

Policy Options for Sea-Level Rise and an Eroding Property Tax Base in Cape Charles, Virginia

An Applied Policy Project

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Disclaimer

This study was conducted in partial fulfillment of the course requirements for the Master of Public Policy degree at the Frank Batten School of Leadership and Public Policy at the University of Virginia. The judgments and conclusions are solely my own, and are not necessarily endorsed by the Batten School, the University of Virginia, the Town of Cape Charles, my client, or any other person or agency.

Acronyms and Definitions

CRS

The Community Rating System, which is administered by FEMA as part of the NFIP

Episodic Flooding

The occasional flooding of a given area brought on by severe storms

FEMA

The U.S. Federal Emergency Management Agency

Inundation

The complete and permanent flooding of a given area

NFIP

The National Flood Insurance Program, which is administered by FEMA

SLR

Sea-level Rise

SFHA

Special Flood Hazard Area, which is designated by FEMA to indicate the 1% annual chance flood plain, otherwise known as the 100-year flood plain, as part of the NFIP

Subsidence

The sinking of land, which accelerates the effects of SLR, especially on the Eastern Shore

Executive Summary

Cape Charles is a small, low-lying town on Virginia's eastern shore. In the wake of sea-level rise, it is facing an unprecedented adaptive challenge. While sea level rise will affect Cape Charles in many different, important ways, this report focuses on how it will affect the Town's property tax revenues. This is because like most local governments in the United States, property tax revenues make up more than half of Cape Charles's general revenues. The inundation of property and the increased episodic flooding that sea-level rise brings, then, could threaten the town's long-term financial stability.

This report provides the Town of Cape Charles with four options to reduce total discounted losses in property tax revenues given sea-level rise. These options include Maintain the Status Quo, Adjust Property Tax Rates Accordingly, Further Participation in the NFIP Community Rating System, and Annex Surrounding Property in Northampton County. These options are evaluated on the criteria of reducing total discounted losses to property tax revenue, reducing total discounted losses to property value, minimizing initial discounted costs of implementation, attaining political feasibility, and promoting equity.

Given the significant risks that sea-level rise poses to the long-term viability of the Town, the ultimate goal of this report is to ignite serious conversation and inspire action regarding the Town's best options. Upon evaluation, it is recommended that the Town of Cape Charles further its participation in the NFIP Community Rating System while also planning to adjust property tax rates accordingly.

Problem Statement

Cape Charles, Virginia is a small incorporated town in Northampton County, Virginia whose total property value is threatened by sea-level rise. This impedes Cape Charles' ability to generate revenues. Property tax revenues accounted for about 53% of the Town's general revenues in fiscal year 2016 (Robinson & Farmer, Cox Associates, 2017). This in turn threatens Cape Charles's long term ability to provide key public services to its residents.

Background

Cape Charles, Virginia

Population

Cape Charles's population has steadily declined since 2000 according to the U.S. Census and American Community Survey (ACS) estimates. The most recent ACS estimates indicate that Cape Charles's current population is approximately 982 full-time residents, down from 1,009 in 2010 and 1,134 in 2000 (US Census Bureau, 2018). While Cape Charles has clearly been experiencing out-migration, it has also been experiencing in-migration. In the past decade, Cape Charles has become a popular destination amongst retirees, tourists, and second home owners increasing its number of seasonal residents. Town officials expect some of these seasonal residents to become full-time residents in the coming years as they retire to Cape Charles (Accomack-Northampton Planning District Commission, 2016).

The median household income in Cape Charles is \$49,792. This is higher than the County median household income of \$37,011, while lower than the State median household income of \$66,149 (US Census Bureau, 2018). The median home value in Cape Charles is approximately \$338,300 (US Census Bureau, 2018). This is higher than both the County median home value of \$164,600 and the State median home value of \$248,400 (US Census Bureau, 2018). The homes in Cape Charles tend to be significantly older than those throughout the rest of Northampton County and Virginia. Approximately 36% of homes in Cape Charles were built before 1939 (US Census Bureau, 2018). While the historic nature of Cape Charles homes may contribute to their higher median values, it also makes them more vulnerable to flooding.

Geography

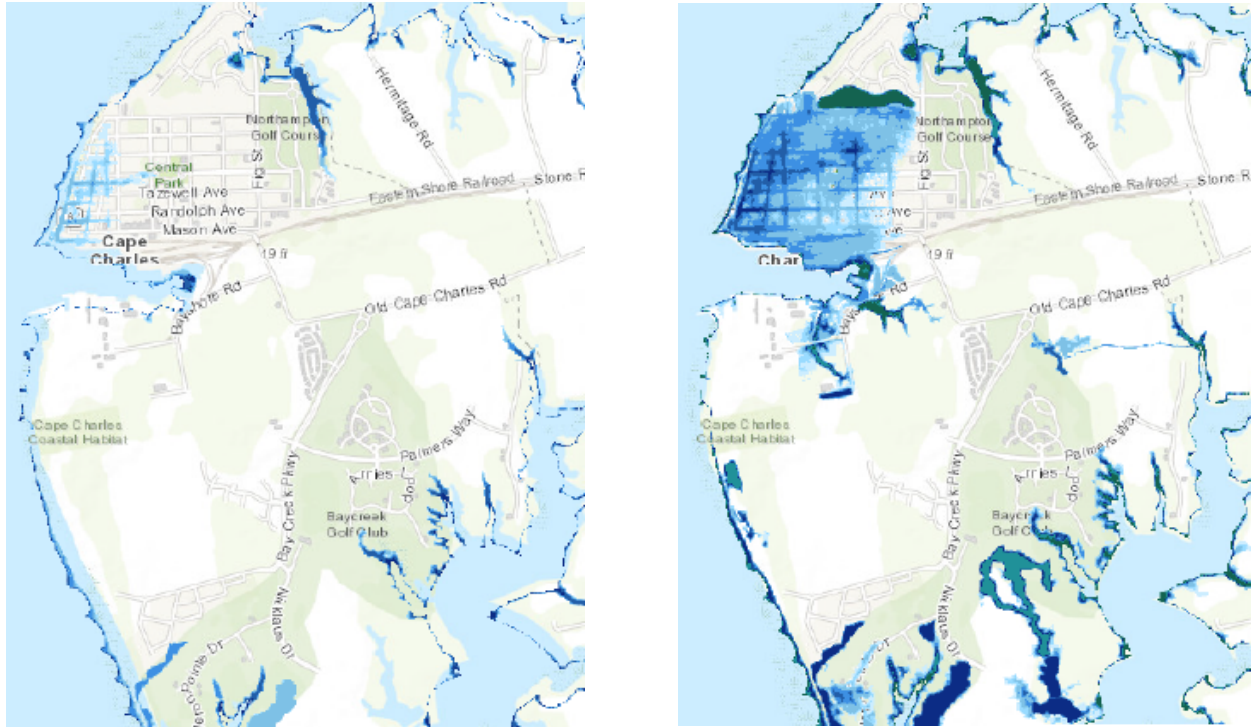
Cape Charles consists of about 4.4 square miles, 3.7 of which are land and 0.7 of which are water (Accomack-Northampton Planning District Commission, 2016). The Town, located on the Chesapeake Bay, has very low-lying topography making it extremely susceptible to flooding. The Town's highest point is approximately 15 feet above sea-level (Cape Charles Planning Commission, 1999). While most of the town's physical development sits between five and ten feet above sea-level, there is still high-value development located between 10 and 15 feet above sea-level (DiRe, 2018b). The town's historic center, located on Mason Avenue, currently sits at about seven feet above sea-level (Accomack-Northampton Planning District Commission, 2016). The historic center is thought to be crucial for sustaining the town's tourist economy.

In all, about 70% of the Town's total property value lies below an elevation of 10 feet. Infrastructure investments, like sea walls, limit the Town's total property value exposure to about 48% in the event of a 10-foot flood (Climate Central, 2017). Some of Town's older protective infrastructure disproportionately benefits historically wealthier and whiter neighborhoods. For example, double curbs, used to increase the distance between street-level flooding and sidewalk-level property, are not as prevalent in historically black neighborhoods.

Projected Sea-Level Rise

While sea-level rise could occur at numerous different rates, the National Oceanic and Atmospheric Administration (NOAA) recommends that government officials use its estimates of medium and extreme rates of sea-level rise to frame their decision making and long-term planning (Sweet et al., 2017). Using this data from NOAA, Climate Central (2017) estimates that by 2050 sea-levels will rise from anywhere between 1.9 feet under medium rates to 3.8 feet under extreme rates at Kiptopeke water level station, which is six miles from Cape Charles. Climate Central estimates that by 2100 sea-levels will rise from anywhere between 4.6 feet under medium rates to 11.7 feet under extreme rates. The permanent flooding in Cape Charles from both medium and extreme rates of SLR are shown below in *Image 1*.

Image 1: Approximate Medium SLR & Extreme SLR Scenario (Inundation) in Cape Charles in 2100



Source: The Nature Conservancy

In 2017, Cape Charles experienced nine total flood days, seven of which were driven by climate change (Climate Central, 2017). Flooding is said to occur when water levels exceed the local threshold established by the National Weather Service as “minor” flooding, based on observed impacts of the flood. For Cape Charles, flooding occurs when water exceeds 1.7 feet. The total number of flood days, and the severity of the flood itself in regards to water depth, is only expected to increase due to sea-level rise, subsidence, and a global trend of increasing storm frequency and severity. The estimated water level for a mild flood in Cape Charles given medium sea level rise is 3.9 feet above current water levels in 2050 and 6.5 feet above current water levels in 2100. The estimated water level for a mild flood in Cape Charles given extreme sea level rise is 5.8 feet above current water levels in 2050 and 13.6 feet above current water levels in 2100 (Climate Central, 2017). Mild floods are defined as occurring when water exceeds 2 feet above the typical water level (Climate Central, 2017). Even

though mild floods are thought to occur on average, once a year, the fact that Cape Charles experienced nine flood days last year with at least 1.7 feet of water indicates that in the future mild floods, as defined, will occur more than once a year.

