."
- The AO Zone indicates shallow flooding.
- The Coastal A Zone is for areas "that are subject to wave heights between 1.5 feet and 3 feet, and identified on the FIRM by the Limit of Moderate Wave Action (LiMWA) line."
- The VE or V Zones are for "areas that are known as Coastal High Hazard areas, extending from offshore to the inland limit of a primary frontal dune along an open coast."

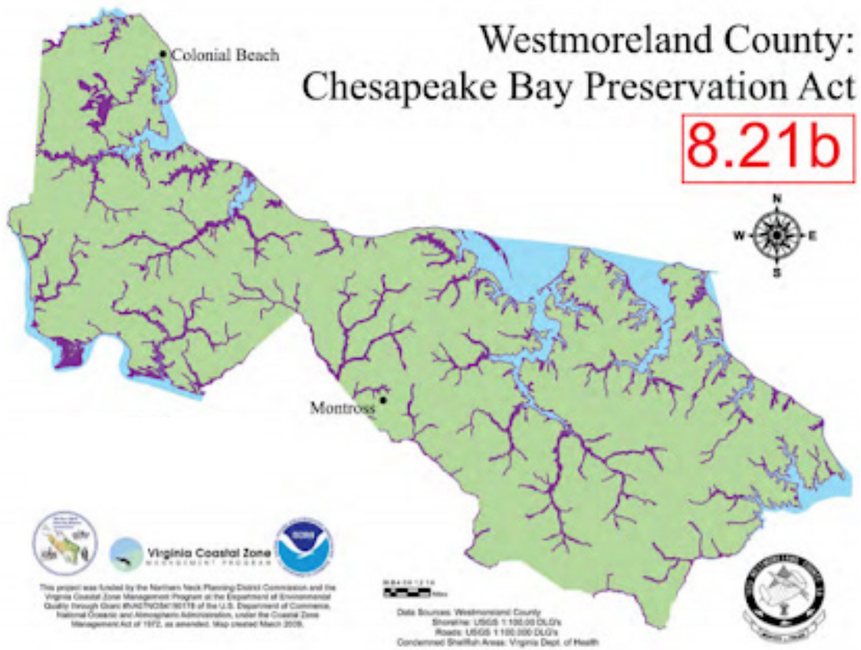
The other major overlay enacted in the municipality is the Chesapeake Bay Preservation Area Overlay District. The goal of this ordinance is to protect water quality for the bay through the protection of environmental resources in a resource protection area or a resource management area. The resource protection area includes features such as wetlands, tidal shores, "slopes equal to or greater than twenty-five (25) percent" in certain areas, and "a 100 foot wide vegetated buffer area located adjacent to and landward of the components listed." The other area includes all other areas of the town not included in the Resource Protection Area. Development is heavily restricted in the Resource Protection Area, with goals to protect natural features, tree restoration, limiting impervious surfaces, creating buffer areas, and water quality impact assessments[2].

The Town of Colonial Beach is investigating the possibility of utilizing new overlay zones, or expanding upon existing ones, to guide development of the town. Two of these are Rt. 205 Overlay District and the Colonial Avenue Corridor Overlay District. The former focuses on the goal to "preserve the integrity of this important transportation," which translates to limiting conflicts between the main roadway and secondary and access roads, and beautification measures. It covers all portions of Rt. 205 within the town borders. The latter focuses on the main town avenue and how the municipality aims to revitalize the corridor through street redesigns, including beautifications and building code changes. This zone extends from the intersection of Rt.205 & Colonial Beach to the beginning of the Resort Commercial District.

The next overlay the municipality aims to implement is the creation of an Historic District that would cover much of the Southern portion of the town. The main drivers for seeking historic designation status from the Virginia Department of Historic Resources are that the potential funding and grant benefits that the town and residents would be able to access, and the justification of creating a local historic overlay for additional land use and structure regulations.

Two other types of overlays that the town is exploring to implement and/or expand are Enterprise Zones and the HUB Zone. The enterprise zone is a partnership between the locality and the Commonwealth where grants can be bestowed upon businesses for economic development and is located

Right: Westmoreland County Cheseapeake Bay Preservation Act Map
Facing Page, left: Colonial Beach Future Land Use Zoning Map
Facing Page, Right: Proposed Historic Disctrict Map



Resource Protection Area

Resource Management Area

along Colonial Avenue and the Resort Commercial District. The HUB Zone is a federal program that steers federal contracts towards small businesses in these areas.

1. *Town of Colonial Beach, "Colonial Beach Zoning Ordinance: Article 21 Floodplain Ordinance Updated January 2015," https://colonialbeachva.net/wp-content/uploads/2018/07/Article-21-Floodplain-Ordinance-Updated-January-2015.pdf*
2. *Town of Colonial Beach, "Colonial Beach Zoning Ordinance: Article 22 Chesapeake Bay Preservation Overlay Updated December 2006," https://colonialbeachva.net/wp-content/uploads/2018/07/Article-22-Chesapeake-Bay-Preserv-Overlay-Updated-December-2006.pdf*
3. *Town of Colonial Beach, "Town of Colonial Beach 2009 Comprehensive Plan: Chapter 4 Future Land Use Plan," https://colonialbeachva.net/wp-content/uploads/2018/06/Ch4-Draft-Future-Land-Use-Plan-8-17-09.pdf*

Below: Images from VFRIS illustrating the flood zone overlays for key sites around the town

Future Land Use Plan

For their future land use plan, the Town of Colonial Beach has created multiple different zoning classifications to guide future development. The main categories are Residential Districts and Commercial Districts.

Within the residential category, there are Neighborhood Preservation Designations, Cluster Development, Planned Unit Development, and Medium Density Multi-Family Residential.

The Neighborhood Preservation designation covers almost all of the current land zoned for some form of residential and is used to preserve the area's current aesthetic regarding the shape and use of structures. For example, the different planning areas have their own versions. Starting in the south, both the The Point and Central Area aspire to maintain the surrounding historic and small character of the area and restrict future development to low density housing, small stores, and waterfront businesses. Just North of these areas, Classic Shores aims to maintain its focus on accommodating for more housing, albeit with a preference for single family homes. Finally, Bluff Point and Riverside Meadows have a similar outlook compared to Classic Shores, except with much larger lots and no tolerance for multifamily structures[1].

The Cluster Development designation is for the fringe areas in and around the town to preserve much of the natural and agricultural open space. However, this requires coordination with Westmoreland County since these areas are outside of the municipal jurisdiction.

The Planned Unit Development is for the undeveloped area of Potomac Crossing. There are plans for a master planned mixed-use community combined with preservation and golf opportunities, but this has not gone into fruition yet.

The Medium Density Multi-Family Residential designation is for current multi-family structures in the town. These areas are very limited and are subject to multiple regulations on form.

There are 3 commercial designations under the Commercial category. The first is General Commercial, which covers most of the existing commercial uses in the town and concentrates development into a few select areas which encourages redevelopment and reinvestment in existing commercial zones. The Historic Resort Commercial designation is for a small defined area in Central Area for the development of tourism while maintaining the town character. Finally, Maritime Commercial covers water-related businesses on both the bay and the river[2].

1. *Colonial Beach 2020 Comprehensive Plan*
2. *Town of Colonial Beach 2009 Comprehensive Plan, ch.4*

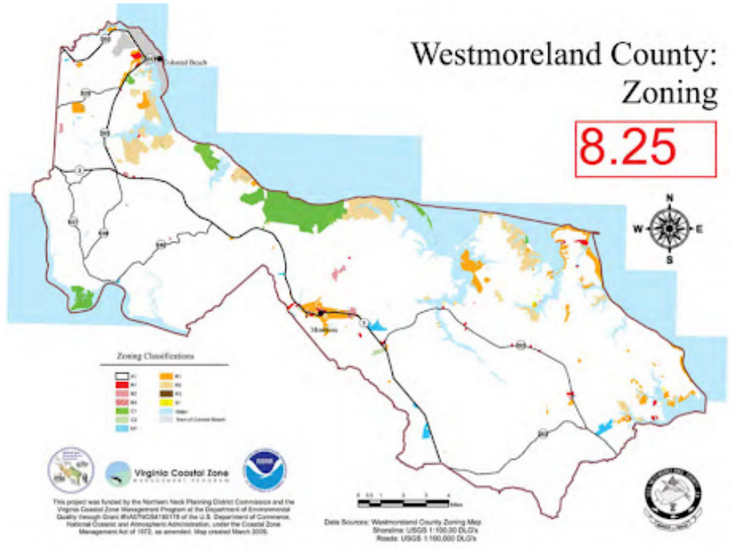
Below: Colonial Beach Future Land Use Map (2009-2029), Colonial Beach 2009 Comprehensive Plan

BACKGROUND INFORMATION

Westmoreland County Land Use

The Town of Colonial Beach is surrounded by Westmoreland County. According to the County's Zoning Map, areas outside of the town borders are currently zoned as Agriculture (A-1), Residential General Uses District (R-1), or Business General District (B-1). The R-1 and B1 zones are for less dense development of residential and commercial areas respectively[1]. Additionally, according to the Westmoreland Comprehensive Plan, the county's main goal is to concentrate future growth around existing towns in designated primary and secondary growth areas. Although these areas will host a majority of the new development, the county still aims to maintain the existing characteristics of the towns. While the primary growth areas are for the development of multiple types of residential, commercial, and industrial uses, with the potential for expansion of public infrastructure, the secondary growth areas are second priority regarding development and utility expansion[2].

1. *Westmoreland County, "Westmoreland County's Vision 2030 Comprehensive Plan 3.2 Future Land Use," https://www.westmoreland-county.org/sites/default/files/docs/comp_plan_adopted.pdf*
2. *Westmoreland County, "Zoning Ordinance: Article 2 Base District Regulations," https://www.westmoreland-county.org/sites/default/files/docs/Article%202%20Base%20District%20Regulations.pdf*



Top: Westmoreland County Zoning, Westmoreland County's Vision 2030 Comprehensive Plan
Bottom: Westmoreland County Future Land Use, Westmoreland County Vision 2030 Comprehensive Plan

Housing

Colonial Beach's housing stock of approximately 2,100 units is **dominated by single-family detached units**[1] which are dispersed throughout the town, including along the waterfronts of Monroe Bay and the Potomac. As of 2018, nearly 82% of housing structures were of this type[2], with a slight downward trend (1.6%) since 2000[3]. Sixty-three percent of occupied dwelling units in Colonial Beach are owner-occupied[4], which is slightly lower than Virginia's average owner-occupancy rate of 66%[5]. Data from 2000 shows that 20% of housing units were occupied seasonally[6], reflecting the **large proportion of second or vacation homes in the town.** 2018 data from surrounding Westmoreland County indicates that 21% of housing in the county is seasonally occupied[7].

Aside from single-family homes, approximately 8 percent of the housing market is five- to nine-unit buildings[8], including Riverwood Apartments and Colonial Beach Apartments. The Meadows provides 33 units restricted to elderly and rent-restricted residents. Additionally, there are numerous condominium buildings located along the Potomac, including Potomac Renaissance Condominiums, St John's Condominiums, and Potomac Wharf Condominiums, that cater to seasonal residents. There is also a sizable development of attached single-family units at Monroe Point and Lynnhaven Court, both of which are river and inlet adjacent. The median home value for owner-occupied residences is approximately $230,000[9], however, there is a fairly wide range of housing prices, with 80% of owner-occupied housing value falling between $150,000 and $499,000. Rental pricing also has a wide range, with a median of $1,019.

According to the town's 2009 comprehensive plan, building permit issuance over the period 2000 to 2007 indicates a 22 percent increase in new construction of single family housing units, including condominiums and townhomes. This trend didn't continue following the housing crisis and Great Depression; 3 percent of the town's housing stock was built since 2010. Otherwise, **the housing stock varies widely in age,** with periods of development throughout the past century. Fully 11 percent of the town's housing stock was built before 1939, reflecting the town's history as a resort town in the early twentieth century[10]. Future housing development must occur either in the planned unit development space in the town's northwest corner, or as infill.

1. *United States Census Bureau, "Selected Housing Characteristics: Colonial Beach town, Virginia," 2018, https://data.census.gov/.*
2. *United States Census Bureau, "Selected Housing Characteristics"*
3. *Town of Colonial Beach, "Town of Colonial Beach 2009 Comprehensive Plan: Chapter 1 Community Profile," https://colonialbeachva.net/wp-content/uploads/2018/06/Chapter-1-Community-Profile.pdf.*
4. *United States Census Bureau, "Selected Housing Characteristics*
5. *United States Census Bureau, "Selected Housing Characteristics*
6. *Town of Colonial Beach, "2009 Comprehensive Plan"*
7. *Spencer Stanholtz, "Where are the vacation homes in Virginia?" StatChat, University of Virginia Weldon Cooper Center for Public Service, March 25, 2020, http://statchatva.org/2020/03/25/virginia-vacation-homes/.*
8. *United States Census Bureau, "Selected Housing Characteristics*
9. *Realtor.com, "Colonial Beach, VA Real Estate Market," Accessed 11 December 2020, https://www.realtor.com/realestateandhomes-search/Colonial-Beach_VA/overview.*
10. *United States Census Bureau, "Selected Housing Characteristics*

Above: Standard single-family housing stock, Zillow
Below: Single-family house on the water, Samantha Lewis

BACKGROUND INFORMATION

Infrastructure

The infrastructure of Colonial Beach can be categorized into civic infrastructure and climate infrastructure.

The town is dependent on Route 205 to provide access to the greater highway system and also serves as the primary entrance/exit for the Town and the primary evacuation route. For the Route to keep up with projected population increases, the lanes must expand from two (2) lanes to four (4). Route 205 also maintains arterial sidewalks at 5' widths that allow for pedestrian circulation throughout the Town. The typical local street condition lacks proper stormwater drainage and sewer access along with a lack in sidewalk infrastructure connecting to the rest of the Town. Overall, traffic congestion throughout the year is relatively low with the exception of local festivals and holidays. Looking ahead, the town must also consider paving the remaining gravel roads and increase overall sidewalk infrastructure. The existing street network also functions as bikeways that connect with beachfront boardwalks and tourist areas.

Colonial Beach also maintains a public transit service aimed at the aging population. These shuttle buses are equipped with handicap accessibility and maintain routes in all neighborhoods and surrounding nearby areas.

Natural infrastructure is also found throughout the town with a primary hard edge of rip rap lining the eastern city edge. Down south on the peninsula, segmented breakwaters are incorporated into the beach edges to reduce tidal velocity, flooding, and to increase sediment accretion for the beaches. The northern communities of the Town also maintain low-lying vegetated areas which help with flood and stormwater control. Looking ahead, these forms of green infrastructure must be maintained and expanded to create a resilient network of infrastructure that works to protect the citizens and property of the Town.

