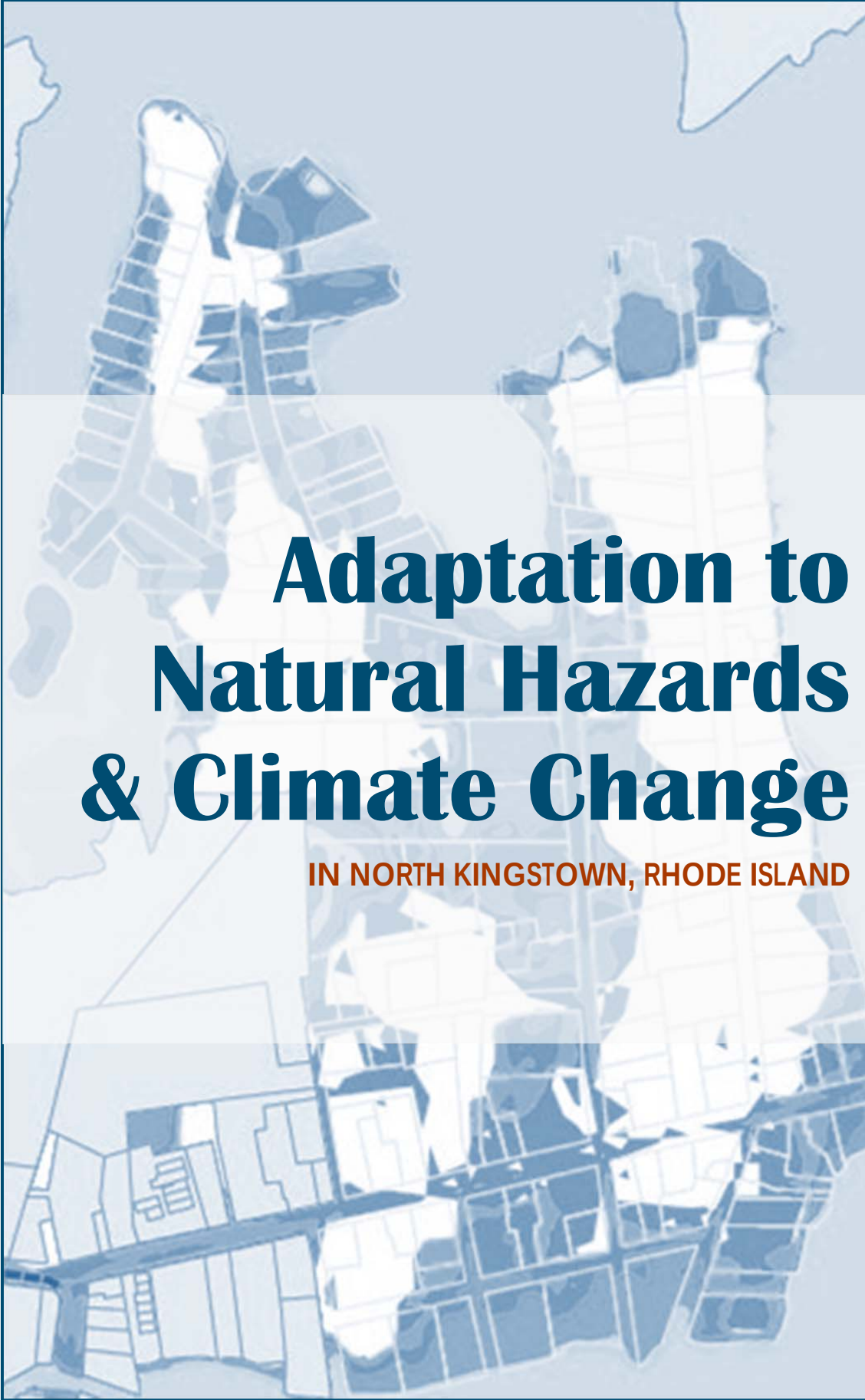




Adaptation to Natural Hazards & Climate Change

IN NORTH KINGSTOWN, RHODE ISLAND



U.S. Department of Transportation
Federal Highway Administration



THE
UNIVERSITY
OF RHODE ISLAND
GRADUATE SCHOOL
OF OCEANOGRAPHY



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ADAPTATION TO NATURAL HAZARDS & CLIMATE CHANGE
NORTH KINGSTOWN, RI

CREDIT NOTATION

The Rhode Island Statewide Planning Program (RISPP), Rhode Island Department of Administration, is established by Chapter 42-11 of the General Laws as the central planning agency for state government. The work of the Program is guided by the State Planning Council, comprised of state, local, and public representatives and federal and other advisors.