Governance

As an incorporated town, Cape Charles is self-governing and per its town charter (1978), must maintain a town council, a mayor, a vice-mayor, a town manager, a town clerk, a town treasurer, and a chief of police. As part of its self-governance, the Town has control over its land development policies. Cape Charles also has independent taxing authority and can engage in any revenue-generating activity to the extent that it is not prohibited by Virginia law (Charter for the Town of Cape Charles, 1978). Any property taxes that Cape Charles levies, though, are on top of the taxes already levied by Northampton County meaning residents pay property taxes to both the Town of Cape Charles and to Northampton County.

The Town Treasurer estimates that since Cape Charles does not have its own school system separate from that of Northampton County, that the Town's greatest expenses are maintaining its public beach and harbor (Pocock, 2018). Due to limited personnel and resources, the Town does not engage in long-term budgeting. Rather, the Town projects its expenses and revenues on an annual basis using information from the previous three fiscal years (DiRe, 2018a).

Like most local governments across the nation, the Town's largest sources of general revenues are property tax revenues and intergovernmental transfers (Harris & Moore, 2013). In fiscal year 2016, property tax revenues accounted for about 53% of the Town's total general revenues (Robinson & Farmer, Cox Associates, 2017). Intergovernmental transfers, meaning funds provided directly by the Commonwealth or by the federal government, accounted for 12% of the Town's general revenues (Robinson & Farmer, Cox Associates, 2017). What has in part made the property tax so popular amongst local governments across the Nation is its flexibility in the wake of changing market conditions. While other sources of local government revenue, most notably sales taxes and income taxes, respond immediately to economic downturns, property taxes can continue to provide stable revenues due to manipulated property tax rates (Lutz et al., 2011; Harris & Moore, 2013). In Virginia, there is no upper limit on the local property tax rate. Still, though, even this flexibility of the property

tax has its limitations. A 2015 study by Cromwell and Ihlandfelt concludes that a loss in the property tax base in Florida following the Great Recession lead both cities and counties to increase their property tax rates to compensate for losses in the property tax base, but that both cities and counties still had to decrease their expenditures.

The Impact of Flooding on Property Values

The Impact of Inundation and Episodic Flooding

Sea-level rise will lead to a loss of property and property value. Exactly how much property will be lost and how this will negatively effect property values is location specific. Most studies focus on the impacts of inundation brought on by sea-level rise, rather than on the impacts of increased episodic-flooding brought on by sea-level rise. Inundation refers to property that over time, would become completely and permanently flooded from sea-level rise. Episodic flooding, as the name implies, occurs only every now and then from severe storms. As sea levels rise, episodic flooding is expected to become more frequent and more severe (Liu, 1997; Nicholls, 2002; Nicholls et al., 1999). Academics disagree, though, about the magnitude of the impacts of episodic flooding on property values brought on by sea-level rise relative to the impacts of inundation. West et al. (2001) for example, find that the costs of episodic flooding are far less than the costs of inundation, while Michael (2007) argues that the costs of episodic flooding are far greater than the costs of inundation. Michael (2007) makes a more compelling argument, however, for why this would be the case for local governments in the event of sea-level rise.

Michael (2007) reasons that first, more properties will be affected by episodic flooding than complete inundation. Second, increased damage from episodic floods can still be substantial for small sea-level rise scenarios that result in very small losses from complete inundation. This means that far more property in Cape Charles is at risk than appears to be from mapping tools that depict sea-level rise scenarios like those shown in *Image 1*. Third, Michael (2007) argues that the effects of episodic flooding are felt immediately and not subject to the same discount rates that the effects of inundation from sea-level rise are subject to. Michael then models the impact of both inundation and episodic flooding from slow to medium rates sea-level rise for three Maryland towns located on the Chesapeake Bay. Using a model, known as a no-foresight model, in which the towns make no additional effort to

protect against sea-level rise, he finds that, on average, the costs associated with episodic flooding are five times the costs of inundation.

The Impact of Flood Insurance

Another important way that sea-level rise affects property values is not through the act of flooding itself, but through increased flood insurance premiums. The National Flood Insurance Program (NFIP) was established under the Federal Emergency Management Agency (FEMA) in 1968 to provide affordable flood insurance to homeowners, business owners, and renters (National Flood Insurance Act, 1968). This was in response to high private flood insurance rates and a general unwillingness amongst existing providers to offer flood insurance in the first place (Molk, 2016). In order to access these below-market insurance premiums, properties have to be located within participating communities that enforce minimum floodplain management programs within the FEMA designated Special Flood Hazard Area (SFHA).

NFIP premiums, though, have been rising in recent years (Stiff, 2017a). Effective April 1, 2018, the average NFIP policy premium will increase by 8%, or \$69, for new and renewed policies (FEMA, 2018). With additional fees that must be paid by the policyholder, the total average amount billed to a policy holder will increase by \$194 (FEMA, 2018). This increase is likely greater for areas with increasing flood risks. In Norfolk, Virginia for example, flood insurance rates could rise as much as several thousand dollars in the coming years due to increasing flood risks (Urbina, 2016). Rising flood insurance premiums are causing prolonged market listings for homes in historically popular Norfolk neighborhoods, further lowering the overall market value of the properties in question (Beeler, 2016).

Methodology

The purpose of this report is to propose and evaluate policy options that preserve Cape Charles's ability to generate property tax revenue in the wake of sea-level rise. The next section introduces five criteria used to evaluate the proposed policy options. The rest of the report elaborates on four distinct policy options for the Town of Cape Charles, and will ultimately make a recommendation based on thorough analysis guided by the selected criteria.

Evaluative Criteria

Total Discounted Losses in Property Value

This criterion estimates the Town's total lost taxable real estate as a result of sea-level rise and associated episodic flooding through fiscal year 2100 under the proposed policy. The goal is to minimize total lost value of taxable real estate.

To estimate the Town's total lost taxable real estate, the present value of the difference between projected real estate values given no inundation and values given inundation under both medium and extreme rates of sea-level rise through fiscal year 2100 is used. This is done using a discount rate of 3% in accordance with academic literature and advisement from Professor Jay Shimshack at the Frank Batten School of Leadership and Public Policy at the University of Virginia. This process is further described below.

Projecting the Town's Property Values Given No Inundation

The Town's total taxable property value for fiscal year 2017 is approximately \$360 million. Using data from Climate Central, the value of taxable real estate by elevation is displayed below in *Table 1*. The results assume that elevation does not influence property value, which in reality, is unlikely. No other data was available, though, to better inform this estimate. The results consider how the Town's current flood mitigation infrastructure limits flood exposure within certain elevations.

Table 1: Total Taxable Property Value by Elevation

Elevation Above Sea-Level	Percent of Total Baseline Exposed within Elevation	Value of Taxable Real Estate FY 2017 (Millions)
Total	100.00%	360
0-1ft	0.00%	0
1-2ft	0.90%	3.24
2-3ft	0.00%	0
3-4ft	0.90%	3.24
4-5ft	2.94%	10.584
5-6ft	7.10%	25.56
6-7ft	4.40%	15.84
7-8ft	10.60%	38.16
8-9ft	8.90%	32.04
9-10ft	11.50%	41.4
>10ft	52.76%	189.936

Source: The Town's Annual Financial Reports & Climate Central

The values in *Table 1* are projected out, by elevation, through 2100 using a 4% annual growth rate. The 4% annual growth rate represents the town's average growth rate over the past ten fiscal years (Robinson & Farmer, Cox Associates, 2017). It should be noted, however, that the average annual growth rate of real estate value in Cape Charles varies significantly depending on the years referenced. The average annual growth rate for the 27-year period covering fiscal year 1991¹ through fiscal year 2017 is 12%. The average annual growth rate for the past three fiscal years is -5%. Recall that when projecting future revenues that Cape Charles typically only analyzes the previous three fiscal years. The average annual growth rate for the past ten fiscal years was selected because it more closely resembles the national long-term average real estate value growth rate and because the time period represents close alignment with literature regarding how local governments manipulate tax rates when faced with changing property values.

¹ 1991 is the earliest fiscal year accessible for analysis from digital copies of the Town's Annual Financial Reports.

Projecting the Town's Property Values Given Inundation from Medium and Extreme Rates of Sea-Level Rise

Property value, which has appreciated according to the 4% annual growth rate, is removed from the tax base beginning in the year in which projected sea-levels meet or exceed the elevation of that property value. This assumes that once property becomes inundated, the value of that property is zero. This also assumes that until this occurs, there is no depreciation of property value at that elevation, which is unlikely and represents an underestimation of value lost in the property tax base. At the same time, though, this model also assumes that there is no additional appreciation on top of the 4% annual growth rate due to a shrinking supply of property. In other words, this model assumes that once property is inundated, property owners re-invest outside of Cape Charles. This represents an overestimate of value lost in the property tax base.

Adding the Cost of Episodic Flooding

The process described above finds the present value of property losses from inundation alone. When referenced, total discounted losses in property value will include both the costs of inundation and the costs of episodic flooding. As previously discussed the increased episodic flooding that accompanies sea-level rise can result in property losses more than five times that of inundation alone for localities that exhibit no foresight (Michael, 2007). This evaluation uses a no-foresight model for two reasons. First, a non-foresight model allows the proposed policy options to be evaluated in isolation. This means that the resulting evaluation depicts estimated property losses given that Cape Charles takes no further action to address sea-level rise aside from the proposed policy option. In some ways, this represents a worst case scenario in order to highlight the costs of inaction. Second, a no-foresight model, while not representative of the mentality of the Town's Planning Department, may be more representative of the Town's mentality at large (DiRe, 2018a). To consider the additional costs of episodic flooding, then, the present value of property losses from inundation are multiplied by five, unless the proposed policy option necessitates otherwise, and then added to the losses from inundation.

Total Discounted Losses in Property Tax Revenue

This criterion estimates the Town's forgone property tax revenues as a result of sea-level rise and associated episodic flooding through fiscal year 2100 under the proposed policy. The goal is to minimize total lost property tax revenues. This will be prioritized over minimizing losses to total value of taxable real estate.