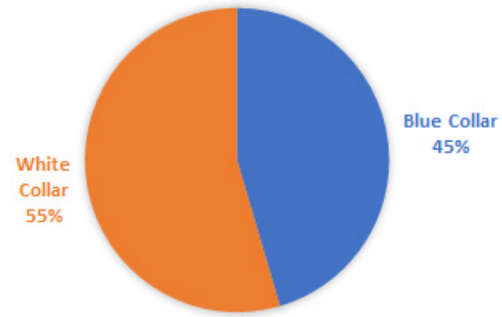
Top: Route 205 Bridge
Bottom: Colonial Beach Yacht Club

Main Economy & Politics

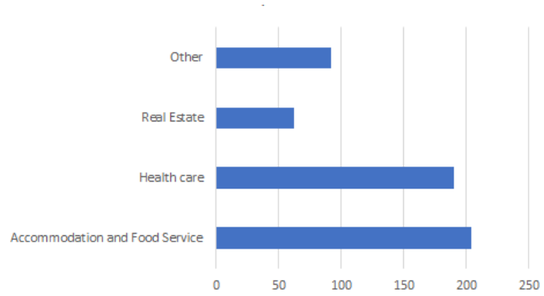
Colonial Beach's main economic drivers center around tourism. This includes restaurants and marinas. Secondarily, it operates as a small bedroom community for nearby larger cities like Fredericksburg, Washington DC, and Dahlgren Naval Station[1]. In 2019, the top jobs by occupation were office/administration, food prep and serving, and sales. The town has a labor force of 1,349 people and the work is fairly evenly split with 45% blue collar workers and 54% white collar workers[2]. In 2019, the town of Colonial Beach had 145 businesses with most having no more than 10 employees in the sectors of accommodation, food service, healthcare, real estate and other services such as personal care, and laundry services.

Colonial Beach has a standard revenue stream from taxes, permits, fees, fines, and interest. Other streams of revenue include federal and state grants and the sale of property which are directed toward specific town needs[3]. One of the needs of the plan per the 2020 Draft Comprehensive Plan is to seek a historic district designation[4]. The town has set up a preliminary historic district that includes areas on The Point and parts of the central area, and recognizes that the area may need to be modified as they continue community discussions. There are three districts within town limits that are designated for tax incentives; an arts and culture district, a technology zone, and a tourism zone[5,6]. In the arts district, qualifying businesses enjoy 100% BPOL tax abatement for two years, reduced BPOL taxes for three years afterwards, one time property tax credit or credit for installing energy star appliances. In the technology and tourism zones, businesses can receive abatement of BPOL taxes for three years and then a reduction in taxes for several years following, a one time waiver of planning and zoning review fees, and businesses can submit an application to the planning commission and town manager to qualify for other incentives.

Job Type



2019 Top Jobs



1. "*Town of Colonial Beach 2009 Comprehensive Plan: Community Profile*" (2009), 12.
2. *ZoomProspector*, "Colonial Beach," ZoomProspector, GIS Planning, Inc, 2019. *https://www.zoomprospector.com/communities/va/city/colonial-beach/5118400*
3. *Colonial Beach Planning Commission*, "*Capital Improvement Plan (2019-2020)*" (Colonial Beach, VA, 2019).
4. *Colonial Beach Planning Commission*, "*Draft: Comprehensive Plan 2020-2030*," (Colonial Beach, VA, 2020).
5. *Municode*, "Colonial Beach, VA-*Code of Ordinances: Chapter 23, Technology Zones*," (Colonial Beach, VA, 2010)
6. *Municode*, "Colonial Beach, VA-*Code of Ordinances: Chapter 24, Arts and Culture District*," (Colonial Beach, VA, 2011).

BACKGROUND INFORMATION

Flood Risk

Localized sea level rise rates in Colonial Beach have been recorded at 4.89 mm/year (see Figure X)[1], 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 Gloucester Point[2].

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 (see Table 1)[3]

These levels will be further exceeded by high tides and storm surges. In addition to bringing rising seas, climate change is forecasted to result in increased rates of precipitation and storm events. Hurricane Isabel, the Town's last major storm event, brought 6.5 ft of storm surge. Overall, precipitation during the summer and fall months is already on the rise in Virginia (see Figure X)[4], and forecasts estimate that the Colonial Beach area will see a 12% rise from historical averages in the number of days per year with rainfall greater than 2" by 2035[5].

As of 2017, there were 13 structures in the Town considered Repetitive Loss, with an additional 30 repetitive losses amounting to $1,452,579 in damage payments for $5,371,179 in property value. The existing stormwall and segmented breakwater infrastructure surrounding the Potomac border of the town provide the primary forms of sea level rise and storm protection. These pieces of infrastructure will continue to serve the Town long-term, but will require maintenance over time. Sediment accretion from the segmented breakwaters will continue to reduce tidal velocity and increase overall sediment levels and the potential for dune creation and maintenance, further diversifying the flood resilience measures.

Additional shoreline management measures and other adaptation strategies will be necessary over the next 50 years to address coastal flooding associated with both sea level rise and storm surge. As the town looks ahead toward a climate adapted future, it should consider incorporating a living shoreline along its Potomac Border, as outlined in the Westmoreland County Shoreline Management Plan. Doing so will help to further protect the city, its people, and its assets, but also to further create terrestrial and aquatic habitats, tourism opportunities and programs, and expand overall ecosystem services. Additionally, the south peninsula will require robust flood control infrastructure implemented as sea level rise forecasts anticipate almost complete submergence of the area. The surrounding marina and waterways will also need protection. As outlined in the Virginia Coastal Master Planning Framework the change in coastline also affects the state's navigable waterways. Here, sediment transport, accretion, and subsidence all shift in volume and pattern, which can cripple these critical channels for boating and navigation for

CHANGE IN SEA LEVEL, COLONIAL BEACH
SOURCE: NOAA

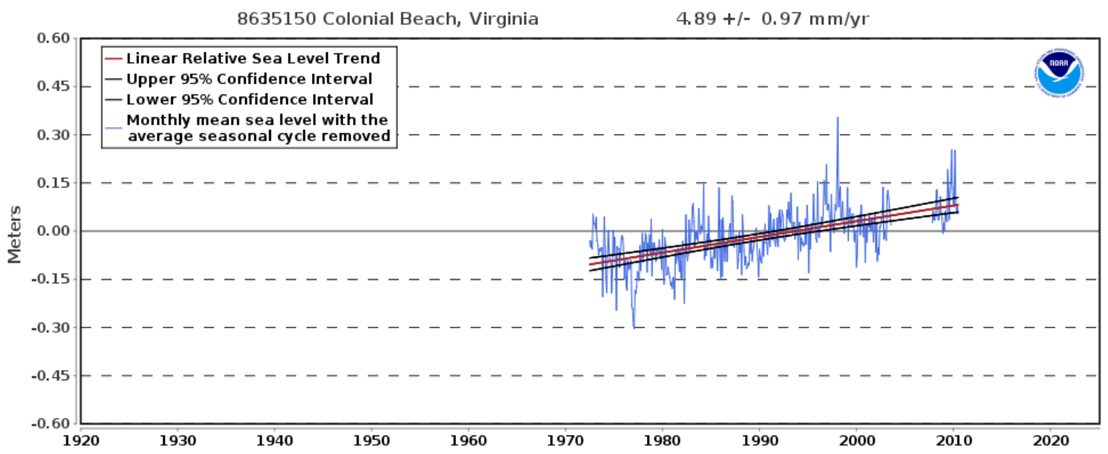
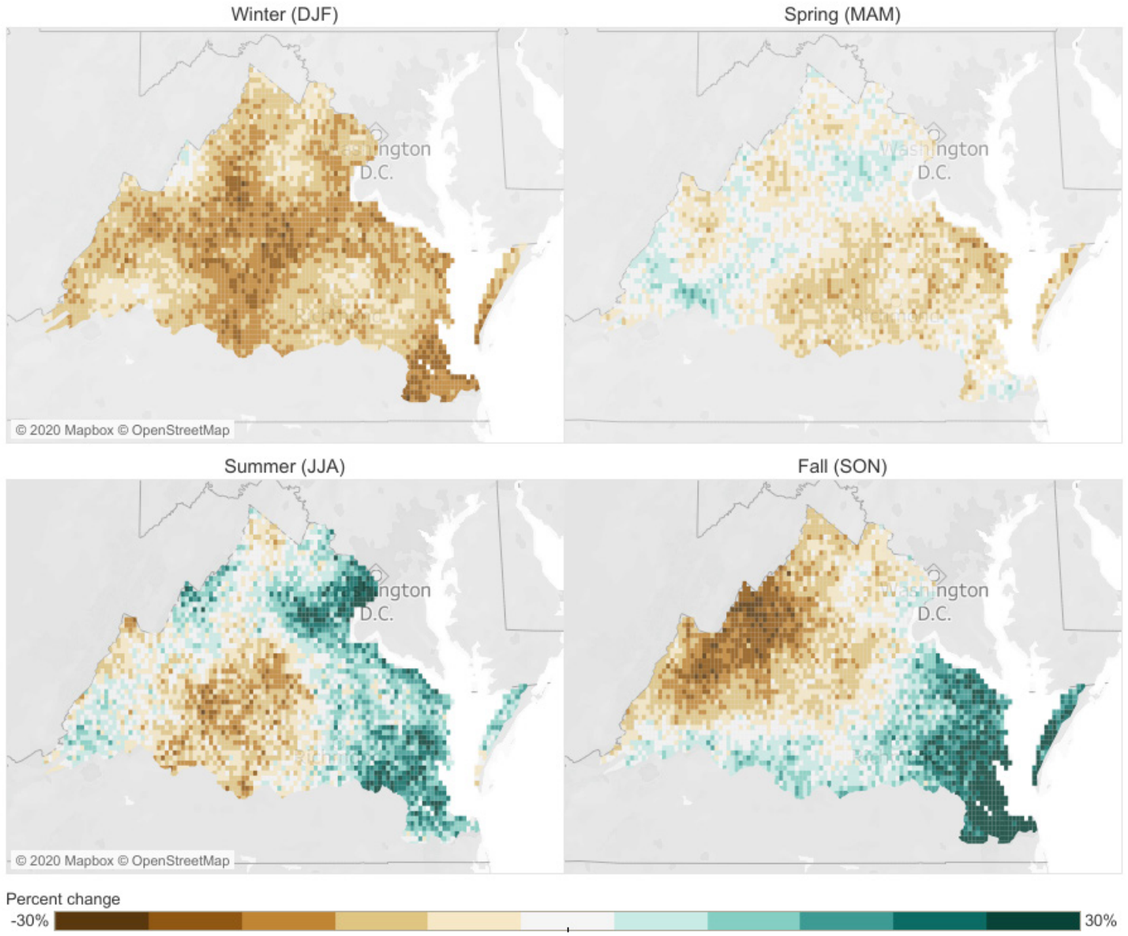


TABLE 01: SEA LEVEL RISE PROJECTIONS IN FEET FOR THE COLONIAL BEACH POTOMAC GAUGE

YEAR	SCENARIO		
	LOW	INTERMEDIATE	HIGH
2040	0.73	0.94	1.59
2060	1.05	1.46	2.76
2080	1.36	2.05	4.23
2100	1.67	2.71	6.00

CHANGE IN AVG. SEASONAL TOTAL PRECIPITATION FROM 1976-2005 BASELINE TO 2006-2017

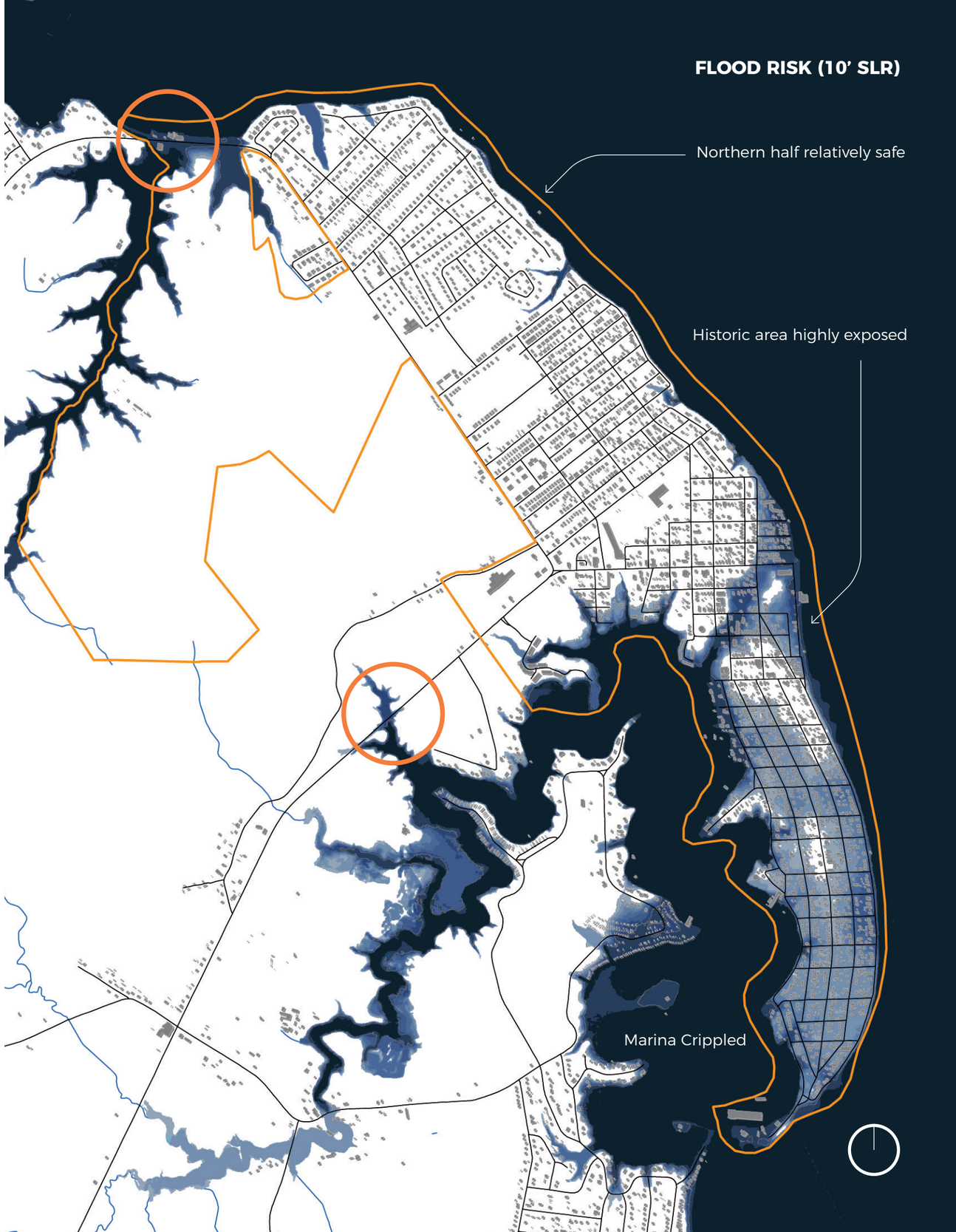


BACKGROUND INFORMATION

the state's fishing economy. Where infrastructure becomes infeasible due to the realities of cost, strategies to relocate development in the area away from risk to the northern half of the Town may be necessary. Infrastructure, especially bridges along Route 205, will require maintenance and renovation to accommodate the encroaching river.