In 2012, RISPP, in an effort to more closely link land and coastal planning strategies, provided Challenge Grant Competition funds to the University of Rhode Island Coastal Resources Center/Rhode Island Sea Grant (CRC/SG) to implement a groundbreaking study for the state: “Adaptation to Natural Hazards & Climate Change in North Kingstown, RI.” The project objectives are to: 1) Prepare language for North Kingstown’s comprehensive community plan that addresses climate change adaptation as it relates to transportation, land use, and other relevant issues; and 2) Provide a detailed listing of priority transportation and land use projects that support climate change adaptation strategies and are appropriate for inclusion in the state Transportation Improvement Program (TIP) and municipal Capital Improvement Program (CIP) proposals.

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The Adaptation to Natural Hazards & Climate Change in North Kingstown, RI report and maps are publicly available through <http://rhody.crc.uri.edu/accnk/>.

REPORT INFORMATION

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ABSTRACT: The purpose of “Adaptation to Natural Hazards and Climate Change in North Kingstown, Rhode Island” is to demonstrate the process and techniques for how to utilize spatial information and relevant exposure and vulnerability data addressing natural hazards, including coastal hazards such as flooding from projected sea level rise and storm surge events, in local planning to prepare implementable adaptation strategies. These strategies can then be used as a foundation for addressing adaptation in North Kingstown’s comprehensive community plan, and to prioritize projects for inclusion in the municipal Capital Improvement Program (CIP), state Transportation Improvement Program (TIP). This pilot project in North Kingstown is intended to serve as a model for other municipalities in Rhode Island to address resilience to natural hazards in their local planning efforts.

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1. Introduction & Project Purpose

“SEVERAL TIMES EACH YEAR, EVEN ON A SUNNY, CALM DAY, SEA WATER FROM NARRAGANSETT BAY FLOODS THE WICKFORD VILLAGE PARKING LOT AT HIGH TIDE.”

PLANNING DIRECTOR, TOWN OF NORTH KINGSTOWN

The coastal municipality of North Kingstown is home to the iconic New England village of Wickford, the vast industrial complex at Quonset, residential neighborhoods that enjoy views and access to the inlets, coves, and marshlands of Narragansett Bay, and many waterfront activities that utilize marinas, public beaches, parklands and public access points. In recent years, the waters of Narragansett Bay have reached notable heights along North Kingstown’s coastline, ranging from “moon tides” that bring extreme high tides several times a year as predicted in annual tide charts (NOAA Tides & Currents website), to periodic storm events and storm surge impacts from nor’easters, tropical storms and hurricanes.

The state of Rhode Island has documented evidence that sea levels have been rising in Narragansett Bay since record keeping was initiated in 1930 (NOAA, Tides & Currents website).¹ Since 1930, sea levels recorded on the Newport tide gauge in Narragansett Bay have increased approximately 10 inches. Recognizing the potential impact sea level rise and climate change will have on the coastline of the state, the Rhode Island Coastal Resources Management Council (CRMC) adopted its Climate Change and Sea Level Rise policy as part of Section 145 of the [R.I. Coastal Resources Management Plan](#)² (RICRMP) in January.

Recent storm events, including nor’easters, Tropical Storm Irene in 2011, and most recently “Superstorm Sandy” in 2012, have occurred frequently enough to reinforce with the residents and decision makers of the town that the waters of Narragansett Bay have the potential to literally reach the doorstep of individual homes in North Kingstown. Storm surge impacts from major storms as well as less severe events have been seen first-hand, and with scientifically-accepted projections that sea level will increase between now and 2100 (and beyond), the time has come for North Kingstown’s municipal government and decision makers to work with partners across Rhode Island to facilitate protection of existing assets in the town, assist individual residents with long-range management of their properties, and employ a “no-regrets” approach to future development proposals and approvals to reduce future losses and keep residents out of harm’s way.

As in recent years, the extreme annual high tides predicted by ocean scientists (NOAA, Tides & Currents website) are expected to temporarily flood individual properties in town several times each

¹ <http://tidesandcurrents.noaa.gov/>

² <http://www.crmc.ri.gov/regulations/RICRMP.pdf>

year through a 24-hour tide cycle over several consecutive days. North Kingstown's municipal parking lot along Brown Street in Wickford Village, located behind North Kingstown's Town Hall Annex office building, floods with sea water during these extreme high tide events with water flowing into the lot up through the storm drain in the middle of the lot, as well as from sea water overtopping the rocky northernmost edge of the property. This results in direct flow of sea water onto the surface of the parking lot, limiting access, parking availability, and overall use of this lot for the village during the period of high tide.