To estimate the Town's total lost property tax revenues, the appropriate property tax rate is applied to the present value of total property losses. This assumes that in the absence of inundation and episodic flooding from sea-level rise, that 100% of the property tax levied would be collected.

Initial Discounted Costs of Implementation

This criterion estimates any additional costs of the proposed policy to the Town of Cape Charles. This is done by identifying important cost categories and applying the same growth rates and discount rates discussed above. This assumes that costs are rising at the same rate as revenues.

Political Feasibility

This criterion evaluates the current political climate in regards to whether or not the policy option has low, mixed, or high levels of support from key stakeholders including the Mayor, the Town Manager, the Town Council, the Town Planner, the Town Treasurer, town residents, and any other relevant stakeholders pertaining to the policy option. High levels of political feasibility are preferred over low levels of political feasibility.

Equity

This criterion assesses whether the policy option has low, moderate, or high levels of wealth-associated equity and/or intergenerational equity. Because this report focuses on preserving property values and resulting property tax revenues, it is acknowledged that the following policy options may, for example, disproportionately benefit relatively wealthy property owners at the expense of property renters. It is also acknowledged that because this report uses an evaluation period stretching through 2100 that the following policy options may disproportionately benefit or burden current residents over future residents. High levels of equity are preferred over low levels of equity.

Policy Options

This report's concern over property values in the wake of sea-level rise stems ultimately from concern that it will decrease the Town's property tax revenues which make up a majority of the Town's general revenues. It would be natural, then, to consider options that introduce other traditional financial tools, like taxes or fees, that would help the Town either increase or diversify its revenues. Bartle et al. (2003) support the idea that local governments should consider other sources of revenue in order to avoid over-reliance on the property tax. The Virginia Municipal League (VML) argues that local government revenue ought to be diversified across income taxes, retail taxes, and property taxes (Virginia Municipal League, 2018). However, municipalities do not have complete authority to do this. Virginia law prohibits localities from levying an income tax ("Incomes not subject to local taxation"). Furthermore, any additional sales tax or fee introduced by the Town of Cape Charles would likely have minimal impact given the Town's small population and could negatively impact the town's tourist economy. Efforts to protect the Town's tourist economy has, for example, prevented Cape Charles from charging an access fee to its public beach, the upkeep of which accounts for most of the Town's expenses. Furthermore, the same geographic areas in which sales taxes would be collected are in the same geographic areas threatened by sea-level rise. Another important consideration is that while local governments throughout Virginia are calling on the Commonwealth for increased resources and inter-governmental transfers to aid in sea-level rise adaptation, it is unlikely that Cape Charles will receive priority over other large localities like Norfolk or Virginia Beach. It is these constraints that inform the proposed policy options.

The resulting four distinct policy options are as follows:

1. Maintain the Status Quo
2. Adjust Property Tax Rates Accordingly
3. Further Participation in the NFIP Community Rating System
4. Annex Surrounding Property from Northampton County

1. Maintain the Status Quo

This option demonstrates the impacts of sea-level rise and associated episodic flooding if Cape Charles makes no significant policy changes going forward. This option is evaluated below. A summary of the evaluation is available in *Table 3*.

Total Discounted Losses in Property Value

Table 2 (next page) shows a snap shot of projected, taxable real estate values, by fiscal year, if real estate values in Cape Charles continue to appreciate at the average annual growth rate from the past ten fiscal years of 4% under a no sea-level rise scenario, a medium sea-level rise scenario, and an extreme sea-level rise scenario. The values only reflect changes from inundation and do not yet factor in the additional costs of episodic flooding unless otherwise specified. The values are discounted to represent their value in terms of today's consumption.

Table 2: Discounted Total Property Value (Millions) by Year and Rate of Sea-Level Rise

Fiscal Year	Projected Taxable Real Estate Value- No SLR	Projected Taxable Real Estate Value – Medium SLR	Projected Taxable Real Estate Value – Extreme SLR
2020	370.59	370.59	370.59
2030	408.18	408.18	408.18
2040	449.59	445.54	445.54
2050	495.19	490.74	471.72
2060	545.43	540.52	519.57
2070	600.75	595.35	529.62
2080	661.69	655.74	484.10
2090	728.82	715.70	384.52
2100	802.75	764.70	423.53
Cumulative for every year through 2100	46405.94	45971.97	39234.57
Cumulative Difference from No SLR Scenario	--	433.967	7171.38
Total Discounted Loss in Taxable Real Estate Value ¹	--	2603.80	43028.26

¹ Includes the costs of both inundation and episodic flooding

Cape Charles's total property value losses from sea-level rise is the cumulative difference between the three scenarios depicted above multiplied by six to represent the fact that the costs of episodic flooding are five times that of inundation. In other words, if Cape Charles expects its total taxable property value to continue to appreciate in value according to the average annual growth rate of the past ten fiscal years, then it will over-estimate the value of its taxable property by a total discounted value of approximately \$2.60 billion with medium rates of sea-level rise. This is a cumulative loss over the years through fiscal year 2100. With extreme rates of sea-level rise, it will over-estimate the value of its taxable property by a total discounted value of approximately \$43.03 billion.

Total Discounted Losses in Property Tax Revenue

As a result of the losses in property value described above, medium rates of sea-level rise and its associated episodic flooding will result in an \$8.48 million property tax revenue shortfall, relative to a scenario in which there was no flooding from sea-level rise, over the coming decades through fiscal year 2100. Under extreme-rates of sea-level rise the estimate property tax revenue shortfall of \$140.27 million. These are the present values of the shortfalls using the discount rate of 3% as described in the Evaluative Criteria section of this report.

Initial Discounted Costs of Implementation

This option has no further costs in regards to implementation.

Political Feasibility

Political feasibility for this option is considered mixed. While this option may be considered ineffective because it takes no additional action to maintain property tax revenues or preserve the property tax base in Cape Charles, it does not send the politically unpopular message that property in Cape Charles is in immediate danger from sea-level rise. Although there is little political incentive to openly acknowledge sea-level rise, the Town Council has been accepting regular updates from the RAFT project. A partnership between the University of Virginia, William & Mary College, and Old Dominion University, the RAFT project assists communities in evaluating and responding to coastal flooding. This demonstrates some sort of interest on the part of the Town Council to act on increasing flood risks, although these flood risks might not be acknowledged as related to sea-level rise, and consequently, not as severe as medium rates or extreme-rates of sea-level rise depict them.

Equity

This option has low levels of equity. This option places a disproportionate burden on future generations, who may struggle to not only recuperate value from any inherited property, but to continue to fund the town's operations in the wake of property tax revenue shortfalls. As one property owner in Cape Charles put it, "We think about leaving our house to our son, but wonder if it will be worth anything to him. And that's a problem for his generation" (Anonymous, 2018).

Table 3: Summary of Option 1 Evaluation

Criteria		Option 1: Status Quo
Total Discounted Losses in Property Tax Revenue through 2100	<i>Medium SLR</i>	\$8.48 million
	<i>Extreme SLR</i>	\$140.27 million
Total Discounted Losses in Property Values through 2100	<i>Medium SLR</i>	\$2.60 billion
	<i>Extreme SLR</i>	\$43.03 billion
Discounted Costs of Initial Implementation		\$0
Political Feasibility		High
Equitability		Low

2. Adjust Property Tax Rates Accordingly

An alternative to the status quo presented above is to raise tax rates in order to compensate for the losses in the property tax base. As discussed previously, this is one of the primary advantages of using property taxes to fund local government operations. *Table 4* (next page) indicates a historic pattern in Cape Charles of either raising tax rates when the annual percent growth rate of taxable real estate value is negative or lowering tax rates when the annual percent growth of taxable real estate value is positive. This appears to be particularly true over the past ten fiscal years in which property tax revenues remain relatively constant even with relatively large fluctuations in total taxable real estate value. Take, for example, the changes between fiscal year 2008 and 2009 and the changes between fiscal year 2016 and 2017. From fiscal year 2008 to fiscal year 2009, the total taxable real estate value in Cape Charles increased by about 88% while the tax rate decreased from \$0.3008 per \$100 of assessed value to \$0.1628 per \$100 of assessed value. This resulted in only a 2% increase in total property tax levied.¹ From fiscal year 2016 to 2017, the total taxable real estate value in Cape Charles decreased by about 14% while the tax rate increased from \$0.2759 per \$100 of assessed value to \$0.326 per \$100 of assessed value and the total property tax levied increased by only 2%.

¹ Except for FY 2017, these are estimates using the total taxable property value, and the property tax rate from the Town from annual financial reports.

Table 4: Historic Property Values and Approximate Tax Levies in Cape Charles

Fiscal Year	Property Tax Rate Per 100 Dollars	Taxable Real Estate Values in 2017 Dollars ¹	Annual Percent Change in Real Estate Values	Approximate Property Tax Levied in 2017 Dollars ¹	Annual Percent Change in Property Tax Levies
1991	0.34	\$36,024,439.35	--	\$68,174.08	--
1992	0.34	\$47,152,800.5	31%	\$91,920.02	31%
1993	0.34	\$45,739,933.63	-3%	\$91,835.02	-3%
1994	0.34	\$70,218,497.77	54%	\$144,592.14	54%
1995	0.35	\$68,283,342.32	-3%	\$148,844.85	0%
1996	0.37	\$65580067.88	-4%	\$155,583.15	2%
1997	0.37	\$64390861.12	-2%	\$156,266.91	-2%
1998	0.37	\$63364389.45	-2%	\$156,171.08	-2%
1999	0.37	\$61877521.07	-2%	\$155,874.71	-2%
2000	0.37	\$76576022.96	24%	\$199,385.56	24%
2001	0.37	\$75087113.83	-2%	\$201,072.06	-2%
2002	0.37	\$97623466.26	30%	\$265,554.18	30%
2003	0.37	\$107015688.30	10%	\$297,737.15	10%
2004	0.47	\$131426698.90	23%	\$476,847.43	56%
2005	0.3008	\$269185661.80	105%	\$646,246.24	31%
2006	0.3008	\$301996816.90	12%	\$748,405.13	12%
2007	0.3008	\$332488751.40	10%	\$847,266.67	10%
2008	0.3008	\$351624069.90	6%	\$930,607.37	6%
2009	0.1628	\$660211380.50	88%	\$942,173.17	2%
2010	0.1828	\$684760860.80	4%	\$1,115,672.73	16%
2011	0.1828	\$672779529.20	-2%	\$1,130,327.90	-2%
2012	0.1828	\$663007325.00	-1%	\$1,137,188.43	-1%
2013	0.1828	\$654430931.10	-1%	\$1,139,100.29	-1%
2014	0.2759	\$423673245.00	-35%	\$1,130,699.05	-2%
2015	0.2759	\$417974502.50	-1%	\$1,116,904.05	-1%
2016	0.2759	\$418193274.70	0%	\$1,131,634.08	0%
2017	0.3260	\$360101034.00	-14%	\$1,171,766.00	2%

Source: Town's Annual Financial Reports

¹ Calculated using annual chained CPI (Federal Reserve Bank of Minneapolis, 2018).