Top: Damage from Hurricane Isabel, 2003
Middle: Flooding after Hurricane Isabel, 2003
Bottom: Flooding impacts after major storm

1. *Tides and Currents, "Relative Sea Level Trend: Colonial Beach, Virginia," NOAA, Accessed December 11, 2020, https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8635150#tabscenario.*
2. *City of Virginia Beach, "Virginia Beach Sea Level Wise Adaptation Strategy," March 2020, https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Documents/20200330%20FullDocument%20(2).pdf.*
3. *US Army Corps of Engineers, "USACE Sea Level Change Curve Calculator (2017.55)," Revised July 18, 2017, http://corpsmapu.usace.army.mil/rccinfo/slc/slcc_calc.html.*
4. *Mid-Atlantic RISA, "Changes in Seasonal Total Precipitation from 1976 to Present," March 25, 2019, https://www.midatlanticrisa.org/resources/climate-data-tools/seasonal-precipitation-historic.html.*
5. *Mid-Atlantic RISA, "Changes in Future Extreme Precipitation," Accessed December 11, 2020, https://www.midatlanticrisa.org/resources/climate-data-tools/extreme-precipitation-projected.html.*



Co-Creation & Community Engagement

A VISION FOR CO-CREATION

Any plan is most successful if developed in close coordination with the community at large, as opposed to by town staff and traditional subject matter experts alone. The local community offers valuable insights into current conditions, and also should drive the process of creating a vision for the future of the community at large. Should the Town of Colonial Beach pursue the creation of a coastal flooding adaptation plan, we recommend that it actively involve Colonial Beach's residents and business owners from many walks of life in developing each element of the plan. In doing so, the Town can create a shared understanding of evolving needs related to the impacts of climate change and coastal flooding. It can also use this process to give voice to an adapted future through collective visioning, and create support and buy-in for plans through representation and transparency.

We did not utilize co-creation nor conduct community outreach to develop this framework. However, we do aim to provide guidance by which co-creation could occur in the context of the framework, premised on best practices learned by other communities. We present this in the context of Colonial Beach by offering some initial ideas about key stakeholders that might be engaged in this process. These ideas, however, should not be adopted as they are, but instead should be adapted by the town based on local knowledge around key stakeholders and existing communication networks. The following steps can be used by the Town in pursuing a co-creation strategy.

Identify Stakeholders

Colonial Beach is a small town with a strong network of engaged residents. It's likely that the town staff already have ideas about who the active groups are in the community who would be important to engage in order to get the word out about the planning process. Nevertheless, documenting these groups through an iterative process may be helpful to ensure all stakeholders are invited to participate. Although an initial effort to identify stakeholders should be made at the beginning of the co-creation process, it is important that as planning develops and new stakeholders emerge, the Town continues to identify and engage additional stakeholders.

Document stakeholders in a stakeholder diagram.

One method of documenting stakeholders is through a stakeholder diagram. Diagrams can range in complexity from documenting primary and secondary stakeholders through concentric circles, to a more complex analysis of stakeholder power by positioning stakeholders on axes for level of impact felt, and amount of influence produced by each stakeholder (see Fig.1)

Begin brainstorming stakeholders amongst experienced town staff.

We recommend that the process of stakeholder identification begin with experienced town staff or representatives who will be involved in the adaptation planning process. If the town establishes a Resilience Committee, for example, the committee members could initiate this process. From there, the town can contact identified stakeholders and ask that they provide feedback and help to identify additional key actors to involve. In developing this framework, we created a simple, illustrative stakeholder diagram for coastal flooding in Colonial Beach, shown in Figure 2, which may serve as a starting point for the Town.

Consider the following questions to help identify stakeholders[1]:

- Who is currently affected or is likely to be affected by coastal flooding?
- Who might benefit from a plan to adapt to coastal flooding?
- Who is unlikely to actively participate in this planning process?
- Who is likely to work against a coastal flooding adaptation planning process?
- Who has useful resources, skills, or knowledge to support coastal flooding adaptation?

In addition to documenting the stakeholder individuals and groups themselves, the town can document the answers to these questions in a table format to consolidate findings and compare results across individuals and groups. Ultimately, this tool will help the Town to craft a path forward to build a

Fig. 1

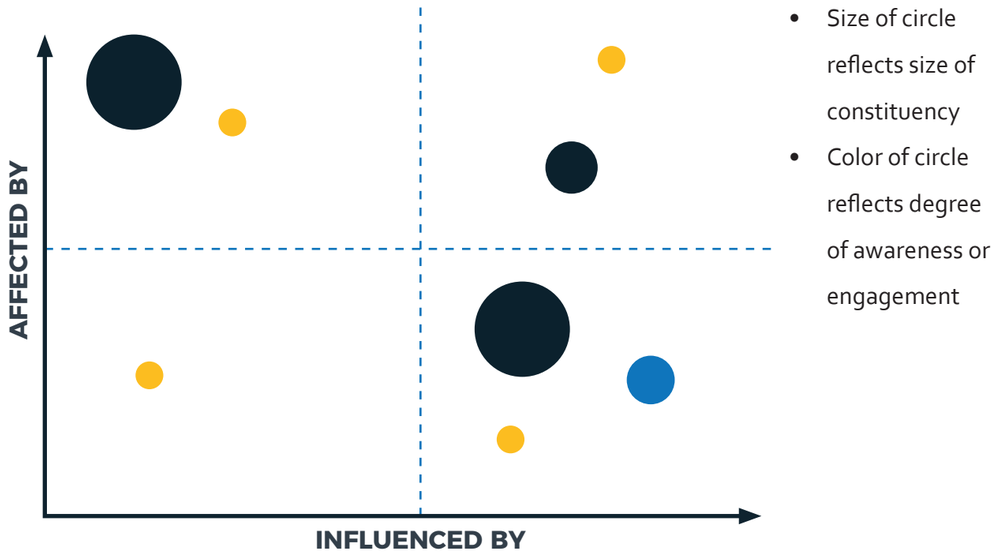


Fig. 2

strong network of engaged stakeholders to co-create the adaptation plan.

Ensure the stakeholders represent interests from diverse groups

Once stakeholders are identified, it is important to review the list of representatives and ensure that they represent a diverse set of perspectives in terms of race, gender, age, and income level. If a particular demographic present in the town is missing, endeavor to identify individuals who can give voice to unique or varied perspectives that demographic group may offer to the process. Amplifying the voices of marginalized and vulnerable groups that are often excluded from planning processes is a critical step in reducing their vulnerability in the future, including to climate-driven flood events.

Top: Focus Group meetings
Below: Direct community engagement

Build a Network

Once stakeholders are identified and prioritized, they can be engaged. This process should start with establishing relationships and building trust to create a solid foundation on which to build co-creation.

Meet with key stakeholders indentified:

The Town can begin by scheduling meetings with key groups or individuals to convey the intention to develop a plan, and ask for participation in the co-creation process. There may be opportunities to align outreach with existing initiatives related to coastal adaptation. These may include:

- The RAFT three-university team is actively working with Town Staff, business owners, residents, and regional actors - including the PDC - to implement a series of actions to improve the town's resilience to coastal flooding. Building on these strategies and the partnerships, capacity, and enthusiasm is an important opportunity for the town to launch this planning effort.
- There are numerous local non-profit organizations that are very active in the town, including establishing a historic district, and creating greenspaces. Partnering with these groups would afford an opportunity to coordinate efforts and meet multiple town goals through the plan's strategies.
- The Town is finalizing its comprehensive plan update. There may be opportunities to partner with and build on the work the planning commission has recently done to engage the community in this effort, and to connect the comp plan to the climate adaptation plan.

Trust will be built as these relationships are maintained with regular communication, and as stakeholders' recommendations and expertise is integrated into the plan.

Identify and engage champions to amplify outreach efforts:

Stakeholders who are particularly passionate or interested, as well as those who have strong networks and resources related to coastal adaptation, can be identified as champions who can further get the word out to the Town about the plan and encourage participation. These individuals will likely be people who already believe that climate adaptation and resilience strategies are crucial to planning for the town's future; for example, they may be members of the RAFT implementation team. Ideally, this group will help to promote the adaptation planning process through the networks in which they are a part, such as social and religious groups, neighborhood associations, and school groups. By using trusted communicators from within the community, the Town can build trust in the process.

However, care should be taken to avoid relying too heavily on unpaid support from partner organizations; the Town would ideally have a paid staff member leading co-creation efforts, and would endeavor to provide those groups who contribute their time and effort with compensation, perhaps in the form of refreshments at meetings, and childcare and transportation for those who require it.

Create a Broad Outreach Strategy

Additionally, the Town should develop a broader outreach strategy to keep the public informed and establish a platform on which to request feedback and provide updates throughout the planning process. For this, the Town might consider the use of social media, and partner with non-government managed social media accounts where appropriate. Further, the Town can participate in local events, like the Osprey Festival, to speak with the community face-to-face about the process and encourage participation.

Co-Create the Plan with the Network

The stakeholder network should be involved in developing the adaptation strategy at every step in the process. This includes establishing a shared vision, identifying assets and vulnerabilities, and identifying adaptation strategies. Opportunities to gather input from these groups to design the plan can take a variety of formats, depending on the types of stakeholders being engaged and the type of input being collected. Care should be taken to ensure that opportunities to participate are provided to all stakeholders in a format that is functional to meet their needs. For example, if there are Latinx or hispanic populations with limited English proficiency who should be engaged, invite them to a focus group meeting with a Spanish-speaking individual present to facilitate translation.

Establish a Shared Vision:

Visioning is an important step in the planning process that should occur early on. Stakeholders can use this time to set their goals, values, and priorities for the future of the Town, especially as it relates to the coast and the challenges climate change driven sea level rise will create. Section 1 of this Framework "Introduction" provides examples for the direction that values (or guiding principles) may take. *Co-creation methods include: focus groups, open houses, pop-up events, children's drawing activities.*

Identify Strategies:

Once assets and their vulnerabilities to coastal flooding are identified, Stakeholders can begin to explore strategies to employ to address those vulnerabilities. Section 5 of this Framework, "Adaptation Strategies" outlines a variety of options for ways that the town could reduce its vulnerability. While these may serve as a useful starting point, strategies should ultimately be catered toward assets identified by town residents. Some elements of strategy identification will require expert input (for example, VIMS may help to identify the best form of living shoreline to utilize), however, broad stakeholder participation should still be pursued. Here, targeted stakeholder groups conducted separately with individuals like marina owners, restaurant owners, waterfront home owners, and naturalist groups offer an ability to have more intimate and focused conversations on the benefits and drawbacks of various strategies relevant to the individuals participating.

Share the Plan

The final plan, the result of months of hard work by both Town and stakeholders, should be shared broadly, openly, and with celebration! Continuing to

A VISION FOR CO-CREATION

draw on the support of champions who have been engaged throughout the process, as well as utilizing the established outreach platforms on social media, will be key to sharing the news and the plan itself. In-person outreach can also continue to serve as a useful means of disseminating the plan and helping residents who were not engaged in the planning process to understand what it means for them.

Continuously Solicit & Respond to Feedback

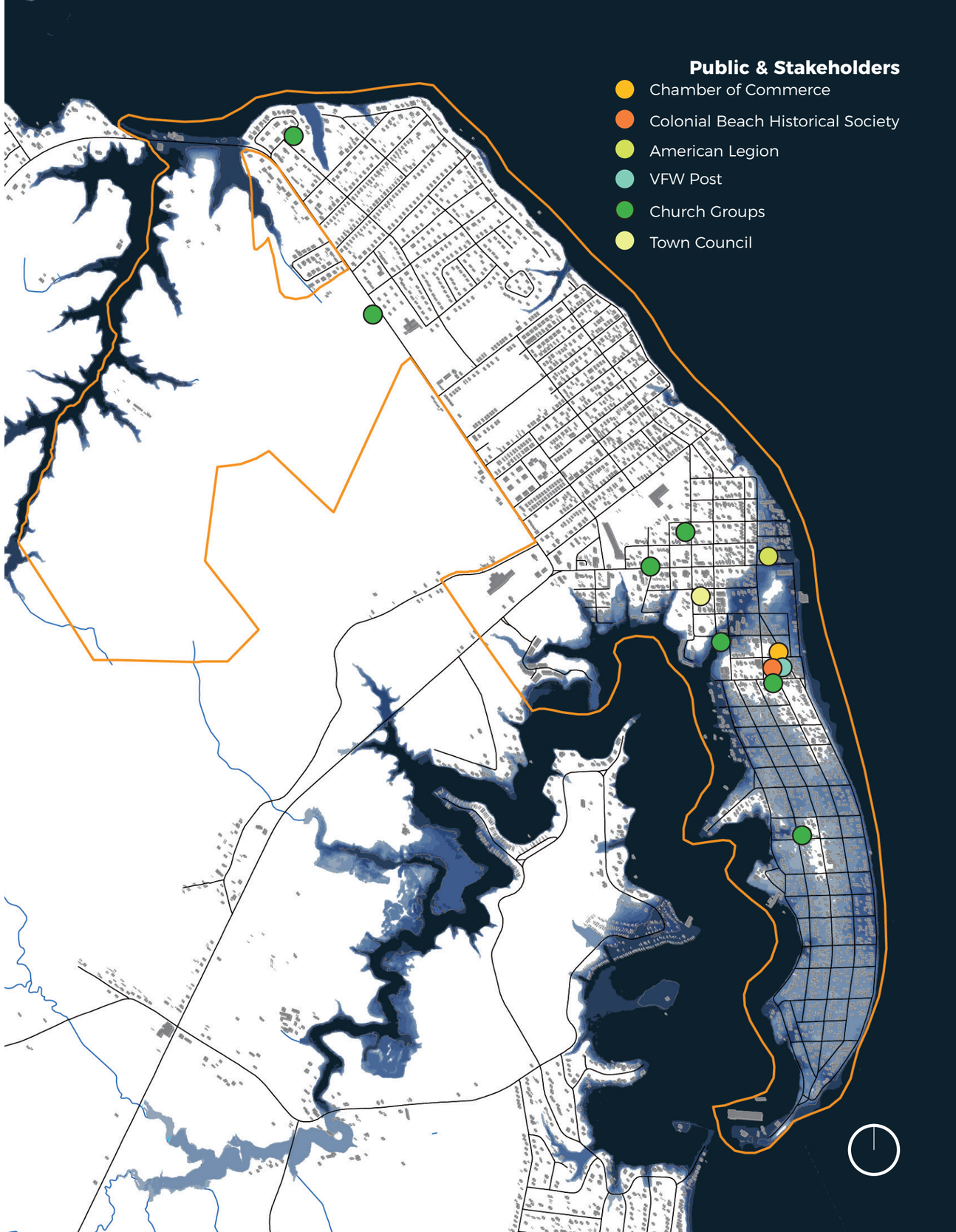
Even after the plan is complete, feedback and public engagement will be critical to plan implementation. As discussed in Section 7 of this Framework "Steps Forward," monitoring & evaluation of the plan, and adjusting in response to the results gathered, is a critical element of successful adaptation. One method of monitoring & evaluation is to understand how the strategies are impacting stakeholders in the community. If a Colonial Beach Resilience Committee is established, feedback could be collected through their regular public meetings. Additionally, the Town could establish a simple, permanent online survey linked through its website that could be reviewed by Town staff quarterly, and would allow residents to provide feedback at any time. As feedback is collected, the Town should consider it an important element of its learning process and incorporate findings into future adaptation efforts. Efforts should be made in particular to understand how adaptation is influencing vulnerable and marginalized communities by specifically seeking out their feedback.