The coastline of Rhode Island is constantly changing, and with a projected increase in the frequency of severe storm events, coupled with increases in sea levels over time, the coastline will continue to erode and change. As state and local leaders begin to explore changing coastal conditions at the municipal level, they are charged with thinking about the built environment and coastal infrastructure protecting roads, houses, businesses, libraries, schools, and emergency facilities, and focus their efforts on avoiding or minimizing effects that these hazards in North Kingstown pose to lives, infrastructure, and property. There are two separate but related factors that must be considered when planning for coastal hazard resilience in the cities and towns in Rhode Island: 1) STORMS: When the next storm hits Rhode Island this year and in years ahead, how far will the storm surge reach inland roads and properties, and how will the coastline erode and change as the waters surge and recede? and 2) SEA LEVEL RISE: Over the next 20, 50, and 100 years, how will incremental sea level rise change the coastline of town, and what roads and properties will be inundated by two high tides per day at levels higher than we are seeing today?

The state of Rhode Island and its municipalities will inevitably be faced with difficult decisions related to the length of time critical infrastructure is designed to last and how to decide where to invest federal, state, and local capital improvement funds locally. Citizens and business owners will need to be better informed and prepared to withstand both the next storm event on their properties, as well as the impacts incremental sea level rise will have not only on their individual properties, but to any transportation access routes into and out of neighborhoods. This report aims to provide decision makers and residents of North Kingstown with the base information they need to start grappling with these difficult decisions.

1.1. ABOUT THE PROJECT

The University of Rhode Island Coastal Resources Center (URI-CRC) and Rhode Island Sea Grant College Program (RISG) at the Graduate School of Oceanography (GSO) has a long-term commitment to understanding climate change impacts related to sea level rise, flooding and erosion, and the resulting economic, social and environmental implications for Rhode Island's 21 coastal communities. Working with partners from CRMC, the Rhode Island Statewide Planning Program, The Nature Conservancy (TNC), the Rhode Island Emergency Management Agency (RIEMA), the University of Rhode Island Environmental Data Center (URI-EDC), and other institutions, advancements have been made in science synthesis, policy development, and outreach on these issues. From this work, a need was identified for a

more detailed analysis of vulnerable assets, adaptation strategies and implementation techniques that can be applied in Rhode Island's coastal communities.

This project consolidated the best available digital elevation data for coastal Rhode Island as of 2011, resulting in a series of map and data products that resource managers and decision makers can use to assess vulnerability to projected sea level rise. The high resolution topography (surface) and bathymetry (subsurface) data can be used for many other applications as well. In addition, a participatory process with targeted stakeholders, municipal decision makers, and interested residents in town was undertaken to ensure that the products are not only well suited to aid in future state and municipal decision making, but also reflect the values of the citizens of the town. This "pilot project" for the Town of North Kingstown is intended to demonstrate the process and techniques for how to utilize this data in local planning and action to address sea level rise and increased inundation expected in the future and serve as a model for other towns in the state.

Through synthesis of the maps, spatial data, town input, and the participatory process among various stakeholders, this project provides:

1. A new chapter/element for North Kingstown's comprehensive community plan that addresses climate change adaptation as it relates to transportation, land use, and other relevant issues.
2. A detailed listing of priority transportation and land use projects that support climate change adaptation strategies and are appropriate for inclusion in the state Transportation Improvement Program (TIP) and municipal Capital Improvement Program (CIP) proposals.

With a foundation of high quality, statewide digital elevation data, it is expected that managers and decision makers can: 1) Begin to assess vulnerability and to prioritize risks to sea level rise and increased storminess; 2) Implement existing state sea level rise policy and programs which consider the impact of accelerated sea level rise on coastal permitting; 3) Develop new programs that incorporate sea level rise considerations into local comprehensive plans, hazard mitigation plans, and capital improvements; and 4) Address ecosystem-based adaptation options for wetlands and living shorelines. The ability of municipalities to implement climate adaptation strategies at the local level will help Rhode Island build increased resilience to coastal hazards and climate change statewide.

1.2. USING THIS REPORT

This report is arranged into eight chapters, with several related Appendices. Each table and figure presented in the report is designed to be self-explanatory, and thereby can be taken out of this report and used on its own for targeted discussions. Decision makers and residents of North Kingstown are encouraged to review this information and subsequently explore the feasibility for implementation and/or incorporation into local planning and budgeting processes.

Chapters

- **Chapter 2** provides background information and context of climate change adaptation planning in Rhode Island, and a summary of state and local efforts that have informed the contents of this report.
- **Chapter 3** offers a summary of sea level rise projections, the methodology of the sea level rise scenario maps, and a table summarizing the impacted sectors in North Kingstown.
- **Chapter 4** provides detailed information about the impacted areas of North Kingstown from future sea level rise projections.
- **Chapter 5** outlines adaptation strategies that North Kingstown can consider as it advances adaptation planning at the local level.
- **Chapter 6** describes the process for prioritizing adaptation and what projects should be including in transportation or capital improvement programs at the state and local level.
- **Chapter 7** offers language that can be incorporated into the town's Comprehensive Community Plan.
- **Chapter 8** suggests some next steps to build upon this work.