Data from recent storm events, though, indicate that this flexibility of the property tax is limited. The *New York Times* recently published findings indicating that, in total, municipalities of Ocean County, one of the hardest hit counties by Hurricane Sandy, still fell \$7.8 billion (8%) short of their pre-storm property tax base even five years after the storm hit (Corasaniti, 2017). This option is evaluated below according to the previously established criteria. A summary of the results is presented in *Table 5*.

Total Discounted Losses in Property Value

This option does nothing to mitigate total discounted losses in taxable property value. As a result, the total discounted losses in taxable property value are the same as the status quo.

Total Discounted Losses in Property Tax Revenue

Theoretically, the tax rate could be adjusted in order to perfectly compensate for the losses in the property tax from inundation and episodic flooding so that there are zero, or at least close to zero, total discounted losses in property tax revenue. In reality, though, it seems unlikely that Cape Charles would experience almost no losses in its property tax revenues relative to no inundation if it were to pursue this option. This would only be true if Cape Charles maintained constant collection rates, which given the previously presented evidence regarding tax revenues following Hurricane Sandy, seems improbable. However, Cape Charles could adjust its tax rate to account for decreases in collection rates. In fact, evidence from Annual Financial Reports indicates that Cape Charles may already be doing this. For the purposes of this analysis, it is assumed that Cape Charles can in fact adjust its tax rate to perfectly, or near perfectly, compensate for losses in taxable property value and reduced collection rates.

Initial Discounted Costs of Implementation

The only costs associated with implementing this option are the costs of notifying residents of the tax rate changes. This is essentially free to the town since announcements regarding tax rates can be made online or during regular Town Council meetings.

Political Feasibility

A study by Ihlandfelt (2011) shows that residents care far less about the tax rate itself than they do about the total tax paid, but the Mayor of Houston was met with substantial political pushback after he attempted to raise the property tax rate following property losses from Hurricane Harvey (Shaforth, 2017). Therefore, political feasibility for this option is considered mixed. While it is normal for local governments, including Cape Charles, to adjust tax rates in response to changes in property value, it is unpopular to do so in response to losses associated from flooding.

Equity

This option has moderate levels of equity. Like the status quo, this option places a disproportionate burden on future generations who may struggle to not only recuperate value from any inherited property, but unlike the status quo, it works to ensure funding for the Town's future operations.

Table 5: Summary of Option 2 Evaluation

Criteria		Option 2: Raise Rates Accordingly
Total Discounted Losses in Property Tax Revenue through 2100	Medium SLR	\$0 (roughly)
	Extreme SLR	\$0 (roughly)
Total Discounted Losses in Property Values through 2100	Medium SLR	\$2.60 billion
	Extreme SLR	\$43.03 billion
Discounted Costs of Initial Implementation		\$0
Political Feasibility		Mixed
Equity		Moderate

3. Further Participation in the NFIP's Community Rating System

Another alternative to the status quo is to increase the Town's participation in the NFIP's Community Rating System. Communities that exceed minimum NFIP requirements can qualify policyholders for insurance premium discounts through the Community Rating System (CRS). Interest in CRS has increased within Virginia as NFIP premiums increase (Stiff, 2017a).

Discounts through the CRS are determined by a community's Class. A community's Class is dependent on accrued points for engaging in any number of 19 creditable activities related to flood risk reduction. These 19 creditable activities fall under four categories: public information, mapping and regulating, flood damage reduction, and warning and response (FEMA, 2017). A community's Class can range from 9 to 1. Class 9 communities entitle policyholders in the Special Flood Hazard Areas to a five percent flood insurance premium discount. Each Class improvement results in an extra 5 percentage point discount on flood insurance premiums for SFHA properties. This means that Class 1 communities earn SFHA policyholders a 45% premium discount (FEMA, 2017). As of June 2017, there is only one Class 1 community in the entire nation (FEMA). In Virginia, the highest ranked communities come in at a Class 6. As of April 2018 Cape Charles is a Class 9 community (FEMA). The town is awaiting re-evaluation to determine if it has attained Class 8 status (DiRe, 2018a)

Regardless if Cape Charles attains Class 8 status in its upcoming re-evaluation, the Town could work to increase its engagement in the CRS's 19 creditable activities. This could either ensure Class 8 accreditation or start of the town on the path towards Class 7 accreditation. Increased CRS participation increases the Town's total taxable real estate value and keeps real estate in the tax base longer when faced with flooding from sea-level rise. This is because CRS participation lowers the expensive flood insurance premiums that devalue property and certain CRS activities actually physically protect property from flooding. This option is evaluated below according to the establish criteria. A summary of the evaluation is available via *Table 6*.

Total Discounted Losses in Property Value

There are few studies that attempt to estimate the impact of CRS participation directly on property value losses in the event of sea-level rise or episodic flooding. A 2011 study by Highfield et al. estimates that a one class increase within the CRS was associated with an average reduction of \$303,525.00 in

property losses per flood event in Florida from 1997 to 2011. While this dollar figure would be difficult to extrapolate to Cape Charles due to differences in flood risks, flood events, and property values, Highfield and Brody undertook a national study in 2013 that can, in some ways, be more easily extrapolated to Cape Charles. Highfield and Brody (2013) estimate the impact of CRS participation on average total flood losses across the nation by analyzing differences in NFIP-insured loss claim payments between CRS communities and non-CRS communities. Because CRS participation is not random, they control for important differences in the communities' flood policy exposure, flood risk, typical inundation from storm events, socioeconomic factors, and geographic factors. They find that, on average, communities participating in the CRS report 31% fewer building related flood losses within the SFHA (with a 95% confidence interval ranging from 18.55% to 41.54%) and 30.25% fewer building related flood losses outside the SFHA (with a 95% confidence interval ranging from 18.58% to 40.25 %) than NFIP communities that do not participate in the CRS.

Recognizing that Cape Charles already participates in the CRS, albeit at the lowest class, it is unreasonable to expect that furthering its class accreditation would result in the average 31% property loss savings cited above. Instead, to evaluate this policy option, the costs of episodic flooding will be reduced by 18%, relative to the status quo, to represent the lower bound 95% confidence interval cited above. This results in a total discounted loss of taxable property value of \$1.78 billion with medium rates of sea-level rise. With extreme rates of sea-level rise, this results in a total discounted loss of taxable property value of \$36.42 billion.

This is still an imperfect estimate, but it is the most informed estimate given the extremely limited academic literature on the subject. It is important to note, that this method of evaluation does not also consider how CRS may keep property in the tax base longer by delaying inundation from sea-level rise, nor does it consider how reduced insurance premiums may immediately increase the total value of taxable property. This immediate increase is likely to be relatively small, however, considering that at the moment, there are only 31 NFIP policy holders within Cape Charles's SFHA.

Total Discounted Losses in Property Tax Revenue

Assuming a constant \$0.326 tax rate per \$100 of value, the resulting total discounted loss in property tax revenue is \$7.22 million with medium rates of sea-level rise and \$119.23 million with extreme rates of sea-level rise.

Initial Discounted Costs of Implementation

Since local governments pay no fee to the NFIP to participate in the CRS, the primary costs of participation are thought to be staff time dedicated to maintain necessary CRS documentation (Highfield & Brody, 2013; Stiff, 2017a).

The Town's Code Official from the Department of Building and Code Enforcement acts as the CRS Coordinator for Cape Charles. It is estimated that the Code Official spends between one and five percent of his time on CRS related activities. According to 2016 budget documents, it appears that the Code Official's annual salary is approximately \$80,000. If the Code Official currently uses five percent of his time on CRS coordination, then the town spends about \$4,000 a year on its current Class 9 CRS participation. If he spends less than five percent of his time, then the town spends less than \$4,000 a year. Again, though, this is not a cost that the Town pays directly to the NFIP. This is a monetization of the time spent on CRS activities and represents employee time that could be spent elsewhere.

It is reasonable to assume that if Cape Charles wishes to further its CRS participation, it would have to devote more time to CRS coordination. Currently, Cape Charles dedicates less full-time employee resources to CRS than the Virginian median. A survey of Virginia CRS coordinators indicates that the median percentage of full-time employee resources on CRS upkeep is 13 % (Stiff, 2017a). If Cape Charles were to increase its time spent on CRS coordination to the State median, then the Town would spend, at most, an additional \$6,400 a year. This is not additional, money, though that the Town Council would have to appropriate specifically towards its CRS participation. If the Code Official were to immediately increase their time spent on CRS accreditation, then, the total present value of the time spent through year 2100 would be \$810,723.

There are, though, other costs associated with increasing a community’s CRS Class, especially if changes to flood infrastructure or flood mapping are made. These costs might include, for example, paying for structural elevation of key buildings, outsourcing GIS mapping, or funding community outreach initiatives. Minutes from a Town Council meeting indicate that the Nature Conservancy is interested in helping Cape Charles receive higher Class accreditation, including potential financial support to address costs outside of staff time (“Town Council Regular Meeting March 15, 2018,” 2018).

Political Feasibility

This option has high levels of political feasibility because it has buy-in from all relevant stakeholder groups in addition to support from area non-profits interested in promoting CRS participation.