CO-CREATION METHODS INCLUDE:

- Focus Groups
- Open houses
- Surveys
- Pop-up events tied to ongoing festivals or activities
- Oral histories
- Hands-on drawing activities for children
- Design charettes
- Participatory mapping

1. Adapted from Mayers, James. "Stakeholder power analysis." International Institute for Environment and Development. March 2005.

Below: Colonial Beach Festival



Climate Impacts & Hazards

ASSESSING VULNERABILITY & IDENTIFYING ASSETS

An initial step traditionally employed in climate adaptation planning is to identify assets in the planning area, and understand their level of vulnerability to expected climate impacts. This section lays out a process of conducting this assessment, alongside our findings. These strategies and the information generated can be built upon by the Town and stakeholders as they co-create a coastal flooding adaptation plan.

Defining Vulnerability and Risk

To ensure the guidance included in this Framework to support the town in developing a plan is clear, we have defined key terms below. These definitions are pulled from the U.S. Climate Resilience Toolkit's Glossary[1].

Adaptive Capacity
The process of adjusting to new (climate) conditions in order to reduce risks to valued assets.

Exposure:
The presence of people, assets, and ecosystems in places where they could be adversely affected by hazards.

Resilience:
The capacity of a community, business, or natural environment to prevent, withstand, respond to, and recover from a disruption

Risk:
The potential total cost if something of value is damaged or lost, considered together with the likelihood of that loss occurring. Risk is often evaluated as the probability of a hazard occurring multiplied by the consquence that would result if it did happen.

Sensitivity:
The degree to which a system, population, or resource is or might by affected by hazards

Vulnerability:
The propensity or predisposition of assets to be adversely affected by hazards. Vulnerability encompasses exposure, sensitivity, potential impacts, and adaptive capacity. (See Figure 3)

Climate Forecasts

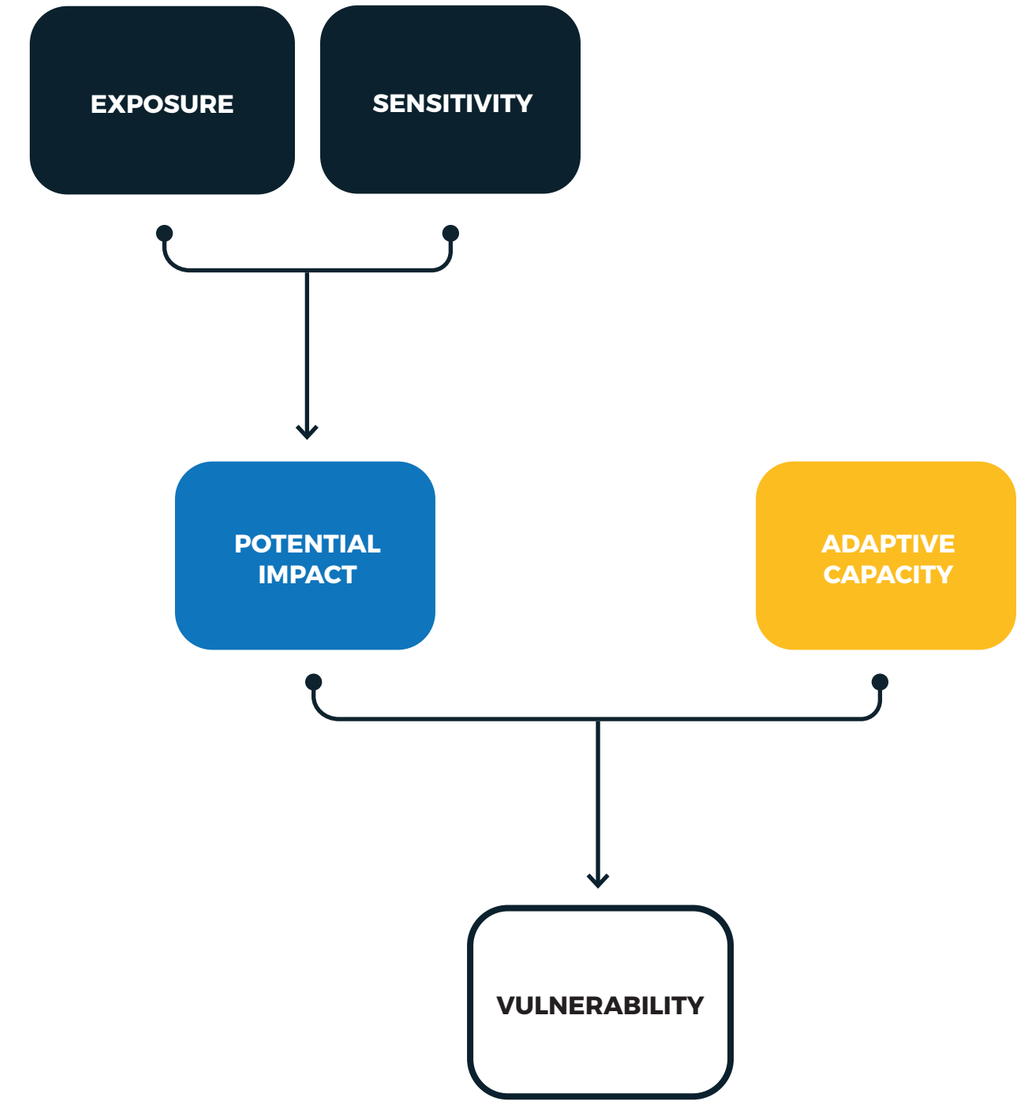
We are using climate forecasts that are generally accepted as the basis for climate adaptation work from sources such as the US Geological Survey (USGS), Federal Emergency Management Agency (FEMA), and ESRI. We have used a scenario that accounts for 1.5 degrees Celsius of warming by 2030-2050, in addition to accelerated storm events and force.

Socioeconomic Forecasts

Alongside climate changes, Colonial Beach can expect to see socioeconomic and demographic shifts in the coming decades that may create shifting vulnerabilities. The town has a large elderly population that will continue to age and become increasingly vulnerable to climate threats. Population growth modeling conducted by ESRI suggests that Colonial Beach will experience modest overall increases in the number of residents, of around 0.25%[3]. However, recently the Town approved a purchase and development agreement for a new $25 million development project. The project is expected to bring 35 new three bedroom townhomes, 36 new condominium units, 10,000 square feet of new retail space along the Town's boardwalk, renovation of existing commercial space, and a new riverfront hotel. This project may foreshadow higher levels of economic development and higher density growth in the Town. It may also point to tourism growth and increasing numbers of seasonal residents. In identifying assets and vulnerabilities, the Town should consider population and demographic forecasts as an important element of understanding how assets will shift in the future.

Fig. 3

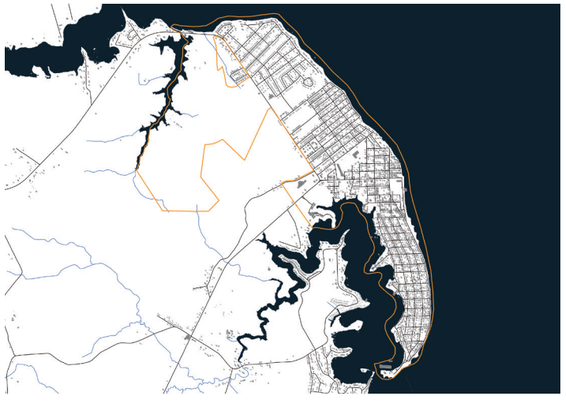
Vulnerability is a function of exposure, sensitivity, and adaptive capacity[2]



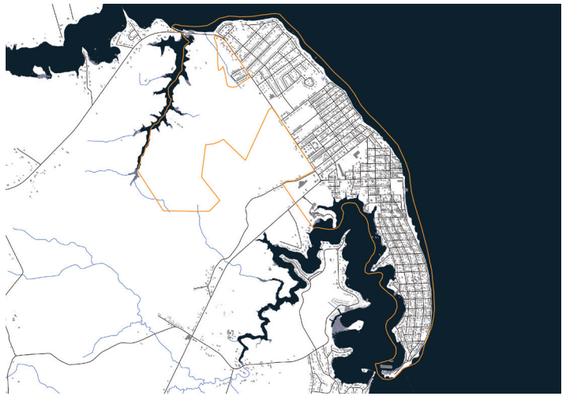
COLONIAL BEACH VULNERABILITY TO FLOODING & SLR

Colonial Beach's existing flood infrastructure provides adequate protection for 1-3 ft. of SLR or storms with up to 3 ft. of storm surge. Looking ahead, after storms like Hurrican Isabel in 2003 which brought 6.5 ft. storm surge, the town faces critical infrastructure being compromised and the southern peninsula being cut off. Critical evacuation routes are also under threat of SLR and storm surge as well which must be maintained and protected.