Appendices

- **Appendix A** – Creating Sea Level Rise Maps for North Kingstown
- **Appendix B** – Links to Finding the North Kingstown Sea Level Rise Maps and SLAMM Maps Online
- **Appendix C** – Process Overview- Neighborhood-Scale Parcel Maps- provides a prioritization matrix for the 12 study areas in North Kingstown, as well as tables summarizing the total property values and road segments that intersect projected sea level rise scenarios and the 1938 Hurricane water levels.
- **Appendix D** – Maps- North Kingstown's Neighborhoods Vulnerable to Sea Level Rise contains the maps for each of the 12 study areas, showing the sea level scenarios, and impacted parcels and roads contained within each scenario.
- **Appendix E** – Comprehensive Parcel List within Projected Future Sea Level Rise Areas includes property tables showing the different categories of North Kingstown properties and individual parcels that intersect projected sea level rise scenarios and the 1938 Hurricane water levels.

2. Background Information

“THE GENERALLY ACCEPTED THEORY OF CLIMATE CHANGE AND SEA-LEVEL RISE IS NO LONGER A SITUATION THAT IS CONSIDERED TO BE PREVENTABLE. IT IS HAPPENING AND AS WE WORK TOWARD REDUCING OUR CARBON EMISSIONS, WE MUST ALSO PLAN FOR IMPACTS TO OUR INFRASTRUCTURE BY SEA-LEVEL RISE.”

STATE OF RHODE ISLAND, TRANSPORTATION 2035

Rhode Island’s state agencies, universities, non-governmental organizations, and municipalities have been closely collaborating to determine exposure, vulnerabilities, and strategies to adapt to changing sea levels, frequency and intensity of storm events, and resilience to impacts of natural hazards on its cities and towns. While protecting public health, safety, and welfare through responsible land use policies and transportation planning is a primary driver in adaptation planning, cities and towns must also consider the long-term resilience of our state’s natural habitats and cultural resources as our coastal conditions change.

North Kingstown aspires to tailor its municipal blueprint and future land use strategies on the emerging coastal adaptation techniques that have been building through various federal, state, and local efforts around the United States. Rhode Island’s state regulatory agencies and municipal governments are actively undertaking programs to develop, review and test strategies for long-term resiliency to effects of climate change and coastal hazards, and there is statewide momentum to better understand how Rhode Island cities and towns are empowered to take action in the face of storm impacts, increasing tide levels, and changing coastal conditions along the state’s 400+ miles of coastline.

This chapter provides a brief summary of the active plans and programs at the state and local level that were considered in the development of adaptation strategies for North Kingstown.

2.1. CLIMATE CHANGE ADAPTATION PLANNING IN RHODE ISLAND

Climate Change and Rhode Island’s Coasts, 2012. This report offers an overview of the climate trends, a science summary, and a snapshot of the major issues and challenges facing Rhode Island resulting from changing climate³. In Rhode Island, current climate trends include the warming of air and ocean and coastal water temperatures, accelerating sea level rise, increasing storm and precipitation intensities, and declining wind speeds. Also, the number of extremely hot days is increasing, and coastal and ocean waters are becoming more acidic. This is a concern to the state because coastal flooding can threaten historical and cultural assets, recreation and tourism, and fisheries, while posing some new risks to human health and overall social well-being.

³ <http://seagrant.gso.uri.edu/climate/index.html>

Adapting to Climate Change in the Ocean State: A starting point, 2012. The Rhode Island Climate Change Commission emerged from the Rhode Island Climate Risk Reduction Act of 2010 (RIGL 23-84) with a mandate to: (1) Study the projected impacts of climate change on Rhode Island; (2) Identify and report methods of adapting to these climate change impacts in order to reduce likely harm and increase economic and ecosystem sustainability; and (3) Identify potential mechanisms to mainstream climate adaptation into existing state and municipal programs including, but not limited to, policies, plans, infrastructure development and maintenance. The Commission established working groups focused on key infrastructure and the built environment, natural resources and habitat, and human health and welfare.

Rhode Island Climate Challenge: Waves of Change, 2014⁴. “This website is designed to broaden the understanding of people concerned with climate change, from the general public to scientists.” This site offers a variety of articles, videos, and news stories to assist Rhode Islanders as they prepare for the impacts of climate change, and was designed to “... respect diverse opinions on how best to adapt to climate change, while illustrating the inevitable problems with which we all have to deal.”