Equitability

This option has moderate levels of equitability. There are some CRS activities from which all residents will benefit, like those that fall under the category of public information and warning and response, regardless of whether or not they hold an NFIP policy. One of the primary benefits of CRS participation to residents is discounted flood insurance premiums. These discounts, while available to every policy holder in the Town’s SFHA, will likely benefit relatively wealthy property owners with high value homes the most (Stiff, 2018).

Table 6: Summary of Option 3 Evaluation

Criteria		Option 3: Advance CRS Class
Total Discounted Losses in Property Tax Revenue through 2100	<i>Medium SLR</i>	\$7.22 million
	<i>Extreme SLR</i>	\$119.23 million
Total Discounted Losses in Property Values through 2100	<i>Medium SLR</i>	\$1.78 billion
	<i>Extreme SLR</i>	\$36.57 billion
Discounted Costs of Initial Implementation		\$.81 million
Political Feasibility		High
Equitability		Moderate

4. Annex Surrounding Property from Northampton County

An additional option for the Town of Cape Charles is to pursue annexation of surrounding land currently under Northampton County's jurisdiction. A summary of this option's evaluation is available via *Table 7*. Annexation of surrounding lands would serve a dual purpose for Cape Charles. First, annexation could immediately expand the town's tax base and increase its revenue generation in areas not likely to be impacted by sea-level rise in the coming years. This would not only include new property tax revenue, which is the primary focus of this report, but also sales tax revenue and intergovernmental transfers (Commission of Local Government, 2001). Second, annexation could provide land for future development in areas not likely to be impacted by sea-level rise including relocation of the town's historic district in the event of strategic retreat. The Commission of Local Government (2001) echoes these benefits of town annexation and adds that it can support community economic and development goals through negotiation agreements to attract business and industry.

However, the Commission of Local Government (2001) warns that there are also several drawbacks to town annexation. Annexation requires that the town extends its services to the annexed areas, the cost of which could exceed any potential revenues gained from the areas. Annexation also involves an extensive review process meaning that a successful annexation as the town envisions it is not guaranteed. This is especially true because counties may resist annexation because it restricts county non-property tax revenues and potential new residents may resist annexation because they do not want to pay additional taxes and fees for town services.

There is very little literature regarding the merits of annexation for towns, such as Cape Charles, surrounded by predominantly rural areas. Breen et. al (1986) contend, though, that even small towns may wish to consider annexation if the benefits outweigh the costs. Additionally, while the Code of Virginia places a moratorium on city annexations, there are no such restrictions on town annexations. The vast majority of academic literature regarding the merits of annexation focuses instead on central cities surrounded by emerging suburbs. Within this context, academics widely agree that annexation is financially beneficial to existing municipalities (Heim, 2006; Rusk 2003, 2006 as cited by Smith & Afonso, 2016). Smith and Afonso (2016), though, come to a strikingly different conclusion. While they had hypothesized that annexation activity would be associated with higher levels of fiscal health based upon the previous literature just referenced, they conclude that annexation activity is associated

with negative fiscal health upon analyzing over 6,000 annexations that took place in North Carolina between 1990 and 2000. Annexation activity is defined by the number of annexations undertaken by a municipality and fiscal health is assessed using the municipality's operating deficit, long term debt, and debt service. The results, though, are not substantively significant nor statistically significant for localities that had undertaken less than three annexations over the ten-year period. It is also unclear whether the relationship between annexation activity and fiscal health is casual or correlational. While Smith and Afonso include several controls in their data analysis, it is very possible that municipalities experiencing fiscal stress are more likely to annex to alleviate that fiscal stress rather than the annexation causing the fiscal stress.

Total Discounted Losses in Property Value

The Town's Planner identified a tract of land historically zoned by Northampton County as the Town Edge District that the Town would be interested in annexing. Technically, the Town Edge District is intended "to provide potential development areas adjacent to incorporated towns which may, in the future, be served by extensions of public water and sewer services from the towns" ("2016 Adopted Zoning Ordinance," 2016). Essentially, then, the Town Edge District represents land that the County has acknowledged may be annexed by the adjacent incorporated town in the future. The tract of land identified by the Town Planner is between Stone Road and Old Cape Charles Road, including inside Parsons Circle while excluding the Railroad. This tract of land encompasses 43 unique parcels, with a total value of approximately \$7 million according to Northampton County's current assessment maps. This \$7 million of additional property value sits, for the most part, above ten feet meaning that if Cape Charles were to annex it, then 53.66% of the Town's total property value would sit above ten feet. Currently, 52.76% of the Town's total property value sits above ten feet.

Assuming that Cape Charles could begin annexation procedures immediately and incorporate this land by fiscal year 2020, the total discounted loss in property value through year 2100 is \$1.72 billion under medium rates of sea-level rise. This is compared to a scenario in which the Town, with its current land area, experiences no further changes in property value from sea-level rise. The total discounted loss in property value through 2100 is approximately \$42.59 billion under extreme rates of sea-level rise.

Total Discounted Losses in Property Tax Revenue

Assuming a constant tax rate of \$0.326 per \$100 of value, the total discounted loss in property tax revenues is approximately \$5.62 million under medium rates of sea-level rise. Under extreme rates of sea-level rise, the total discounted loss in property tax revenues is \$138.83 million.

Initial Discounted Costs of Implementation

The primary costs associated with annexation are those associated with extending Town services to the annexed area. Given the definition of the Town Edge District, it appears that the most notable service extension is public water and sewer services. Water and sewer services in Cape Charles are operated as “Business-type activities” meaning they are “intended to recover all or a significant portion of their costs through user fees and charges” (Robinson & Farmer, Cox Associates, 2017). For fiscal year 2016, Cape Charles operated its water and sewer services with \$1,745,557 in expenses and \$1,530,673 in revenue from user fees. This resulted in net operating costs of \$214,884. According to the American Community Survey, there are 1,005 housing units in Cape Charles as of 2016. This means that for fiscal year 2016, the Cape Charles operated its water and sewer services at a net cost of \$213.81 per housing unit.

While some of the 43 parcels of land referenced above are simply land without any type of housing unit, if we assume that this proposed annexation adds at most 43 housing units to Cape Charles, then the Town would have to increase its water and sewer annual net expenses by \$9,193.83 to accommodate the annexed property. The total discounted value of this cost through year 2100 is \$1,146,156.

There are, of course, other important costs associated with Annexation, mostly notably time costs of Town employees who must plan for the annexation. Cape Charles’s last annexation, which occurred in 1991, was officially initiated more than full year prior in 1990. That annexation resulted in hiring a Town Planner, which the Town had not previously employed (DiRe, 2018a). Since this proposed annexation of 43 parcels is significantly smaller in land area than the 1991 annexation and since the 1991 annexation has yet to reach its full growth potential, it seems unlikely that Cape Charles would take on additional employees in preparation of this proposed annexation. Furthermore, there is no data available regarding exactly how many hours Town employees and Town Council members spent

on ensuring the success of the 1991 annexation, nor are there estimates of any associated legal fees. Similar data for other recent annexations that have occurred throughout the Commonwealth also could not be obtained. Given this, and given the importance of water and sewer extension as stressed by Northampton County, this analysis will consider the costs associated with initial implementation of this option to only be the costs associated with water and sewer extension as stated above. This is, however, an underestimate of the discounted implementation costs of this policy.

Political Feasibility

The political feasibility of this option is low due to conflicting interests between the Town of Cape Charles and Northampton County. In Cape Charles, this option could gain a lot of support given the propensity of the Mayor and select Town Council members to think and act as “empire builders.” Northampton County has previously demonstrated a willingness to part with land near Cape Charles by zoning it as the Town Edge. The County’s new comprehensive plan, however, does not include this Town Edge as previously defined. Instead, Northampton County districts this land as “Potential Development Areas” and removes language insinuating that this area may at some point be served by any town service extensions (“Comprehensive Plan,” 2018). This may indicate a shift in County attitude towards annexation. Annexation of any part of the Town Edge would limit county non-property taxes and would impose additional fees and taxes on residents currently living there.

Equity

Since this option provides both immediate and long-term benefits for all town residents in terms of increased property revenues that can be used to fund Town operations it possesses high (Lutz, Molloy, & Shan, 2011) levels of equity.

Table 7: Summary of Option 4 Evaluation

Criteria		Option 4: Annexation
Total Discounted Losses in Property Tax Revenue through 2100	<i>Medium SLR</i>	\$5.62 million
	<i>Extreme SLR</i>	\$138.83 million
Total Discounted Losses in Property Values through 2100	<i>Medium SLR</i>	\$1.72 billion
	<i>Extreme SLR</i>	\$42.59 billion
Discounted Costs of Initial Implementation		\$1.15 million
Political Feasibility		Low
Equitability		Moderate

Table 8: Summary of Policy Options

		Option 1: Status Quo	Option 2: Raise Rates Accordingly	Option 3: Further CRS Class	Option 4: Annexation
Total Discounted Losses in Property Tax Revenue through 2100	<i>Medium SLR</i>	\$8.48 million	\$0	\$7.22 million	\$5.62 million
	<i>Extreme SLR</i>	\$140.27 million	\$0	\$119.23 million	\$138.83 million
Total Discounted Losses in Property Values through 2100	<i>Medium SLR</i>	\$2.60 billion	\$2.60 billion	\$1.78 billion	\$1.72 billion
	<i>Extreme SLR</i>	\$43.03 billion	\$42.85 billion	\$36.57 billion	\$42.59 billion
Discounted Costs of Initial Implementation		\$0	\$0	\$0.81 million	\$1.15 million
Political Feasibility		Mixed	Mixed	High	Low
Equitability		Low	Moderate	Moderate	High

RECOMMENDATION & IMPLEMENTATION

Recommendation

Based on the chosen evaluative criteria and projected outcomes, it is recommended that the Town of Cape Charles pursue Option 3 and further its participation in the Community Rating System. The town should also be prepared to raise its property tax rate accordingly as proposed in Option 2.