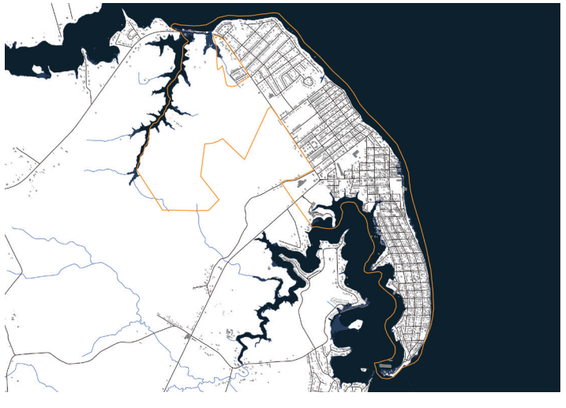
01 ft. SLR



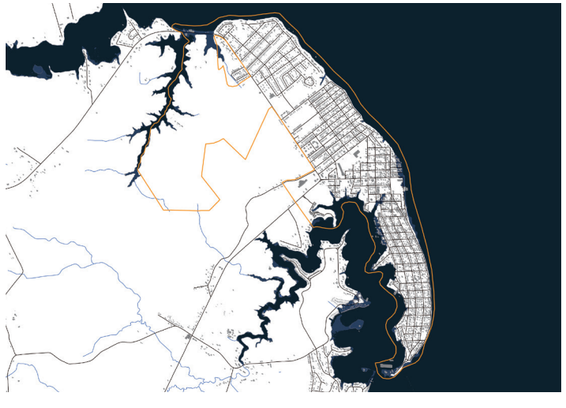
02 ft. SLR



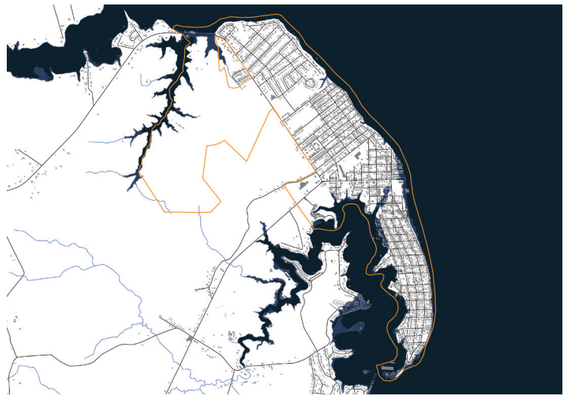
03 ft. SLR



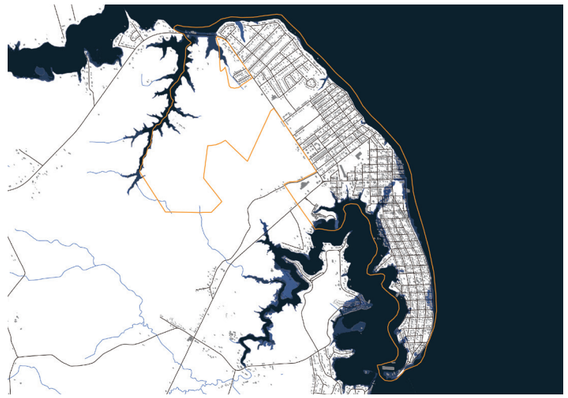
04 ft. SLR



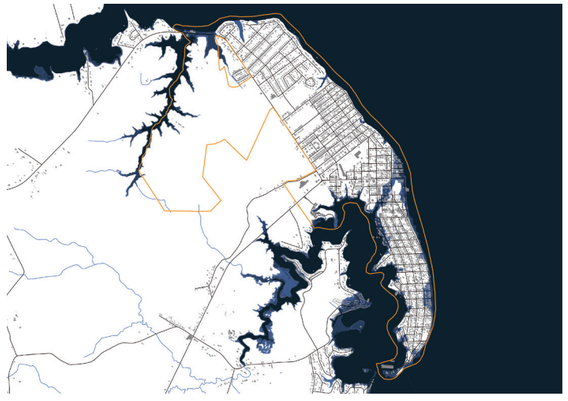
05 ft. SLR



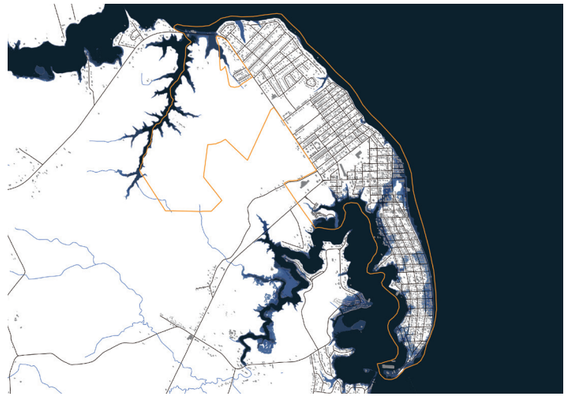
06 ft. SLR



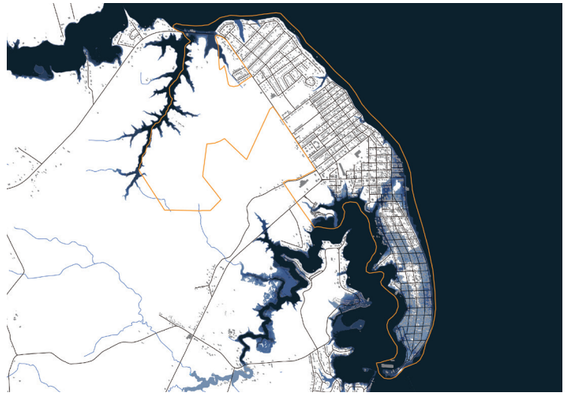
07 ft. SLR



08 ft. SLR



09 ft. SLR



10 ft. SLR

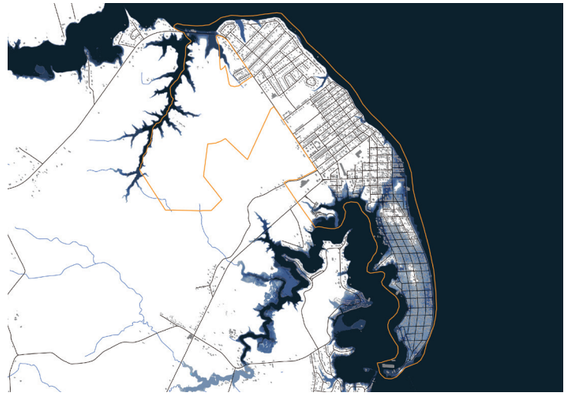


TABLE 01: VULNERABILITY ASSESSMENT

HIGH MEDIUM LOW

Category	Key Asset	Weather / Climate Hazard	Potential Consequences	Climate Stressors	Non-Climate Stressors & Trend	Potential Tipping Point & Probability	Sensitivity	Adaptive Capacity	Exposure
Civic	VA St. Route 205	SLR, CF	Road Closure	SLR, Storm Surge	Riverbank hardening upstream reduces sediment supply, increasing scouring power at high water levels; increasing	Highway department declares bridge unsafe; increasingly probable			
Civic	Municipal Pier	SLR, CF	Repairs, Loss	SLR, Storm Surge	Lack of maintenance and care by town / community	Massive destruction from a storm and or very high SLR, slightly probable			
Civic	Public Boat Ramp	SLR, CF	Repairs, Loss	SLR, Storm Surge	Lack of maintenance and care by town / community	Massive destruction from a storm and or very high SLR, slightly probable			
Civic	Food Bank	Storm Events	Elec. Loss, damages, repairs	Storm Freq., Strength	Lack of maintainence/care by the town. Unused by community	Massive destruction from a storm and or very high SLR, slightly probable			
Civic	Guadalupe Free Clinic	SLR, CF, Storms	Elec. Loss, damages, repairs	Storm Freq., Strength	Lack of maintainence/care by the town. Unused by community	Lack of customers makes operations unprofitable and/or inoperable due to SLR, increasingly probable			
Civic	Regional Libary	SLR, CF, Storms	Repairs, Loss	SLR, Storm Surge	Population (tax base) loss	Population emigration inland, lack of available workforce			
Civic	K-12 Schools	Storm Events	Elec. Loss, damages, repairs	SLR, Storm Surge	Population (tax base) loss	Population emigration inland, lack of available workforce			
Civic	Food Lion	Storm Events	Elec. Loss, damages, repairs	Storm Freq., Strength	Resident Emigration	Lack of customers makes operations unprofitable and/or inoperable due to SLR, increasingly probable			
Community	CB Comm. Center	SLR, CF, Storms	Loss of gathering space	SLR, Storm Surge	Lack of maintainence/care by the town. Unused by community	Massive destruction from a storm and or very high SLR, slightly probable			
Community	Elderly Residents	Storm Events	Elec. Loss, damages, repairs	Storm Freq., Strength	Resident Emigration	Population emigration inland, lack of available workforce			
Community	Historic Dist. (prop.)	SLR, CF, Storms	Loss of hist. buildings & character	SLR, Storm Surge	Lack of maintenance and care by current homeowners	Destruction from a storm or surge or flooding. Increasingly probable			
Community	Churches (8)	SLR, CF, Storms	Repairs, Loss	SLR, Storm Surge	Resident Emigration	Destruction from a storm or surge or flooding. Increasingly probable			
Community	Town Hall	SLR, CF, Storms	Repairs, Loss	Storm Freq., Strength	Lack of maintenance and care by town / community	Destruction from a storm or surge or flooding. Increasingly probable			
Enviro	Ecosystem Services	SLR, CF, Storms, Heat	Develop, Loss	Storm Freq., Strength	Riverbank hardening upstream reduces sediment supply, increased development, larger imperveous town footprint	SLR reaches certain threshold; heating above 1.5C			
Enviro	Monroe Bay	SLR, CF, Storms	Erosion, Loss	Development	Land use distruptions such as additional building that could accelerate erosion and increase vulnerability	SLR reaches certain threshold; Increasingly Probable			
Tourism	Accomodation	CF, Erosion	Repairs, Loss	SLR, Storm Surge	Lack of usable beaches, shrinking tourism opportunities	Population emigration inland, lack of available workforce			
Tourism	Marinas (4+)	SLR, CF, Storms	Closure, Repairs	Storm Freq., Strength	Resident Emigration	SLR reaches certain threshold; Increasingly Probable			
Tourism	Boardwalk	SLR, CF	Repairs, Loss	SLR, Storm Surge	Lack of maintenance and care by town / community	Parts of the board walk become partially or completely submerged for longer, increasingly probable			
Tourism	Restaurants	SLR, CF, Storms	Repairs, Loss	SLR, Storm Surge	Shrinking tourism income base and resident emigration	Lack of customers makes operations unprofitable and/or inoperable due to SLR, increasingly probable			
Tourism	Rental Properties	CF, Erosion	Repairs, Loss	SLR, Storm Surge	Lack of usable beaches, shrinking tourism opportunities	Population emigration inland, lack of available workforce			
Tourism	River Boat	SLR, CF, Storms	Repairs, Loss	SLR, Storm Surge	Shrinking tourism income base and resident emigration	Significant slr or a powerful enough storm/surge that destroys the structure. Increasingly probable			

The authors of this report are not residents of Colonial Beach, nor are they experts on the Town. These assets may or may not reflect local stakeholders' opinions. In creating a coastal adaptation plan, one way in which the Town can assess vulnerabilities is to replicate this process together with local stakeholders.

ASSESSING VULNERABILITY & IDENTIFYING ASSETS

Identifying Assets

In assessing vulnerability to coastal flooding, we utilized a tool provided by the US Climate Resilience Toolkit that is free and available online for download[4]. Using this tool, we conducted an initial process of identifying and inventorying Town assets, relying on Town documents, including the comprehensive plan and zoning map, design guidelines, and Business Revitalization Plan. We also referenced on Google Maps, GIS Data, and experiences from a site visit to the town. Once assets were recorded, we assigned them to categories (civic, community, environmental, and tourism) to facilitate a broad review and summary of the data.

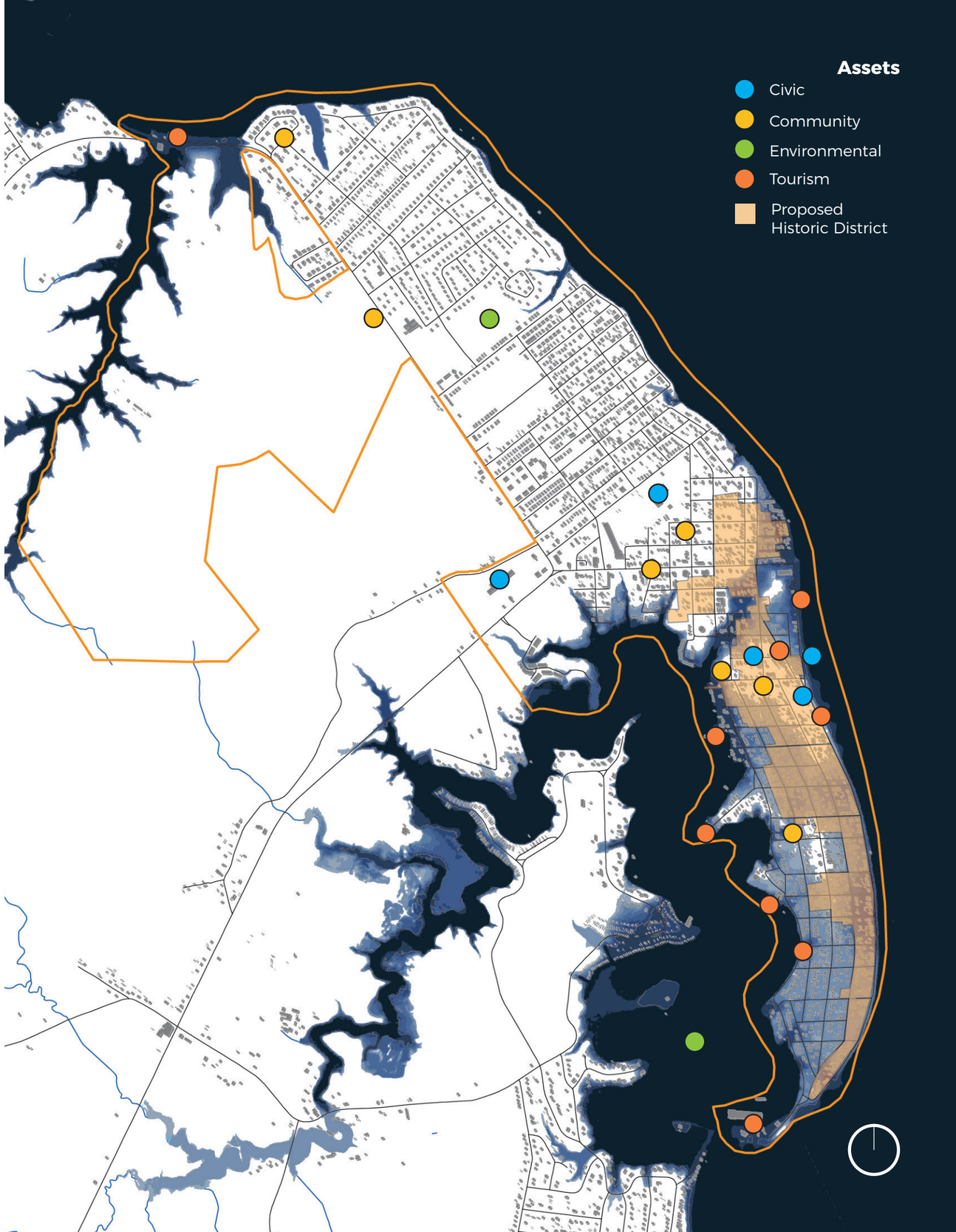
Understanding Assets' Vulnerability

Once assets were identified, we reviewed them against coastal flood risks, categorizing each in terms of sensitivity, adaptive capacity, and exposure (See Table 1). This was supported by mapping exercises, in which we overlaid forecasted sea level rise with asset locations (where relevant), to observe which assets were most exposed to flooding in future scenarios.These initial ratings can help to illustrate the unique situation of each asset, which will translate into unique adaptation responses over time. We recommend that in future coastal adaptation planning efforts the Town conduct similar exercises to understand a comprehensive picture of vulnerability to flood events based on its assets. This exercise would ideally be informed with support from experts, perhaps including state-level entities and universities, in addition to local stakeholders, who can provide specific expertise on the ways in which assets will react to varying levels of flooding.

Setting Acceptable Levels of Risk

Risk is a final consideration that must be weighed before moving from assessing potential impacts to developing strategies. Understanding risk requires that the Town consider both costs and likelihood of flooding and its impacts on assets. There is no scenario in which risk can be entirely eliminated. Instead, the Town must identify an acceptable level of risk it is willing to tolerate in its plans. For the purposes of this project, we defined an acceptable level of risk as that scenario which would result in the low levels of socio-economic and cultural damage, as well as relocation in Colonial Beach.

1. "Glossary," U.S. Climate Resilience Toolkit, January 7, 2020, https://toolkit.climate.gov/content/glossary#Vulnerability.
2. EcoAdapt. "Assessing Socio-economic Vulnerability to Climate Change." Accessed December 9, 2020. http://ecoadapt.org/data/documents/NPCWHumanDimensionsResources.pdf
3. https://uvalibrary.maps.arcgis.com/home/item.html?id=13260948120c4eacadaff3ecd38c8796.
4. Tab 2, "Vulnerability," of the "Documenting Steps to Resilience" spreadsheet. Available for download at: https://toolkit.climate.gov/sites/default/files/Documenting_Steps_to_Resilience_170405.xlsx



Adaptation Strategies

ADAPTATION STRATEGIES: GREEN INFRASTRUCTURE

Key Issues

To physically equip Colonial Beach with the tools necessary to mitigate the effects of climate change, green infrastructure presents a variety of implementable options that can combine for a resilient and vibrant future. Green infrastructure are nature-based tools that provide key infrastructural services like flood protection, stormwater management, and sediment accretion while having strong ecological services. Below are key examples of green infrastructure opportunities that can be used both individually and collectively around the Town.