Towards a Resilient Rhode Island: Responding to climate change with leadership, innovation, and economic development, 2014⁵. “The Resilient Rhode Island Act, introduced in 2014, seeks to protect the people of Rhode Island and make our state economy and society resilient in the face of nearly certain, but not precisely predictable, effects of climate change. The Act builds off of Governor Chafee’s Executive Order creating Rhode Island Executive Climate Change Council⁶ (February 21, 2014), providing a framework for state government to adaptively plan for and manage climate change impacts. The bill emphasizes the need for inclusive public dialogue on the challenges ahead, and seeks to position Rhode Island for future economic development.”

Examples of **municipal-scale climate adaptation projects** recently completed or underway in Rhode Island include a recent report prepared for the South Kingstown, RI Land Trust, ***Building Capacity to Adapt to Climate Change Through Local Conservation Efforts: A South Kingstown Land Trust Pilot Project, 2013***, that outlines a strategy for local conservation organizations to strengthen their stewardship role by incorporating climate change adaptation into their acquisition and management programs; an ongoing project in the city of Newport, RI, “Building Resilience of the Newport Waterfront,” that will engage waterfront businesses in the city to explore strategies and actions to increase resilience to sea-level rise and storm events; and University of Rhode Island student projects focused on engineering and landscape architecture on individual properties in North Kingstown and Newport, RI.

⁴ <http://riclimatchange.org/>

⁵ <http://www.resilientri.org/>

⁶ http://www.governor.ri.gov/documents/press-attachments/14_01_Executive%20Order.pdf

2.2. R.I. CRMC SEA-LEVEL RISE POLICY

Recognizing the potential impact sea-level rise and climate change will have on the coastline of the state, the Rhode Island Coastal Resources Management Council (CRMC) adopted its ***Climate Change and Sea Level Rise policy as part of Section 145 of the R.I. Coastal Resources Management Plan (RICRMP)***⁷ in January 2008. The policy specifies that the CRMC is proactively planning for sea level rise and climate change impacts, as well as integrating this information into decision-making.

The findings within Section 145 indicate that, based on historic observations, sea level has already risen nearly 10 inches at the Newport, R.I. tide station since 1930 and that the rate of sea-level rise is accelerating. The CRMC notes that the rate of rise during the past 20 years is 25% faster than the rate of rise in any other 20-year period recorded in Newport. Future projections of sea-level rise in the state based on scientific models suggest that the rate of sea-level rise will continue to accelerate and that by 2100 Rhode Island can expect conservatively between three and five feet. In the end, the rate and extent of sea-level rise in Rhode Island will ultimately be determined by global changes in temperature and the extent of glacial melting in Greenland and, especially, the West Antarctic. While the future projections for sea-level rise for Rhode Island are continually refined based on new scientific evidence, the CRMC will be adapting its policies to reflect the best available information. However, the need to plan for rising sea level remains constant.

As a result of increasing sea level, CRMC findings state:

- There will be wide-scale changes in both terrestrial and marine environments that will result in ecosystem shifts and present major challenges to natural resource managers;
- Coastal populations will be displaced and infrastructure threatened;
- Residential and commercial structures, roads and bridges will become more susceptible to flooding;
- Existing sea walls and revetments will be less effective; and
- Salt water intrusion may impact drinking water supplies, and higher water tables may compromise wastewater treatment systems and impact storm water dynamics.

From a coastal zone management perspective, perhaps no other factor associated with climate change is more problematic than sea-level rise and its impacts along the coastline. Through the policies enacted by the CRMC in Section 145 of the RICRMP and the comprehensive planning effort underway through their Shoreline Change Special Area Management Plan (see Section 2.5), the state's coastal administrator is making climate change and sea-level rise planning priorities.

2.3. COMPREHENSIVE PLANNING

The ***Rhode Island Comprehensive Planning and Land Use Act*** (RIGL 45-22.2) was created to encourage coordination between state government and municipalities of Rhode Island and require local comprehensive plans to meet minimum standards within the State Guide Plan while "...maintaining municipal discretion in land use decision-making." The Act also requires zoning to be consistent with

⁷ <http://www.crmc.ri.gov/regulations/RICRMP.pdf>

Comprehensive Plans. The Act was updated in 2011 with several new requirements that municipalities must meet by 2016, including the requirement to address natural hazards in the municipal comprehensive plans, as outlined in Section 45-22.2-6(b)(10): “*Natural hazards*. The plan must include an identification of areas that could be vulnerable to the effects of sea-level rise, flooding, storm damage, drought, or other natural hazards. Goals, policies, and implementation techniques must be identified that would help to avoid or minimize the effects that natural hazards pose to lives, infrastructure, and property.”

The Rhode Island ***Handbook on the Local Comprehensive Plan*** was last updated in 2003, and the Rhode Island Statewide Planning Program (RISPP) is preparing a full rewrite of this guidance document for release in 2014. This guidance document will include a chapter titled, “Planning for Natural Hazards,” and define the requirements for addressing natural hazards as well as the impacts of climate change in the local comprehensive community plan. This chapter clearly defines that local comprehensive plans must include goals, policies, and implementation actions that address, “Avoiding or minimizing the effects that natural hazards pose to lives, infrastructure, and property.”