Furthering participation in the CRS is the only proposed policy option that mitigates total property tax revenue losses by mitigating total property losses given the Town's current land area. While annexation (Option 4) does increase the town's total taxable property value, it does so by adding physical land area to the Town. Perhaps more importantly, Option 3 is the only proposed policy option that reduces the cost of episodic flooding, the costliest aspect of sea-level rise, rather than the just the costs of inundation. Option 3 is also the only proposed option with high levels of political feasibility.

In addition to Option 3, the Town should also be prepared to raise its tax rate accordingly as proposed in Option 2. This follows typical local government operating procedure. As discussed, though, there are limits to Options 2's ability to continually deliver steady property tax revenues in the wake of flood events. Because raising tax rates on its own does nothing to reduce property value losses, it must be combined with an option, like furthering CRS participation, that does in order to be sustainable.

Implementation Considerations

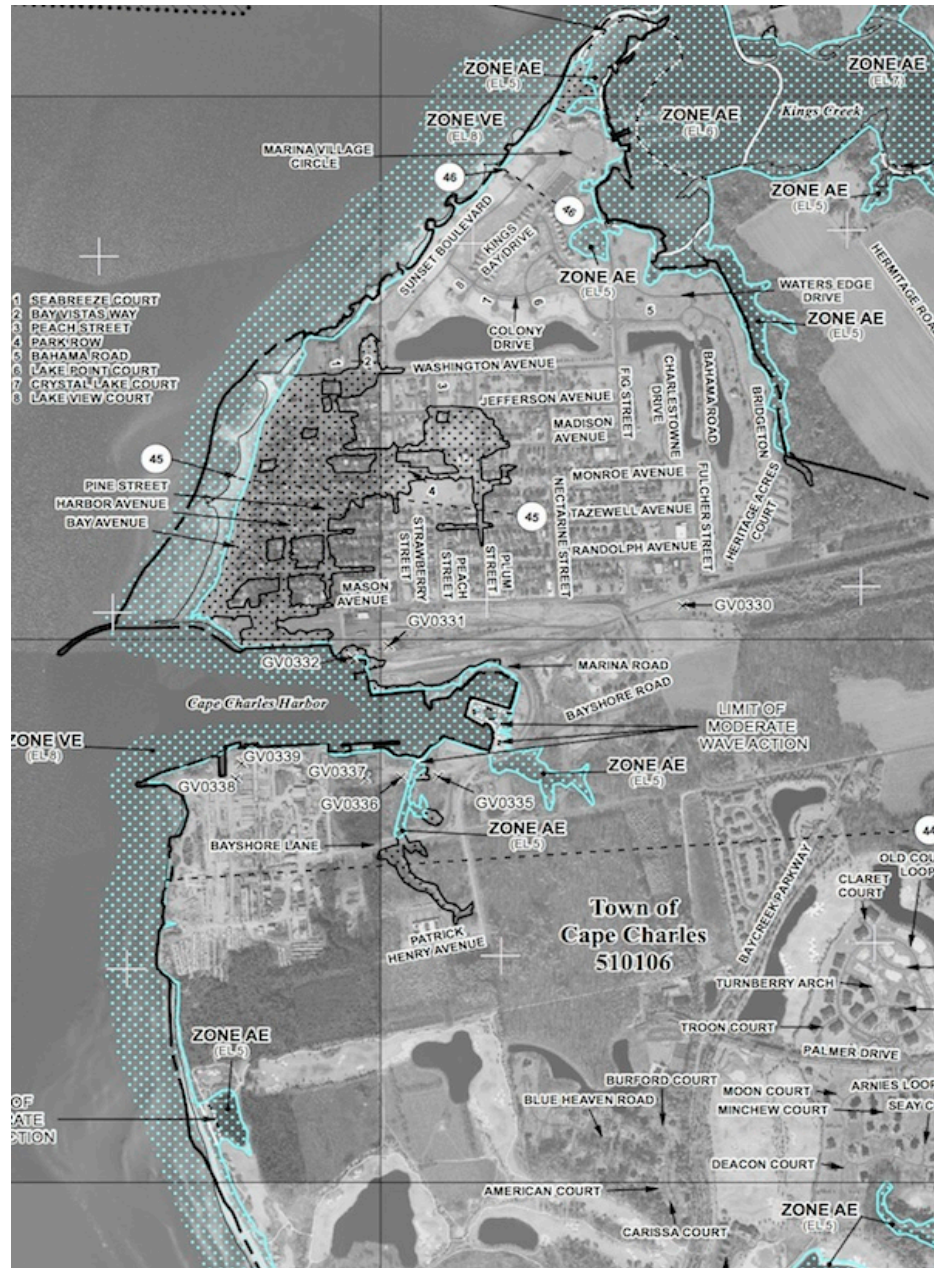
Cape Charles could further its participation in the Community Rating system in several ways. Cape Charles currently has 902 credit points. To reach Class 8, it needs 1000 total credit points. To reach Class 7, it needs 1500 total credit points (Stiff, 2017a). As stated previously, the Nature Conservancy has indicated the availability of funds to help the Town further its Class accreditation. The top three eligible activities in terms of demonstrated flood loss savings per year per point are Higher Regulatory Standards (activity 430), Open Space Preservation (activity 420), and Flood Protection (activity 530) (Highfield & Brody, 2013). According to Wetlands Watch and as of November 2017, Cape Charles engages in all three of these activities, but does not maximize its participation in these activities. Cape Charles only receives, then, 255 out of the 2,740 available for Higher Regulatory Standards, 63 out of the 900 available points for Open Space Preservation, and 25 out of the 2,800 points available for Flood Protection (Stiff, 2017b).

Cape Charles could potentially increase its points under Higher Regulatory Standards by changing the definition of its Flood Plain District. Section 15.2-2283 of the Code of Virginia states that the purpose of local zoning ordinances is to promote the health, safety, or general welfare of the public. It also states that zoning ordinances should facilitate adequate flood protection. Section 15.2-2284 specifies that not just zoning ordinances, but entire zoning districts ought to consider preservation of flood plains and flood protection. Under the authority of these two statutes and the requirements of the NFIP, Cape Charles has established a Flood Plain District with the purposes of regulating and restricting areas in the tidal flood plains of the Chesapeake Bay and all creeks and streams subject to overflowing (Article VI).

Cape Charles currently defines its Flood Plain District as land within the FEMA designated SFHA. FEMA only designates flood plains, though, using historical flood data. This practice assumes static climate conditions, and as such, does not accurately reflect increased flood risk imposed by rising sea levels. This means that Cape Charles's current Flood Plain District does not protect against flooding as well as it could. The same section of the Code of Virginia that authorizes special districts for the purpose of flood plain protection, also specifies that localities ought to consider changing trends, although it does not specify what kinds of changing trends. The Governor's Commission on Climate Change advised in 2008 that Virginia's coastal local governments should include projected sea level rise and storm surge in "all planning efforts, including local government comprehensive plans and land use plans."

Cape Charles could expand its definition of its Flood Plain District so that instead of only encompassing land identified by FEMA as within the 100-year flood elevations, it would encompass land identified by FEMA as within the 500-year flood elevations, otherwise known as the 0.2% annual chance flood plain or non-SFHA. What this change would look like can be seen in *Image 2*. Expanding the Flood Plain District could better protect property in the event of flooding and may allow Cape Charles to receive additional credits towards its CRS class accreditation under activity 430. Since the mapping of this area has already been completed, this would only require an amendment to the Code of Cape Charles and would require little additional time to document -the primary cost of CRS participation to the Town.

Image 2: FEMA Identified 100-year (blue dots) and 500-year Flood Plains (black dots) in Cape Charles



Source: FEMA

Further Considerations

Because of state imposed limitations on local government revenues, Cape Charles's relatively small population, the inclination to protect the Town's burgeoning tourist industry, and the propensity for self-reliance, this report focused on policy options that allow the town of Cape Charles to preserve as much of its property tax revenues and property tax base as possible without considering other forms of revenue generation. Even after considering the best ways to do this, the proposed policy options in this report still result in losses to the Town's tax revenues and tax base. This report also only considers property tax losses and not losses from other sources of revenue in the wake of sea-level rise. Given this, the Town should still consider ways to diversify its revenues in the future as well as increase its capacity to engage with long-term budgeting. Failure to ensure long-term financial stability could result in the Town's dissolution via reversion.

Reversion is the process in which an incorporated town annuls its town charter and reverts to an unincorporated town. While this is not something Cape Charles needs to consider immediately, it is something the Town may have to consider in coming decades depending on the severity of sea-level rise and associated losses in property tax revenues. There have only ever been three successful town reversions in Virginia, but the most recent one occurred in 2016 when the Town of Columbia annulled its town charter due to a declining population and persistent flooding (McKenzie, 2016). The need for Cape Charles to act quickly and swiftly, then, in the wake of sea-level is paramount.