Strategies

Breakwaters

- Already used in the Town, breakwaters are an approachable method of green infrastructure that help reduce tidal velocity and promote healthy beach levels. Compositionally, breakwaters can be made of scrap concrete or stone, or with fabricated new material that are deployed in a linear form which physically reduces the power of waves.
- Breakwaters primarily remain below the surface of the water, helping to reduce coastal view obstruction. Below the surface, breakwaters can also encourage vibrant aquatic species habitats like that of bivalves, fish, and aquatic flora.
- Costs range, but the average cost of breakwaters is $1500/ linear foot

Wave Attenuation Devices (WADs)

- Wave attenuation devices are shallow water deployed systems that provide similar services like that of the breakwater. WADs are individual units that can be deployed as a series, providing more fluid forms and shapes that can meet unique needs.
- WADs can be fabricated on-site, creating short-term job opportunities for the town. Each unit is fabricated with concrete and rebar for strong, long-lasting coastal protection
- WADs also have voids in the unit's form which create attractive spaces for aquatic habitats for fish, bivalves, and more.

Dredging

- One of the most intensive options that provides long-term protection is dredging. This process removes years of built up sediment from underwater areas helping to keep healthy, deep, and viable waterways and habitats.
- Dredging is usually targeted in key boatways like marina or harbors helping to keep economic vitality in the area.
- These projects also help to help create deeper water habitats which help promote healthier and more robust habitats.
- The dug up sediment from the process can also be used and placed elsewhere in the area which may be subject to sediment loss.

Storm Infrastructure

- Including rain gardens and bioswales in certain town areas would provide natural forms of stormwater management, water purification and groundwater recharge, and stormwater velocity reduction.
- Rain gardens and bioswales also allow for native species use which attract pollinators and small animals.
- The Town could create a program to incentivize onsite rainwater capture. This could pair with VCAP funding.

Utilizing these three strategies, the Town can layer additional technologies that help further create and promote healthy habitats. Products like ECONcrete are concrete-based strategies that are designed to stimulate habitat creation while doing little to disrupt existing infrastructure. These can be added to breakwaters, marina edges, and wooden pillars to help create a thriving aquatic habitat. Investing in the habitat quality of the Town helps with overall flood management and storm surge over time.

Once the various strategies are implemented, the Town can also aim to layer pedestrian-friendly infrastructure to bring people in touch with climate infrastructure and the new opportunities they may bring. Breakwaters can have ADA pathways on top which can be programmed as a fishing pier, viewing deck, or part of the larger bike path network around the town. With stronger aquatic habitats around the Town, migratory birds will come through the Town, creating new bird watching opportunities for the Town and the surrounding tourism.

While one of many strategies to create a climate adaptive future for Colonial Beach, green infrastructure can be utilized around the Town to help improve the ecological health of the Town while also ensuring the Town's protection for generations to come.

Ongoing Work

Karen Firehock and the Green Infrastructure Center have worked with students enrolled at UVA in the fall 2020 semester to develop a town-wide green infrastructure strategy for Colonial Beach. This strategy will be available to the town in early December 2020, and can be used in combination with the strategies and case studies presented in this document.

The RAFT program is actively working with Colonial Beach town staff to identify areas of high concern for shoreline erosion, and prioritize these based on needs for improved shoreline management. The Virginia Institute for Marine Sciences (VIMS), as well as the Virginia Department of Conservation and Recreation's Shoreline Erosion Advisory Service are partnering in this effort. VIMS is currently updating its shoreline erosion rate analysis with data from the year 2017. This data and analysis will be critical in developing a complete resilience plan that identifies specific areas of intervention for green infrastructure strategies.

Resources:

- Virginia Institute of Marine Sciences. "Shoreline Evolution GIS Map." https://www.vims.edu/research/departments/physical/programs/ssp/gis_maps/index.php.
- Small-Lorenz, S.L., W.P. Shadel, and P. Glick. 2017. Building Ecological Solutions to Coastal Community Hazards. The National Wildlife Federation. Washington, DC. https://www.nj.gov/dep/bcrp/docs/bescch-final.pdf
- De Mooy, Jennifer, Miriam Balgos, Susan Love, Michael Skivers. 2016. Green Infrastructure Primer: A Delaware Guide to Using Natural Systems in Urban, Rural, and Coastal Settings. http://www.dnrec.delaware.gov/GI/Documents/Green%20Infrastructure/Green_Infra_Primer2016_FINAL%20web%20version.pdf.
- Guidance for Considering the Use of Living Shorelines. 2015. NOAA. http://web.archive.org/web/20170120140747/http://www.habitat.noaa.gov/pdf/noaa_guidance_for_considering_the_use_of_living_shorelines_2015.pdf.

Top: Typical parking lot rain garden
Middle: Deployed Wave Attenuation Devices, Florida

ADAPTATION STRATEGIES: GRAY INFRASTRUCTURE

Functional infrastructure is a cornerstone of any town's success. Rising sea levels and increased periods of heavy precipitation, as well as the likelihood for more numerous and powerful tropical storms and hurricanes, make building resiliency into critical infrastructure a necessity for Colonial Beach. Two key infrastructure assets at risk from increased coastal flooding and shoreline erosion are transportation networks and water, stormwater, and sewer networks.

TRANSPORTATION INFRASTRUCTURE

Key Issues

The town must work with the Virginia Department of Transportation to address flooding and erosion impacting - or likely to impact in the near future - key bridges and roadways that serve as vital transportation networks for this small town. Specific areas of concern are Route 205 at points both south and west, as well as Irving Avenue, which parallels the shoreline of the Potomac in the southern portion of town. Maintaining this transportation infrastructure is vital to the functionality of the town on a day-to-day basis, but further, during an extreme weather event such as a hurricane, flooding conditions may make the roads impassable. Maintaining evacuation routes safe from the worst impacts of flooding is therefore a critical concern.

Strategies

The following strategies can be employed by the town to lessen the impacts of coastal flooding on at-risk transportation infrastructure assets.

Road Elevation

Work with VDOT to establish road elevation standards above anticipated flood levels to be used in new construction or rehabilitation in coastal areas.

- Cost: $$
- Efficacy: Medium
- Time-Frame: Short to Medium

Bridge Maintenance & Expansion

Work with VDOT to evaluate risk of bridge infrastructure and act to fortify, elevate, and maintain critical bridges considering anticipated climate impacts.

- Cost: $$
- Efficacy: Medium
- Time-Frame: Medium

Evacuation Route Relocation

Identify evacuation routes at risk of inundation and erosion. Where necessary, identify alternative routes to be prioritized for infrastructure upgrades in coordination with VDOT.

- Cost: $
- Efficacy: High
- Time-Frame: Medium

Long Range Planning

Incorporate anticipated road network challenges resulting from flooding into the comprehensive plan, as well as updates to the regional hazard mitigation plan and transportation plan led by the Northern Neck Planning District Commission.

- Cost: $
- Efficacy: High
- Time-Frame: Long

WATER, STORMWATER & SEWER INFRASTRUCTURE

Key Issues

The town's water supply, wastewater treatment, and stormwater drainage infrastructure is a critical asset to the Town that must be maintained to ensure the health, safety and wellbeing of residents. Again, day-to-day functionality of these critical utilities is necessary, but additional consideration must be given to planning for their functionality in case of severe weather and flooding events. The town is aware of some deficiencies in its stormwater and wastewater systems, but limited data is on hand at present to provide a holistic picture of these systems' engineering and functionality. An initial step Colonial Beach is taking to address this is to work with its newly hired GIS Technician to map the system. Further, addressing stormwater infrastructure by creating an analysis of stormwater flows, and designing a standard outfall design to be applied at various locations in the town are actions identified on the town's RAFT Resilience Action Checklist.

Strategies

The following strategies can be employed by the town to lessen the impacts of coastal flooding on at-risk water infrastructure assets.

Inspect Integrity of Existing Infrastructure

The town is actively seeking funding to purchase a camera to insert into its water infrastructure systems to identify leaks or breaks in the pipes and use this to help prioritize infrastructure projects.

- Cost: $$
- Efficacy: High
- Time-Frame: Short to Medium

Model and Reduce Inflow/Infiltration in the Sewer System

Understanding the impact of sea level rise and storm events on the system is a critical first step, in complement to understanding the integrity of the system, in order to prepare for future climate impacts. The town is actively seeking support for this action through The RAFT.

- Cost: $$
- Efficacy: High
- Time-Frame: Short to Medium

Integrate Climate-Related Risks into Capital Improvement Plans

Once climate impacts on system functionality is understood, integrate necessary system improvements and needs into the Town's capital improvement plan, and establish timeframes and funding sources to meet infrastructure improvement needs.

- Cost: S
- Efficacy: High
- Time-Frame: Medium to Long

Implement Distributed Green Infrastructure

Build green infrastructure at a variety of scales - from larger wetlands to residential rain gardens - to better filter and store rainwater and reduce the likelihood that heavy precipitation events will overwhelm the stormwater system's capacity.

- Cost:$-$$$
- Efficacy: Medium to High
- Time-Frame: Short to Medium

Increase Overall Stormwater System Capacity

The town has identified a need to improve stormwater outfalls throughout the system. Storm drains can be fabricated to absorb debris and chemical runoff from initial stormwater drainage, helping to reduce pressures on water management[1].

- Cost: $$$
- Efficacy: High
- Time-Frame: Long

Resources:

- *Climate Resilience Evaluation and Awareness Tool Version 3.0 Methodology Guide, EPA, 2016, https://www.epa.gov/sites/production/files/2016-05/documents/creat_3_0_methodology_guide_may_2016.pdf*
- *Implications of Climate Change for RI Wastewater Collection & Treatment Infrastructure, 2017, http://www.dem.ri.gov/programs/benviron/water/pdfs/wwtfclimstudy.pdf*
- *Creating Resilient Water Utilities (CRWU), EPA, https://www.epa.gov/crwu*
- *Wetlands Watch, "Transportation Planning," http://wetlandswatch.org/long-range-transportation.*
- *Potential Impacts of Climate Change on Transportation Infrastructure, NH Department of Transportation, 2014, https://www.nh.gov/dot/climate-change/documents/climate-change-report-2014.pdf*
- *ICF International. July 2008. Integrating Climate Change into the Transportation Planning Process. Federal Highway Administration. https://web.archive.org/web/20201021014648/https://www.fhwa.dot.gov/environment/sustainability/energy/publications/integrating_climate_change/climatechange.pdf.*
- *Community Resilience Planning Guide for Buildings and Infrastructure Systems, https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1190v1.pdf*
- *Paying it Forward: The Path Toward Climate-Safe Infrastructure in California, Climate-Safe Infrastructure Working Group, 2018 https://resources.ca.gov/CNRALegacyFiles/docs/climate/ab2800/AB2800_ES_FINAL.pdf*

1. https://knowlton.osu.edu/news/2020/01/curbing-sediment

ADAPTATION STRATEGIES: LAND USE & BUILDING CODE

For the town to be prepared for future coastal flooding events and eventual sea level rise, it must analyze its current zoning and building codes for ways it can control future growth and incentivize renovations of existing structures. While existing floodplain ordinances already address regulations and standards for new construction in identified floodplain areas, there is limited mention on addressing existing structures that are at risk of coastal flooding or sea level rise inundation. To address these gaps, the town can enact a multitude of adaptation measures regarding its building code and zoning ordinance that can increase the overall resiliency of the community.

Code Changes

Although the town has already implemented a floodplain overlay and the Chesapeake Bay Preservation Area Overlay, neither of these districts address buildings that existed in these zones before their implementation, except that they would be considered nonconforming uses and that major changes would require them to conform to the code. To increase overal resiliency, the town should provide incentives for owners of nonconforming structures to engage in adaptation measures that can make their structures compliant and decrease the potential damage of future flooding events. The forms of incentives could vary from local tax breaks, low interest loans, to even a grant program.

Wet / Dry Floodproofing

This adaptation strategy requires homeowners to simply modify their existing structures with additional measures to mitigate potential flood damage. These modifications are split between wet flood proofing and dry floodproofing. The former alters the building's interior so that flooding does not damage anything significant, such as emptying the basement of utilities and other items of importance. The latter technique usually involves adding an additional layer around the base of the structure that is waterproof/resistant. These techniques are easy to implement and are relatively inexpensive compared to other forms of floodproofing, making these techniques optimal to address current flooding concerns

Structure Elevation

This option for increasing resiliency involves raising the building above the flood level, either through raising the structure or vacating lower levels of the structure. Although this measure is more intensive and costly, it allows existing structures to accommodate various levels of coastal and tidal flooding, accommodating current flooding levels as well as the predicted increases for the immediate future.

Zoning Ordinance Changes

The town can also implement additional zoning ordinances and designations to further improve upon the community's ability to adapt and overcome future coastal and tidal flooding. Although some of these suggestions cover either worst-case scenarios or concerns that won't be realized until the many decades later, setting the foundation for these measures now would set up the framework for the town to initiate them in the future with relative ease.

Instituting a Rolling Easement

This kind of easement works in tandem with the rising sea level. Essentially, as the sea level rises, the easement prohibiting development and rehabilitation expands, forcing development back from the shore based on the new water levels. This can be considered a form of managed retreat, which would be useful to plan for if the more extreme predictions of global warming and sea level rise come true.

Preparing for Managed Retreat

Having an overall plan to address the possibility of moving development due to increasing sea levels would be a beneficial, long-term strategy that would make implementation easier and build up acceptance among the community. These measures could include the rolling easement mentioned above or shifting development towards the vacant land Northwestern part of town.

Creation of a Historic District to Gain Access to Additional Grants

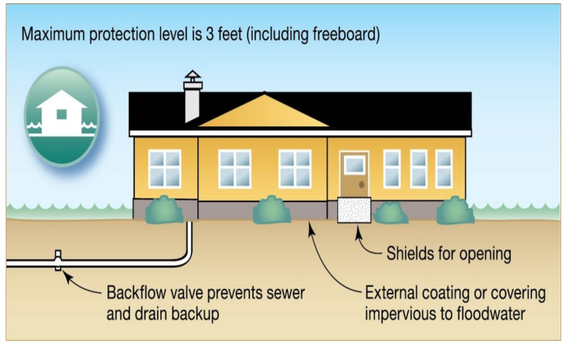
Virginia's Department of Historic Resources (VDHR) is actively working with Downtown Colonial Beach to complete an architectural survey and historic register nomination for the town's historic commercial core. Additionally, VDHR recently received federal disaster relief funding to complete a broad-based historic survey throughout the town. This project will generate specific recommendations for disaster mitigation of historic properties. Both projects will produce data, including spatial data, that can be integrated into the town's resilience planning efforts and comprehensive plan.