Transportation 2035: State Guide Plan Element 611, 2012, is a state plan that addresses Rhode Island’s transportation needs over a 20-year period, and is regularly updated by the RISPP. The plan was updated in 2012 and includes a section describing sea-level rise impacts to transportation that states, “The generally accepted theory of climate change and sea-level rise is no longer a situation that is considered to be preventable. It is happening and as we work toward reducing our carbon emissions (mitigation measures), we must also plan for impacts to our infrastructure by sea-level rise.” This document suggests that state highway segments intersecting areas exposed to future inundation be considered for realignment, elevation, or accepted as a loss with an alternate route identified for the service area of that roadway.

Land Use 2025: State Land Use Policies and Plan was released in 2006 and summarizes, “...the state’s overarching goals, objectives and strategies to guide and coordinate the land-use plans and regulations of municipalities and state agencies and to direct good strategic projects at both state and municipal levels.” This plan states that it is a challenge for coastal communities to “direct development away from areas subject to erosion and flooding from gale-force winds, storm surge, and sea-level (sic) rise,” and that “local officials must recognize that new structures, poorly sited, may be extremely vulnerable to severe weather. Open space landward of sensitive features should be protected as a buffer to storm damage and erosion. Hazard mitigation plans should be developed to deal with potential problems before they become emergencies. (Page 3-16). Because of this, the plan offers this policy: “Guide development in a manner that will prevent encroachment on floodways, dunes, barrier beaches, coastal and freshwater wetlands, and other natural features that provide protection from storms, flooding, and sea-level rise (Land Use Policy [LUP] 10, Page 2-9).”

The **Town of North Kingstown Comprehensive Plan** was last updated in 2008, and addresses elements required by the state: land use, housing, circulation, community services and facilities, economic development, natural and cultural resources, and open space and recreation. North

Kingstown's plan also includes separate elements for Post Road Corridor and the Quonset Business Park. North Kingstown's Comprehensive Plan addresses the 2005 *Hazard Mitigation Plan* in the Community Services and Facilities Element, and lays out goals, objectives and actions in section CS.17. Currently, the town's plan does not specifically address adaptation to climate change or projected future sea-level rise scenarios.

2.4. HAZARD MITIGATION PLANNING & FLOODPLAIN MANAGEMENT

The **Rhode Island State Hazard Mitigation Plan (SHMP)** was updated and released by the Rhode Island Emergency Management Agency (RIEMA) in 2014⁸. This plan puts forward a vision that "Rhode Island is resilient to natural hazards and climate change," provides guidance for hazard mitigation in the state of Rhode Island, and presents actions that are intended to "...reduce or eliminate long-term risk from hazards and their effects." The plan lists the types of hazards that must be addressed, including wind-related (storm surge, hurricanes, tornadoes, and high winds), winter-related (snow, ice, and extreme cold), flood-related (riverine flooding, flash flooding, urban flooding, coastal flooding, climate change/sea-level rise, coastal erosion, and dam breach), geologic-related (earthquakes), and other hazards (wildfire, drought, and extreme heat).

The five goals of the SHMP include: (1) Rhode Island has the capacity to promote and implement projects, programs, plans, policies, and legislative actions to reduce vulnerability to natural hazards, in particular for properties with repetitive and severe losses due to flooding; (2) Statewide coordination with organizations, agencies, and stakeholders; (3) Local communities address natural hazards and long-term risk reduction in local decision making and planning; (4) The public understands, supports, and acknowledges the need for hazard mitigation; and (5) The built environment and infrastructure are resilient to the impacts of natural hazards.

A **template for local Hazard Mitigation Plans** was also prepared by RIEMA in 2014, and is being rolled out to municipalities in coordination with scheduled updates of their local Hazard Mitigation Plans. The Rhode Island template follows FEMA's "Local Mitigation Plan Review Guide"⁹, and RIEMA offers technical planning assistance for any municipality upon request.

North Kingstown's Hazard Mitigation Plan was last updated in 2005, and is currently in the update process for an anticipated 2014 approval and adoption. The goal statement is:

"...to identify areas at risk from natural hazards and develop policies and plans of action that could be implemented to reduce the impacts of natural hazards on the residents, properties, and natural resources of North Kingstown. A high priority is placed on protecting the safety of residents and visitors alike. The town's many historic buildings and coastal resources are of special concern. This hazard mitigation plan update has also taken steps to incorporate climate

⁸ <http://www.riema.ri.gov/prevention/mitigation/index.php>

⁹ <http://www.fema.gov/media-library/assets/documents/23194?id=4859>

change into planning analyses as a first step in considering its impact on North Kingstown, including how they may exacerbate natural hazards such as floods, hurricanes, and drought.”