Works Cited

- 2016 Adopted Zoning Ordinance. (2016, April 12). Northampton County. Retrieved from http://www.co.northampton.va.us/departments/pdf/zoning_pdf/2016%20ADOPTED%20ZONING%20APRIL%2012%202016%20-%20FINAL%20AS%20OF%205-10-2016.pdf
- Accomack-Northampton Planning District Commission. (2016, April). Eastern Shore of Virginia Hazard Mitigation Plan: Town of Cape Charles. Retrieved from <http://www.a-npdc.org/wp-content/uploads/2016/04/Chapter-12-Town-of-Cape-Charles.pdf>
- Anonymous. (2018, March 19). Interview with Cape Charles Resident [In-Person].
- Bartle, J. R., Ebdon, C., & Krane, D. (2003). Beyond the Property Tax: Local Government Revenue Diversification. *Journal of Public Budgeting, Accounting & Financial Management*, 15(4), 622–648.
- Beeler, C. (2016, October 6). How one Virginia city is re-framing sea-level rise as an opportunity [Transcript]. WGBH. Retrieved from <https://news.wgbh.org/2016/10/06/how-one-virginia-city-re-framing-sea-level-rise-opportunity>
- Breen, E., Costa, F. J., & Hendon, W. S. (1986). Annexation: An Economic Analysis: Whether a Small Village or Town Should Annex Adjacent Land Is a Cost/Revenue Problem. *The American Journal of Economics and Sociology*, 45(2), 159–171.
- Brody, S. D., Highfield, W. E., & Kang, J. E. (2011). Rising Waters: The Causes and Consequences of Flooding in the United States. *Cambridge University Press*.
- Cape Charles Planning Commission. (1999, December 14). Cape Charles, Virginia Comprehensive Plan. Retrieved from

- http://www.co.northampton.va.us/departments/comp_plan/Appendix%2002%20CapeCharlesCompPlan.pdf
- Charter for the Town of Cape Charles (1978). Retrieved from <https://law.lis.virginia.gov/charters/cape-charles/>
- Climate Central. (2017). Surging Seas Risk Finder. Retrieved February 25, 2018, from <http://riskfinder.climatecentral.org>
- Commission on Local Government. (2001). Town Annexation Considerations in Virginia. Retrieved from <http://www.dhcd.virginia.gov/CommissiononLocalGovernment/PDFs/town.annex.pros.conditions.pdf>
- Comprehensive Plan. (2018, February 6). Northampton County. Retrieved from [http://www.co.northampton.va.us/departments/pdf/PART%20I%20FULL%20\(Repaired\)%20edited%202-6-18.pdf](http://www.co.northampton.va.us/departments/pdf/PART%20I%20FULL%20(Repaired)%20edited%202-6-18.pdf)
- Corasaniti, N. (2017, July 30). Jersey Shore Towns Scramble for Revenue as Sandy Aid Dries Up. *The New York Times*. Retrieved from <https://www.nytimes.com/2017/07/30/nyregion/hurricane-sandy-jersey-shore-towns.html>
- Cromwell, E., & Ihlandfeldt, K. (2015). Local Government Responses to Exogenous Shocks in Revenue Sources: Evidence... *National Tax Journal*, 68(2), 339–376.
- DiRe, L. (2018a, March 19). Interview with Town Planner During Site Visit [In-Person].
- DiRe, L. (2018b, April 4). Interview with Town Planner Regarding Property Elevations in Cape Charles [Phone Call].

Federal Reserve Bank of Minneapolis. (2018). Consumer Price Index, 1913-. Retrieved April 28, 2018, from <https://www.minneapolisfed.org/community/financial-and-economic-education/cpi-calculator-information/consumer-price-index-and-inflation-rates-1913>

FEMA. Updates to Floodplain Management and Protection of Wetlands Regulations To Implement Executive Order 13690 and the Federal Flood Risk Management Standard, 81 FR 57401 § (2016). Retrieved from <https://www.federalregister.gov/documents/2016/08/22/2016-19810/updates-to-floodplain-management-and-protection-of-wetlands-regulations-to-implement-executive-order>

FEMA. (2017, June). Community Rating System Fact Sheet. DHS. Retrieved from https://www.fema.gov/media-library-data/1507029324530-082938e6607d4d9eba4004890dbad39c/NFIP_CRS_Fact_Sheet_2017_508OK.pdf

FEMA. (2018, April 1). Summary of the NFIP Program Changes Effective April 1, 2018 and January 1, 2019. *Insurance Journal*. Retrieved from <https://www.insurancejournal.com/news/national/2018/04/02/485019.htm>

Governor's Commission on Climate change. (2008, December 15). Final Report: A Climate Change Action Plan. Retrieved from http://www.sealevelrisevirginia.net/docs/homepage/CCC_Final_Report-Final_12152008.pdf

Harris, B., H., & Moore, D. B. (2013, November 18). Residential Property Taxes in the United States. Urban-Brookings Tax Policy Center. Retrieved from <http://www.taxpolicycenter.org/publications/residential-property-taxes-united-states/full>

- Highfield, W. E., & Brody, S. D. (2013). Evaluating the Effectiveness of Local Mitigation Activities in Reducing Flood Losses. *Natural Hazards Review*, 14(4), 229–236.
[https://doi.org/10.1061/\(ASCE\)NH.1527-6996.0000114](https://doi.org/10.1061/(ASCE)NH.1527-6996.0000114)
- Ihlandfeldt, K. (2011). How Do Cities and Counties Respond to Changes in Their Property Tax Base? *The Review of Regional Studies*, 41, 27–48.
- Incomes not subject to local taxation, Code of Virginia § 58.1-300. Retrieved from
<https://law.lis.virginia.gov/vacode/title58.1/chapter3/section58.1-300/>
- Liu, S. K. (1997). Using Coastal Models to Estimate Effects of Sea Level Rise. *Ocean and Coastal Management*, (37), 85–94.
- Lutz, B., Molloy, R., & Shan, H. (2011). The housing crisis and state and local government tax revenue: five channels. *Regional Science and Urban Economics*, 41(4), 306–319.
- Michael, J. A. (2007). Episodic flooding and the cost of sea-level rise. *Ecological Economics*, 63(1), 149–159. <https://doi.org/10.1016/j.ecolecon.2006.10.009>
- National Flood Insurance Act, 42 U.S. Code § 4001 § (a) (1968). Retrieved from
<https://www.law.cornell.edu/uscode/text/42/4001>
- Nicholls, R. J. (2002). Analysis of global impacts of sea-level rise: a case study of flooding. *Physics and Chemistry of the Earth, Parts A/B/C*, 27(32), 1455–1466.
[https://doi.org/10.1016/S1474-7065\(02\)00090-6](https://doi.org/10.1016/S1474-7065(02)00090-6)
- Nicholls, R. J., Hoozemans, F. M. J., & Marchand, M. (1999). Increasing flood risk and wetland losses due to global sea-level rise: regional and global analyses. *Global Environmental Change*, 9, S69–S87. [https://doi.org/10.1016/S0959-3780\(99\)00019-9](https://doi.org/10.1016/S0959-3780(99)00019-9)
- Pocock, D. (2018, March 19). Interview with Town Treasurer [In-Person].

- Robinson & Farmer, Cox Associates. (2017, April 6). Annual Financial Report for the Year Ended June 30, 2016. Retrieved from <http://www.capecharles.org/files/documents/AnnualFinancialReport-FYendingJune3020161468113225071017AM.pdf>
- Shaforth, F. (2017, November). The Before and After Effects of Flooding on Property Taxes. *Governing*. Retrieved from <http://www.governing.com/columns/public-money/gov-noahs-ark-effect-floods-water-damage.html>
- Smith, R. M., & Afonso, W. B. (2016). Fiscal Impact of Annexation Methodology on Municipal Finances in North Carolina. *Growth & Change*, 47(4), 664–681. <https://doi.org/10.1111/grow.12157>
- Stiff, M.-C. (2017a, October). The Costs & Benefits of the CRS Program in Virginia. Wetlands Watch. Retrieved from https://static1.squarespace.com/static/56af7134be7b96f50a2c83e4/t/5a78bb8353450a8baa806766/1517861773717/Wetlands+Watch+VA+CRS+Cost+Benefit+Report_2_05.pdf
- Stiff, M.-C. (2017b, November). Virginia CRS Communities: CRS Activity Scores. Wetlands Watch. Retrieved from <https://static1.squarespace.com/static/56af7134be7b96f50a2c83e4/t/5a09c707ec212d1131c4cd78/1510590218826/VA+CRS+Score+Break+Down+Wetlands+Watch.pdf>
- Stiff, M.-C. (2018, March 26). Interview with Wetlands Watch Staff Member and Author of CRS Reports [Phone Call].
- The Nature Conservancy. (2018). Coastal Resilience | Virginia Eastern Shore. Retrieved May 3, 2018, from <http://maps.coastalresilience.org/virginia/#>

Town Council Regular Meeting March 15, 2018. (2018, March 15). Cape Charles. Retrieved from <http://www.capecharles.org/files/documents/TownCouncilAgenda03-15-18050722031418PM1468.pdf>

Urbina, I. (2016, November 25). Rising seas turn coastal houses into a gamble. *New York Times*. Retrieved from <http://re5qy4sb7x.search.serialssolutions.com.proxy01.its.virginia.edu/?genre=article&issn=03624331&title=New%20York%20Times&volume=166&issue=57427&date=20161125&atitle=RISING%20SEAS%20TURN%20COASTAL%20HOUSES%20INTO%20A%20GAMBLE.&spage=A1&sid=EBSCO:n5h&pid=>

US Census Bureau. (2018). American FactFinder - Community Facts. Retrieved March 2, 2018, from https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml?src=bkmk

Virginia Municipal League. (2018). 2018 Finance Policy Statement. Retrieved from <https://www.vml.org/wp-content/uploads/pdf/2018-Finance-Policy-Statement.pdf>

West, J. J., Small, M. J., & Dowlatabadi, H. (2001). Storms, Investor Decisions, and the Economic Impacts of Sea Level Rise. *Climatic Change*, 48(2–3), 317–342. <https://doi.org/10.1023/A:1010772132755>

William V. Sweet, Kopp, R. E., Weaver, C. P., Obseyekera, J., Horton, R. M., & Zevera, C. (2017, January). Global and Regional Sea Level Rise Scenarios for the United States: NOAA Technical Report NOS CO-OPS 083. Retrieved from https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf

APPENDICES

Appendix A: Calculations for the Status Quo (Option 1)

A.1: Total Discounted Losses in Property Value through 2100

= (Total Discounted Property Values without Future Inundation – Total Discounted Property Values with Inundation from SLR) + Total Costs of Episodic Flooding

Total Costs of Episodic Flooding = Costs of Inundation X 5¹

Medium SLR

= \$433.97 million + (\$433.97 million X 5) = **\$2.60 billion**

Extreme SLR

= \$ 7.17 billion + (\$7.17 billion X 5) = **\$43.03 billion**

This process can be seen below in *Tables A1-A4*. While these tables only show the first three and last three years of analysis, this was done for every year between FY 2017 and FY 2100. The discounted difference in total expected property value was aggregated across every year to arrive at the above estimates.

A.2 Total Discounted Losses in Property Tax Revenue through 2100

Medium SLR

= (\$1.78 billion/100) X 0.326 = **8.48 million**

Extreme SLR

= (\$43.03 billion /100) X 0.326 = **140.27 million**

¹ This is the multiplicative effect of episodic flooding (Michael, 2007).