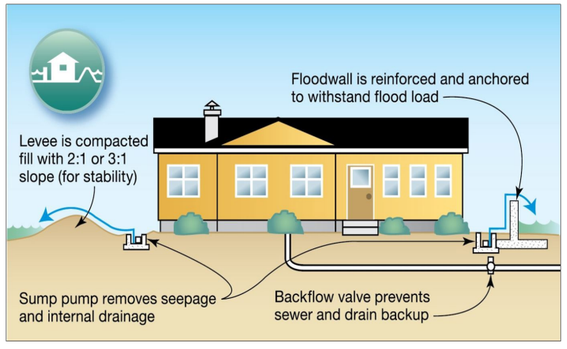
Additionally, the designation of a historical district conveys additional flood insurance relief to owners of historic structures provided by FEMA as well as design guidelines from the organization and the National Park Service on how to implement flooding mitigation techniques on historical properties while maintaining the historical designation. The town should then work towards designating the proposed historical area, in order to begin receiving these grants and insurance discounts.

Resources

- Eastern Shore Land Conservancy. January, 2019. "Mainstreaming Sea Level Rise Preparedness in Local Planning and Policy on Maryland's Eastern Shore." https://www.eslc.org/wp-content/uploads/docs/coastal-resilience/regional-sea-level-rise-study-2019.pdf
- California Coastal Commission. August 12, 2015. "California Coastal Commission Sea Level Rise Policy Guidance: Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits." https://documents.coastal.ca.gov/assets/slr/guidance/2018/0_Full_2018AdoptedSLRGuidanceUpdate.pdf.
- Georgetown Climate Center. 2020. "Managed Retreat Toolkit." https://www.georgetownclimate.org/adaptation/toolkits/managed-retreat-toolkit/introduction.html.

1. *John Squerciati. "Five Prominent Flood Resistant Building Techniques." Dewberry, 18 Oct. 2018, https://www.dewberry.com/news/blog/post/blog/2018/10/18/five-prominent-flood-resistant-building-techniques.*
2.
3. *"Rolling Easement – Wetlands Watch." Wetlands Watch, http://wetlandswatch.org/rolling-easement. Accessed 12 Dec. 2020.*
4. *FEMA, "Floodplain Management Bulletin Historic Structures ," https://www.fema.gov/media-library-data/20130726-1628-20490-7857/tb_p_467_2_historic_structures_05_08_web.pdf*





1. *Dry / Wetproofing a building, floodpanel.com*
2. *Permanent Barrier construction to prevent flooding, floodpanel.com*

ADAPTATION STRATEGIES: ECONOMY

The economy in Colonial Beach is vital to the town's overall wellbeing. Historically, the town was a destination for city dwellers looking to escape for the weekend. Colloquially known as the "Playground on the Potomac", the city hosted several thousand tourists each year, typically arriving by steamboat[1]. Their economy, then and now, centers around tourism with industries like hotels, inns, and short term rental homes, restaurants, and activities along the waterfront. Residents value the tourism industry and town businesses, however, these community assets are vulnerable to climate change. Part of the larger adaptation strategy focuses on protecting the town's economy.

Short Term Strategies

There are several short and long term economic plans the town can explore. Several of the short term options capitalize on the town's proximity to the water and take advantage of the small town features.

- Hosting weekend farmers markets and multiple larger seasonal festivals can bring more dollars to the town. Inviting local artisans, chefs, and watermen to sell their goods and services and advertising to the larger community can draw visitors to the town to shop and eat locally.
- Conducting an audit of all town expenditures and town government operations can help to eliminate waste and redundancies, and also provide the town with some clarity on any inefficiencies. Exceptional town services make this a selling point for any future investors and residents.

Long Term Strategies

Some of the longer term options range in cost and may require additional support and long term commitments from the county, town staff, and town council.

- Pursue a Virginia Main Street Program designation. This program focuses on community development and revitalizing historic commercial areas, and is part of the larger Main Street America Program[2]. This designation provides an opportunity to strengthen the ongoing work of the community to encourage private investment and create a sustainable downtown area for visitors and residents to enjoy[3]. The program can be individualized for the town and there is a lot of flexibility for how the town could utilize this program.
- Other federal grants include FEMA's Building Resilient Infrastructure and Communities (BRIC) program which is currently accepting applications until January 2021[4].

The completion of these applications may require additional staffing time from town employees. This could be alleviated with the implementation of a volunteer Grants Council, which is one of the goals outlined in the draft 2020 Comprehensive Plan[5].

Partnerships & Other Suggestions

Creating micro-economies which stem from the implementation of gray and green adaptation infrastructure strategies would be an economic strategy to promote and diversify tourism.

- For example, fortifying the piers and other hardscapes along the waterfront with ECOncrete. ECOncrete can aid in aquatic habitat restoration which would be a tourist attraction with which the public can interact.
- The Chesapeake Bay Foundation has an ongoing oyster reef restoration program. Several decades ago, the town used to be home to oyster packing services, but left when the health of the river declined[6]. The Chesapeake Bay Foundation, in coordination with state governments and other non-profits, have made huge improvements to the health of the Bay in recent years. Engaging with the Chesapeake Bay Foundation to explore the health of the river and the possibility of implementing oyster reefs will not only help protect the town from flooding events, but also increase the quality of the water and life within the river, and potentially bring back a lost economy.

Bottom Line

The economic vitality of Colonial Beach is critical to its overall climate adaptation strategy. A diversified tax base and an increase in tourism and visitor dollars will provide the necessary capital to fund climate adaptation strategies to protect the town from any potentially catastrophic flooding events.

Resources

- Chesapeake Bay Foundation: Oyster Restoration. https://www.cbf.org/about-cbf/our-mission/restore/oyster-restoration/
- Virginia Main Street Program. https://www.dhcd.virginia.gov/vms
- Main Street America Program. https://www.mainstreet.org/home
- Building Resilient Infrastructure and Communities (BRIC). https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities

1. *"Town of Colonial Beach, 2009 Comprehnsive Plan: Community Profile," (2009).*
2. *Virginia DHCD, "Virginia Main Street," DHCD, accessed November 2020, https://www.dhcd.virginia.gov/vms.*
3. *Virginia DHCD, "Virginia Main Street 2019 Annual Report," DHCD, 2019. https://www.dhcd.virginia.gov/sites/default/files/Docx/vms/vms-annual-report.pdf*
4. *FEMA, "Building Resilient Infrastructure and Communities (BRIC)," FEMA, Oct. 23, 2020. https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities*
5. *Colonial Beach Planning Commission, "Draft: Comprehensive Plan 2020-2030," (Colonial Beach, VA, 2020).*
6. *"Town of Colonial Beach, 2009 Comprehnsive Plan: Community Profile," (2009).*

Below: Chesapeake Bay Foundation Save the Bay portable oyster barge

Case Studies

CASE STUDIES

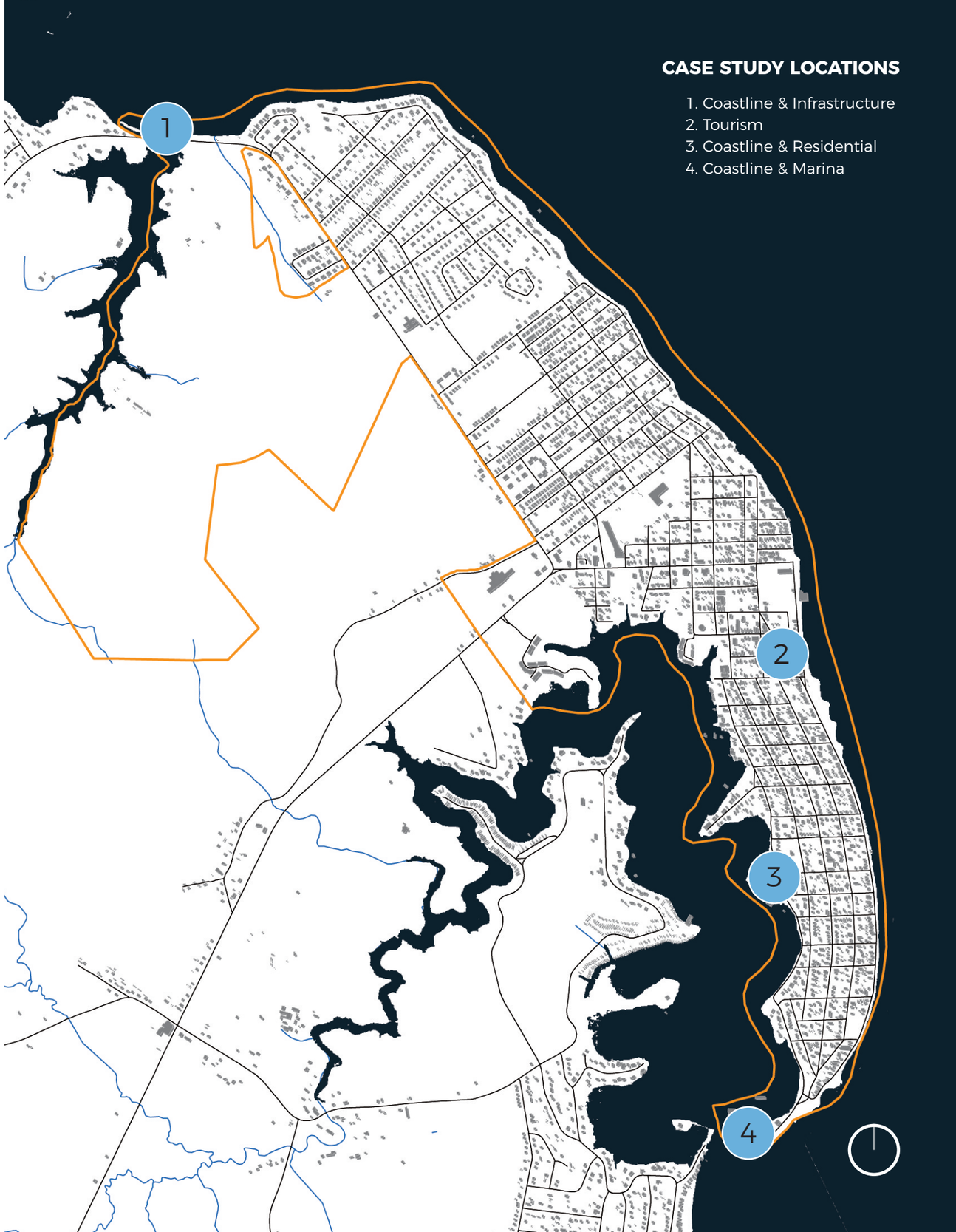
As a means for understanding how the previous strategies come together, intersect, and benefit the town, the team has identified four (4) caste studies that include key Town assets that are under various stressors and threats of coastal flooding and climate change. Each case study presents the current condition of the site, key identified strategies, and how they could be implemented over time, all illustrating the paths the Town can take to prepare for a climate adaptive future.

1. Coastline & Infrastructure

2. Tourism

3. Coastline & Residential

4. Coastline & Marina



CASE STUDY 01: Coastline & Infrastructure

Site: Route 205 & Wilkerson's Seafood Restaurant

Current Conditions:

This gateway into the Town is along a narrow, one way stretch of Route 205 that recently underwent infrastructural improvements to the bridge. Just past the bridge is the local Town landmark, Wilkerson's Seafood Restaurant. This waterfront destination is situated directly at the water's edge and has a boat dock for patrons. The beachspace is not ideal for recreation, but has potential to be upgraded for public use. Water almost entirely surrounds the space creating a series of threats with future storm and flooding predictions, potentially cutting off a critical gateway and evacuation route.

Application of Strategies:

In order to ensure proper viability of the area in the event of storms, flooding, and other surrounding events, the Town must ensure that the bridge and road infrastructure are properly equipped to handle increased vehicular traffic and flooding. The team has outlined two key strategies that can be incorporated over time to help ensure the security of this gateway and landmark restaurant.

Evacuation Redirection (Short term, low cost)

The first strategy would be to create a comprehensive evacuation plan that allows for traffic to be redirected in the event that one, or more bridges become compromised due to storm events.

Road Infrastructure Improvements (Long term, costs range)

As the bridge has been recently improved, the surrounding context can also benefit from additional upgrades. Central to this would be to plant water-tolerant rain gardens around the parking areas and water borders that can act as critical repositories for stormwater and flood management. Porous paving can also be utilized on the parking surfaces to allow for significant reductions in stormwater volume. Over time, the road and bridge could also be expanded with additional lanes to allow for larger volumes of traffic to pass through, particularly in storm events. Together, these strategies can be phased in and together create a robust system of strategies that ensure flood control and stormwater management and safety of town residents.

Measuring Success:

Success will be measured by the ability for this space to act efficiently and effectively as an evacuation route in the event of a storm or flooding event. If this bridge and space fail, the town must act and upgrade the space to ensure long-term safety and security for the town residents.

Top: Route 205 entering Colonial Beach
Botton: Wilkerson's Seafood

Precedent Work

Erie Street Plaza, Milwaukee

Hornsberg Strandpark

Tillet Bridge, Fort Worth

Hunter's Point, NYC

CASE STUDY 02: TOURISM

Site: Colonial Beach Town Pier & Downtown

Current Conditions:

During a recent visit to Colonial Beach in November 2020, the town seemed set up to accommodate activities and tourists in the summer months, rather than year-round tourist season. Washington Avenue between Wilder Avenue and Boundary Street appeared to be the main street with many restaurants and shops along this road. The town has historically been a summer tourist destination focusing on its maritime history; maintaining that identity is important. However, the changing climate threatens this very identity creating undesirable conditions for tourists during the summer months which would greatly impact the economic health of the town. Creating resiliency and diversifying the town's tourism sector is necessary for future climate adaptation planning.