The plan also articulates mitigation goals from which the actions of the plan are developed. These mitigation goals include: (1) Reduce risks from Natural Hazards to life and property in North Kingstown; (2) Ensure the safety of children from natural hazards; (3) Ensure that the town’s emergency services will be operational during a natural disaster, and plans are in place to expedite recovery after a disaster; and (4) Reduce the vulnerability of town sectors to natural hazards, including infrastructure and utilities, municipal facilities, cultural resources, employees and facilities at Quonset Point, and recreational resources.

As with all 39 municipalities in Rhode Island, North Kingstown participates in the **National Flood Insurance Program (NFIP)**, a voluntary program through which participating municipalities agree to regulate development in floodplains according to defined criteria and standards. The program offers flood hazard maps, flood insurance, and regulations (RIEMA 2009).

The **FEMA Digital Flood Insurance Rate Maps (DFIRMS)** are available online through FEMA’s Map Service Center¹⁰ and the following list includes the map number for each map that covers North Kingstown’s coastal area (maps covering North Kingstown’s inland/riverine floodzones are offered through the FEMA website as well):

- 44009C0018J – Pojac Point / Mount View
- 44003C0144H – Pojac Point / Mount View
- 44009C0106J – Quonset / Davisville
- 44005C0076J – Quonset / Davisville
- 44009C0108J – Mill Cove / Shore Acres
- 44009C0104J - Wickford
- 44009C0112J – Duck Cove / Earle Drive
- 44009C0116J – Hamilton / Bissell Cove
- 44009C0118J – Plum Point / Plum Beach
- 44009C0114J – Gilbert Stuart / Walmsley Lane

Additionally, RIEMA launched a Rhode Island Floodplain Mapping Tool in 2013 that offers an online reference for residents interested in flood risk information for properties statewide. This tool can be found online at http://www.riema.ri.gov/prevention/floods/flood_mapping.php and provides an approximate flood zone boundary based on flood hazard areas as presented in FEMA’s FIRM’s (as listed above).

North Kingstown is active in the **NFIP’s Community Rating System (CRS)** program, which awards ratings to municipalities showing commitment to activities that contribute to community-wide reduction of flood risk. The community score awarded by FEMA results in a discount on flood insurance premiums

¹⁰ <https://msc.fema.gov>

for property owners within a Special Flood Hazard Area who hold flood insurance policies, ranging from a score of “9” which offers a 5% discount on flood insurance premiums, down to a score of “1,” which offers the maximum savings of 45% off premiums. As of 2014, North Kingstown is one of only five Rhode Island municipalities enrolled as a CRS community, and is maintaining a score of “9,” which entitles property owners to a 5% discount on their flood insurance premiums. The town planning department continues to work with FEMA to document other achievements in hopes of securing a lower rating, which would result in greater savings to policy holders.

North Kingstown adopted a **Special Flood Hazard Area (SFHA) Overlay District** in 2013. The purpose of the ordinance, as stated in Section 21-188(a) is, “...to ensure public safety, minimize hazards to persons and property from flooding, protect watercourses from encroachment, and to maintain the capability of floodplains to retain and carry off floodwaters.” Section 21-188 (b) states, “This Special Flood Hazard Area Overlay District contains special flood hazard areas, including floodways and coastal high hazard areas. Special flood hazard areas are subject to recurrent flooding which presents serious hazards to the health, safety, welfare, and property of the residents of the Town of North Kingstown. Regulation of the development and alteration of such areas is thus in the public interest.” The ordinance goes on to present administrative requirements related to the granting of building permits and specifically identifies minimum requirements for permitted uses in these areas:

- (1) *Floodways.* No development proposing fill, new construction, substantial improvement, or other encroachment within a floodway which will result in any increase in flood levels during the occurrence of the 100-year flood shall be permitted. The placement of mobile homes shall be prohibited.
- (2) *Coastal high hazard areas.* The alteration of sand dunes, where existent, is prohibited. All new construction shall be located landward of the spring (moon) high tide. The placement of mobile homes shall be prohibited.

It is important to note that the SFHA does NOT account for future sea level rise projections. The information, data, and maps presented in this report will distinguish, where appropriate, between coastal flooding from storm surge and within the SFHA, against flooding from projected future sea level rise resulting in two tides per day at a higher level than we see now.

2.5. R.I. CRMC SHORELINE CHANGE SPECIAL AREA MANAGEMENT PLAN (“BEACH SAMP”)

In 2013, the CRMC in partnership with the University of Rhode Island began a state-wide planning effort dealing with the potential impacts of shoreline erosion, storm related flooding and sea-level rise. The **Shoreline Change Special Area Management Plan**¹¹ (also referred to as the Beach SAMP) includes mapping and identifying areas vulnerable to coastal erosion, storm surge and sea-level rise scenarios, as well as recommendations for adaptation and new or amended CRMC policies on shoreline change. This plan, once adopted by the CRMC, will supplement the RICRMP and existing state coastal policy.