Table A1: Expected Total Taxable Property Value for No SLR & Medium Rates of SLR

	Expected Total Property Value without Inundation							Expected Total Property Value with Inundation						
Year	0	1	2		81	82	83	0	1	2		81	82	83
FY	2017	2018	2019		2098	2099	2100	2017	2018	2019		2098	2099	2100
Elevation														
0-1 ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
1-2 ft	3.24	3.37	3.50		77.67	80.78	84.01	3.24	3.37	3.50		0.00	0.00	0.00
2-3 ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
3-4ft	3.24	3.37	3.50		77.67	80.78	84.01	3.24	3.37	3.50		0.00	0.00	0.00
4-5ft	10.58	11.01	11.45		253.72	263.87	274.42	10.58	11.01	11.45		253.72	263.87	0.00
5-6ft	25.56	26.58	27.65		612.72	637.23	662.72	25.56	26.58	27.65		612.72	637.23	662.72
6-7ft	15.84	16.47	17.13		379.71	394.90	410.70	15.84	16.47	17.13		379.71	394.90	410.70
7-8ft	38.16	39.69	41.27		914.76	951.35	989.41	38.16	39.69	41.27		914.76	951.35	989.41
8-9ft	32.04	33.32	34.65		768.06	798.78	830.73	32.04	33.32	34.65		768.06	798.78	830.73
9-10ft	41.40	43.06	44.78		992.43	1032.13	1073.41	41.40	43.06	44.78		992.43	1032.13	1073.41
>10ft	189.94	197.53	205.43		4553.11	4735.23	4924.64	189.94	197.53	205.43		4553.11	4735.23	4924.64

Table A2: Discounted Differences in Total Taxable Property Value for No SLR & Medium SLR

	Difference in Total Expected Property Value							Discounted Difference in Total Expected Property Value						
Year	0	1	2		81	82	83	0	1	2		81	82	83
FY	2017	2018	2019		2098	2099	2100	2017	2018	2019		2098	2099	2100
Elevation														
0-1 ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
1-2 ft	0.00	0.00	0.00		77.67	80.78	84.01	0.00	0.00	0.00		7.09	7.16	7.22
2-3 ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
3-4ft	0.00	0.00	0.00		77.67	80.78	84.01	0.00	0.00	0.00		7.09	7.16	7.22
4-5ft	0.00	0.00	0.00		0.00	0.00	274.42	0.00	0.00	0.00		0.00	0.00	23.60
5-6ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
6-7ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
7-8ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
8-9ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
9-10ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
>10ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00

Table A3: Expected Total Taxable Property Value for No SLR & Extreme Rates of SLR

	Expected Total Property Value without Inundation							Expected Total Property Value with Inundation						
Year	0	1	2		81	82	83	0	1	2		81	82	83
FY	2017	2018	2019		2098	2099	2100	2017	2018	2019		2098	2099	2100
Elevation														
0-1 ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
1-2 ft	3.24	3.37	3.50		77.67	80.78	84.01	3.24	3.37	3.50		0.00	0.00	0.00
2-3 ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
3-4ft	3.24	3.37	3.50		77.67	80.78	84.01	3.24	3.37	3.50		0.00	0.00	0.00
4-5ft	10.58	11.01	11.45		253.72	263.87	274.42	10.58	11.01	11.45		0.00	0.00	0.00
5-6ft	25.56	26.58	27.65		612.72	637.23	662.72	25.56	26.58	27.65		0.00	0.00	0.00
6-7ft	15.84	16.47	17.13		379.71	394.90	410.70	15.84	16.47	17.13		0.00	0.00	0.00
7-8ft	38.16	39.69	41.27		914.76	951.35	989.41	38.16	39.69	41.27		0.00	0.00	0.00
8-9ft	32.04	33.32	34.65		768.06	798.78	830.73	32.04	33.32	34.65		0.00	0.00	0.00
9-10ft	41.40	43.06	44.78		992.43	1032.13	1073.41	41.40	43.06	44.78		0.00	0.00	0.00
>10ft	189.94	197.53	205.43		4553.11	4735.23	4924.64	189.94	197.53	205.43		4553.11	4735.23	4924.64

Table A4: Discounted Differences in Total Taxable Property Value for No SLR & Extreme SLR

	Difference in Total Expected Property Value							Discounted Difference in Total Expected Property Value						
Year	0	1	2		81	82	83	0	1	2		81	82	83
FY	2017	2018	2019		2098	2099	2100	2017	2018	2019		2098	2099	2100
Elevation														
0-1 ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
1-2 ft	0.00	0.00	0.00		77.67	80.78	84.01	0.00	0.00	0.00		7.09	7.16	7.22
2-3 ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
3-4ft	0.00	0.00	0.00		77.67	80.78	84.01	0.00	0.00	0.00		7.09	7.16	7.22
4-5ft	0.00	0.00	0.00		253.72	263.87	274.42	0.00	0.00	0.00		23.15	23.37	23.60
5-6ft	0.00	0.00	0.00		612.72	637.23	662.72	0.00	0.00	0.00		55.90	56.45	57.00
6-7ft	0.00	0.00	0.00		379.71	394.90	410.70	0.00	0.00	0.00		34.64	34.98	35.32
7-8ft	0.00	0.00	0.00		914.76	951.35	989.41	0.00	0.00	0.00		83.46	84.27	85.09
8-9ft	0.00	0.00	0.00		768.06	798.78	830.73	0.00	0.00	0.00		70.08	70.76	71.44
9-10ft	0.00	0.00	0.00		992.43	1032.13	1073.41	0.00	0.00	0.00		90.55	91.43	92.32
>10ft	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00

Appendix B: Calculations for Adjusting Tax Rates Accordingly (Option 2)

B.1 Total Discounted Losses in Property Values through 2100

= Status Quo Total Discounted Losses in Property Values through 2100

Medium SLR

$$= \$433.97 \text{ million} + (\$433.97 \text{ million} \times 5) = \mathbf{\$2.60 \text{ billion}}$$

Extreme SLR

$$= \$7.17 \text{ billion} + (\$7.17 \text{ billion} \times 5) = \mathbf{\$43.03 \text{ billion}}$$

Appendix C: Calculations for Furthering CRS Participation (Option 3)

C.1 Total Discounted Losses in Property Values through 2100

= Status Quo Discounted Losses in Property Value from Inundation + 5 (Discounted Losses in Property Value from Inundation X Episodic Flood Reduction Rate¹)

Medium SLR

$$\$443.97 \text{ million} + 5(\$443.97 \text{ million} \times 0.82) = \mathbf{\$1.78 \text{ billion}}$$

Extreme SLR

$$= \$7.17 \text{ billion} + 5(\$7.17 \text{ billion} \times 0.82) = \mathbf{\$36.57 \text{ billion}}$$

C.2 Total Discounted Losses in Property Tax Revenue through 2100

= Total Discounted Losses in Property Value X Tax Rate

Medium SLR

$$= (\$1.78 \text{ billion} / 100) \times 0.326 = \mathbf{7.22 \text{ million}}$$

Extreme SLR

$$= (\$36.57 \text{ billion} / 100) \times 0.326 = \mathbf{119.23 \text{ billion}}$$

C.3 Discounted Costs of Initial Implementation

Annual Costs of Furthering CRS Participation

= (Code Official Salary X New Percent of Time Spent) - (Code Official Salary X Current Percent of Time Spent)

$$\text{Annual Costs} = (80,000 \times 0.13) - (80,000 \times 0.13) = 6,400$$

$$\text{Present Value of Costs} = [(6,400 \times (1 + .04)^0) / (1 + .03)^0] + \dots + [(6,400 (1 + .04)^{82}) / (1 + .03)^{82}]$$
$$= \mathbf{\$810,723}$$

The exponents increase by 1 each year so that year 0 represents 2018 and year 82 represents 2100.

¹ CRS communities experience, at most, 18% less flood damage than similar non-participating communities, or rather, 82% of the damage that similar non-participating communities experience ().

Using a growth rate of 4%, which assume that costs are accelerating at the pace that property tax revenues would be accelerating in the absence of sea-level rise, and a discount rate of 3%, then the total discounted costs through year 2100 are \$ 810,723.

Appendix D: Calculations for Annexing Surrounding Land (Option 4)

D.1 Total Discounted Losses in Property Values through 2100

The process for calculating the total discounted losses in property values through 2100 is the same for this option as it is for the status quo, except that \$8.86 million of total taxable land are added in year 2020. This is to represent the fact that the tract of land identified as worth \$7 million for fiscal year 2017 would appreciate at 4% a year¹ before being added to Cape Charles's total taxable land value.

This results in **\$1.72 billion** in total discounted property value losses under medium rates of sea-level rise. Under medium rates of sea-level rise, this results in **\$42.59 billion** in total discounted property value losses. A summary of this is available in Table D1.

D.2 Total Discounted Losses in Property Tax Revenue through 2100

= Total Discounted Losses in Property Value X Tax Rate

Medium SLR

= (\$1.72 billion/100) X 0.326 = **\$5.62 million**

Extreme SLR

= (\$42.59 billion/100) X 0.326 = **\$138.83 million**

D.3 Discounted Costs of Initial Implementation

Annual Costs of Service Extension = (Net Cost of Water and Sewer Services/ New Total Number of Housing Units) - (Net Cost of Water and Sewer Services/ Old Total Number of Housing Units)

Annual Costs of Service Extension= (214,884/ 1048) - (214,884/ 1005) = 9,193.83

Present Value of Costs = $[(9,193.83 \times (1 + .04)^2) / (1 + .03)^2] + \dots + [(6,400 (1 + .04)^{82}) / (1 + .03)^{82}]$
= \$ 1,146,156.

The exponents increase by 1 each year so that year 2 represents 2020 and year 82 represents 2100.

Using a growth rate of 4%, which assume that costs are accelerating at the pace that property tax revenues would be accelerating in the absence of sea-level rise, and a discount rate of 3%, then the total discounted costs through year 2100 are \$ 1,146,156.

¹ Average annual growth rate of total property values in Cape Charles over the past ten fiscal years (Robinson & Farmer, Cox Associates, 2017).