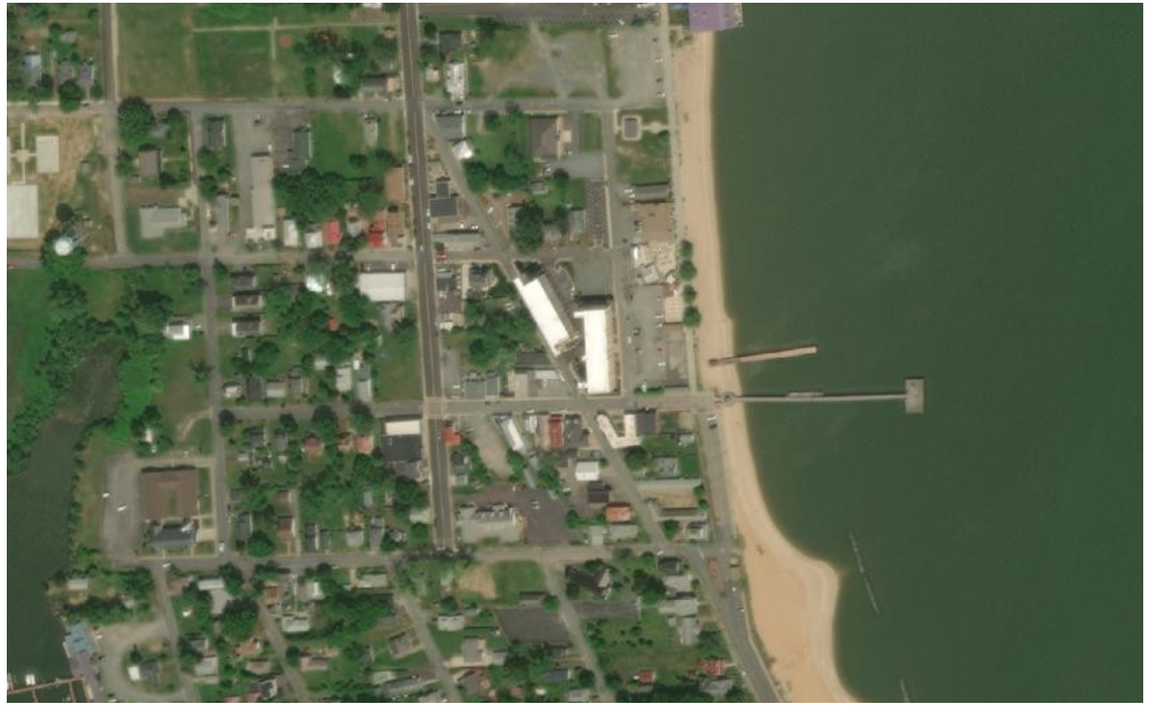
Application of Strategies:

Transitioning from a mostly summer tourism clientele to a year round tourist destination requires some creativity. Year round activities look different for every beach town, but there are several ways to make this jump. Spaces throughout the town should be utilized for town and tourist events. Town Hill can be used for farmers markets and seasonal festivals. Town Hill is also a prime location with access to the waterfront and Washington Avenue. The Colonial Beach Yacht Club parking lot also provides ample space for smaller, more niche markets. The marina is also a prime location given the number of boat slips available for residents from other areas to dock and then shop. Utilizing the towns tax incentive zones to attract businesses and artists to the area to set up in Colonial Beach will also provide more activities throughout the year, and add to the small town character. Watersports and other land activities such as biking, walking, or jogging are still possible in colder months and should be promoted.

Measuring Success:

Successful implementation of a year-round tourism economy includes a robust visioning plan with stakeholders, town council, and residents. Getting the buy-in from the town to implement a few additional events every year will lead to a greater range of activities that tourists can participate in when visiting the town at any time of the year.

The foundation for a truly diverse tourism economy is available in Colonial Beach. By diversifying and building a resilient tourism industry, the town will be able to capture additional tourism dollars that can then be used to implement necessary climate adaptation strategies and infrastructure to protect the town.



Precedent Work

Winter Activities

Off Season Markets

CASE STUDY 03: Coastline & Residential

Site: The Point, from Boundary Street south to Lafayette Street

Current Conditions:

This is a predominantly residential area, bordered by the Potomac to the east, and Monroe Creek to the west. As of the 2009 Comprehensive Plan, the site was primarily zoned for neighborhood preservation. It is adjacent to the Colonial Beach public beach and boardwalk, a central hub for tourism. It is also several blocks south of the Town's densest retail and dining area. This proximity has likely resulted in the quantity of Bed & Breakfasts and short-term rental homes in the area. There are also several marinas located on Monroe Creek. Main flooding risks likely to be experienced on The Point are concentrated on the west side of the peninsula, and will most heavily impact properties fronting Monroe Creek - both homes and marinas. These properties are at risk from inundation due to sea level rise, plus storm surge flooding and shoreline erosion.

Application of Strategies:

This area can benefit from property-level structural retrofits and green infrastructure installations to reduce anticipated flood impacts on homeowners. Thinking ahead to longer-term climate futures, residential properties in this area fronting on Monroe Creek will see portions of their properties inundated year round, and adaptive strategies to accommodate and retreat from this water may be necessary.

Incentivize Dry/Wet Floodproofing Retrofits:

The town could implement new incentives to entice homeowners to retrofit their homes with dry/wet floodproofing. This strategy is the first line of defense against coastal and tidal flooding, reducing the potential harm of floods without a massive investment in cash. This level of adaptation would be suitable for current flooding conditions.

Implementation of a Rolling Easement:

Regarding zoning ordinance changes, the town could look into implementing rolling easements to prevent development and rehabilitation on sites that will be severely flooded again in the future due to rising sea levels. The implementation of a rolling easement would also set the foundation for the town to create a managed retreat plan.

Preparing the Community for the Possibility of Structure Elevation or Retreat:

If the projected sea level rise begins to trend towards the higher end of the predictions, the town should be prepared to enact more long term and involved measures. Preparing guidelines and strategies for structural elevation and the movement of homes, plus other forms of retreat, will prepare the community for the worst case scenario if it does occur, allowing for a smoother adaptation. These preparations can range from setting up a contingency fund, to hosting workshops on structure elevation.

Incentivize GI-Based Shoreline Erosion Measures:

Property owners could be further incentivized and supported to pursue technical assistance and grant funding for green infrastructure measures to reduce the impacts of shoreline erosion and increase absorptive capacity during rain events. Promoting the Northern Neck PDC's Living Shorelines Initiative for private property owners, and continuing to work with VIMS and DCR SEAS to explore living shoreline opportunities are two strategies that could benefit residences in this portion of town.

Application of Strategies:

The Town can track the proportion of at-risk structures that have undergone flood mitigation, including retrofitting, structural elevation, and implementing green infrastructure measures.

Precedent Work

Raised Foundations

Shift of Housing Away from Shoreline

Living Shorelines

CASE STUDY 04: Coastline & Marinas

Site: Colonial Beach Yacht Club & Peninsula

Current Conditions:

The Colonial Beach Yacht Club and surrounding area is a major civic anchor for the town that houses the largest private marina for boat docking. Currently, the site is primarily crushed gravel for parking needs. This extends to the boat dock infrastructure that is a mixture of soft and hardscape with hardened edges and wooden piers. A small fringe of sand and vegetated beach landscape surrounds the riverside edge with segmented breakwaters protecting the yacht club from coastal flooding. There is little public programming available in the space, creating a unique opportunity for integrated green infrastructure.

Application of Strategies:

There are three main strategies that can help adapt the yacht club area to future effects of climate change and coastal flooding. These strategies range from short- and long-term projects with a range of costs as well. While each strategy may be exclusively implemented by the Town, a combination of options would help ensure a robust set of measures that will maintain the longevity of the site.

Fortification of Yacht Club edge and Docks (Short Term, Low Cost)

The quickest strategy of coastal flood protection would be to utilize products like ECOncrete to fortify the existing infrastructure on site. This would include wrapping the piers in additional material that strengthens the piers themselves by promoting aquatic habitat growth. Second, the hard edge could be retrofitted with a similar ECOncrete panel product that helps to stimulate habitat creation. Together, these technologies would help to increase the overall vibrancy of the aquatic habitat which would help manage flood risk with increased aquatic vegetation and bivalve space. These would also remain primarily underwater, allowing the existing character of the space to remain.

Additional Breakwaters and Dune Planting (Medium Term, Medium cost)

Looking ahead to increased storm occurrence and strength, the area could implement additional breakwater infrastructure that expands upon the current capacity. From here, the existing beaches could be planted with native species that help to stabilize the sediment and aid with flood management. Together, these two strategies would help slow the velocity of waves and reduce overall flood damage to the surrounding area. ensure flood control and stormwater management and safety of town residents.

Dredging of Marina (Long Term, High Cost)

The largest and most complex project would be a dredging of the Monroe Bay and marina area. This process would help to remove years of built up sediment and deepen the water, ensuring long-term boat access for residents, companies, and tourists alike. Deeper water in the Bay would help create a more robust aquatic ecosystem that can help to manage flood velocity and allow the area to hold more water during storms.

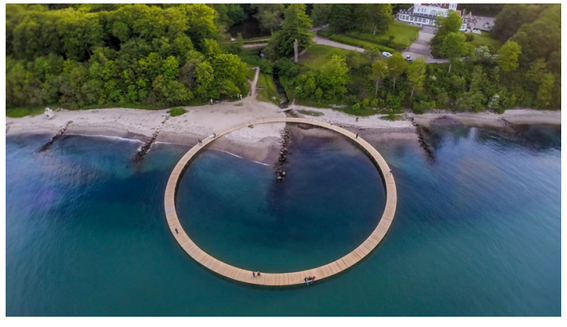
Measuring Success:

Ensuring the future of this area is dependent on the Town investing in additional resources towards coastal flooding mitigation. While the yacht club area already has foundational strategies implemented, additional combinations of strategies will be needed to provide a vibrant and thriving future.

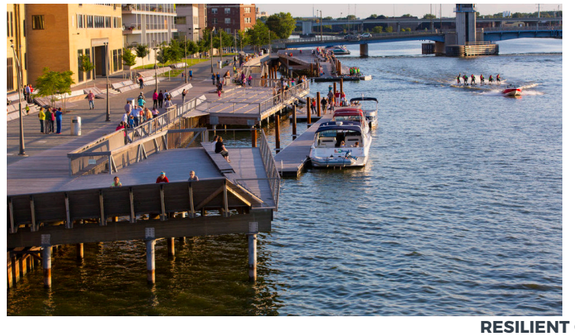
Precedent Work

South Pointe Park, Miami

Infinite Bridge, Aarhus



CityDeck, Green Bay



Alexandria Waterfront, Alexandria

Steps Forward

Moving forward, the Town of Colonial Beach has a multitude of opportunities to begin the creation of its own coastal flooding adaptation plan. While this list is not exhaustive, it highlights the necessary starting points to any climate adaptation plan, along with suggestions involving monitoring & evaluation and sources for additional support.

The Raft Process

The first step should be to complete the RAFT Process, which will integrate resiliency into the town's comprehensive plan. This cooperation with the Virginia Coastal Policy Center, would provide a great basis to begin community discussions on resiliency and how to address coastal and tidal flooding.

Identify Key Issues

Utilizing the previous provided information coupled with additional research, town staff should begin to outline the key threats to the town that relate to climate change. However, this list would only be preliminary and set the guidelines for discussion with the community, which through co-creation, will generate the official issues to be addressed.

Identify Stakeholders

The town should begin to identify key stakeholders within the community that should play a role in the formation of a climate adaptation plan. Staff should compile lists of key individuals, organizations, businesses, and neighborhoods that would be directly affected by this plan and begin initial outreach to gather input. In addition to hosting traditional community engagement meetings and events, the town could also create focus groups composed of key stakeholders that focus on different aspects of the plan, such as equity, financial impact on the community, or preserving town character. Finally, community engagement is not just a single event, but a continuous process that requires frequent check-ins with community stakeholders.

A major theme of stakeholder engagement would be the dual ideas of an equitable future and co-creation. This is partnering with existing community programs that serve low-income and traditionally marginalized communities. This would center the adaptation plan around social and economic justice and set the precedent for how other town plans address community engagement.

Timeline

Planning staff should create a preliminary timeline for the first key steps to the formation of the plan, if not for the entire plan, covering initial outreach to final adaptation.

Monitoring & Evaluation Suggestions

Although specific monitoring and evaluation measures will vary depending on what the town decides to pursue, there are some general guidelines on how to go about in an effective and equitable manner.

- Data should be disaggregated
- Monitoring should be conducted on short time frames
- Outcomes should be made transparent to the general public
- Identify feedback loops for learning to adjust strategies that are unsuccessful or having negative consequences
- As short-term projects are implemented, continue seeking feedback from the public to inform medium- and long-term impacts.
- Consider creating an online community feedback database to collect information on public perception and impacts on an ongoing basis. This could be as simple as a link to an online survey hosted on a no-cost platform that could be downloaded and reviewed by a member of town staff on a regular (quarterly, bi-annually) basis.
- Consider partnering with entities like Virginia Sea Grant, VIMS and DCR to install sensors or conduct remote monitoring which identifies the success and shortcoming of implemented strategies.
- Work with VDOT to regularly review data on road inundations and closures
- Create a data repository for information already collected by the town (such as building permit applications for structural modifications) to track the number and rate at which adaptation uptake is occurring, and impacts are being felt.

FEMA Community Rating System

One source of additional assistance that the town should consider utilizing is FEMA's Community Rating System. This program creates a scorecard and ranking system of all participating communities, facilitating the sharing of different adaptation strategies and providing reductions to flood insurance premiums to, with higher discounts for higher rankings[1]. Partaking in this program would provide the town with additional information on adaptation strategies, as well as a reward for partaking in proactive planning.

Additional Research

During these early stages of formulation, it could be helpful to explore potential funding opportunities at the state and federal levels, and what other localities have done to address coastal flooding, to better inform the initial conversations.

1. *Federal Emergency Management Agency, "Community Rating System Fact Sheet," https://www.fema.gov/media-library-data/1584566648735-b8216fe96907ffae2399034ac-d4c8e92/NFIP_CRS_Fact_Sheet_2020_508OK.pdf*

An Adaptive & Flourishing Social Future

Among the many guiding principles that this plan was built around, equity, accountability, and co-creation were a main focus. An adaptive and flourishing social future for Colonial Beach incorporates those principles. Social justice and equity must continue to be at the forefront of plans moving forward. To develop strong, equitable planning solutions for Colonial Beach, this can look like utilizing existing community programs within the town and county that serve low income and minority communities to be included in future planning processes. An equitable and accountable climate adaptation plan needs co-creation from key members of the town. Frequent check-ins with the community provides the accountability necessary to advance an equity centered climate adaptation plan. These check-ins serve as a continuation of social adaptation and provide opportunities to allocate resources equitably and as needed throughout the town.

Small towns along the eastern seaboard are vulnerable to climate change. Unlike major cities along the coast, these towns typically lack the resources to build robust coastal resilience plans. The Framework for Coastal Flood Planning provides thoughtful research, recommended strategy development and implementation, and incorporates economic and social justice in an accessible and realistic manner for a small town. A deep exploration of the town's current conditions was conducted, and strategies and actionable items were explored. The coastal resilience efforts within this plan are intended to be flexible for town officials to use for inspiration or implementation.

Thank you

UVA SCHOOL OF
ARCHITECTURE