¹¹ <http://www.beachsamp.org/>

However, it is also meant to serve as a valuable resource to coastal communities which are integrating and refining coastal hazard planning into their comprehensive plans.

The Beach SAMP will build upon the work already completed in North Kingstown, and will pursue similar assessments for all coastal communities in the state. In addition, the Beach SAMP will add “dynamic” storm surge scenarios to the existing set of “static” bathtub model sea-level rise maps for North Kingstown. This modeling and analysis will depict areas at risk to storm surge scenarios with varying sea-level rise conditions, as well as new shoreline change maps that illustrate erosion rates and potential changes in coastal conditions for Rhode Island’s coastline. These new maps will not contradict the current set of sea-level rise maps completed for North Kingstown, but will rather provide greater detail on how sea-level rise combined with the dynamic effects of storms and erosion will impact the town.

North Kingstown’s current Shoreline Change Maps¹² were last updated in 2003. Due to recent storm frequency, coastal communities in Rhode Island have been experiencing greater erosion rates than present day shoreline change maps suggest. Therefore the CRMC plans to update these maps as part of the Beach SAMP process.

One component of the Beach SAMP that was completed at the time of this adaptation planning effort for North Kingstown is the modeling of salt marsh migration with sea level rise scenarios. This process is aimed at developing effective adaptation strategies to protect and restore coastal wetland ecosystems, and is producing detailed maps for each of the 21 coastal municipalities in Rhode Island. This analysis illustrates scenarios using the Sea Level Affecting Marshes Model (SLAMM), and provides projections on where salt marshes are likely to persist, migrate, or disappear with rising sea levels. The data from the SLAMM analysis is reflected in the sea level scenario maps presented in Appendix A of this report.

¹² The Shoreline Change maps are available online at http://www.crmc.ri.gov/maps/maps_shorechange.html.

3. Assessment of Risk in North Kingstown

“TODAY’S ‘MOON TIDE’ WILL BECOME OUR REGULAR HIGH TIDE.”

PAM RUBINOFF, UNIVERSITY OF RHODE ISLAND COASTAL RESOURCES CENTER, RI SEA GRANT

Before adaptation actions and implementation programs are enacted, it is important to consider: What has happened in North Kingstown in the past? What might happen in the future? What timeframes will be important to consider when planning for different types of infrastructure upgrades? Which areas/neighborhoods of town are likely to experience the most disturbance from coastal hazards? Which sectors of the municipality and related assets are exposed or may be impacted?

Evaluating risk of municipal assets from natural hazard impacts is addressed in the RI State Hazard Mitigation Plan as well as the North Kingstown Hazard Mitigation Plan, “Strategy for Reducing Risks From Natural Hazards in North Kingstown, Rhode Island.”

The 2014 Rhode Island State Hazard Mitigation Plan defines risk as:

“...the estimated impact that a hazard would have on people, services, facilities and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as high, moderate, or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It can also be expressed in terms of potential monetary losses associated with the intensity of the hazard.”

After collecting anecdotal and responsive information pointing to exposure from past storm events or even regular extreme high tides, North Kingstown has been the focus of a detailed geospatial analysis that provides a clear story on the areas of town that are expected to be exposed to future sea level rise scenarios. This chapter will review current coastal hazards in North Kingstown and describe briefly how future conditions were assessed to examine the impacts sea level rise may have on flooding in the town.

Understanding risk, vulnerability, and exposure of North Kingstown’s coastal landscape will allow the municipality to define and implement strategies for protecting assets in town. Also, based on the long-term predictions of coastal conditions with a changing climate and shifting shoreline, the options to protect coastal structures can be weighed against how the water might be accommodated over time.

3.1. OVERVIEW OF HAZARDS IN NORTH KINGSTOWN

The 2013 North Kingstown Hazard Mitigation Plan details the risk posed by different natural hazards, as well as the vulnerability of the town to those hazards. Table 1 summarizes the past hazard event in North Kingstown from 1938 to 2013 as identified in the 2013 North Kingstown Hazard Mitigation Plan. Wind and flood-related hazards have been the dominant type of hazard impacting the town to date. What is not included in the current hazard mitigation plan but is required for local

comprehensive plans following the *Rhode Island Comprehensive Planning and Land Use Act* (RIGL 45-22.2) is an analysis of the impacts of sea level rise (see section 2.3 of this report for more information). Therefore, the focus of this project was on examining the impacts of future sea level rise scenarios.

In addition to the hazards summarized in Table 1, erosion also impacts coastal regions of North Kingstown. Erosion is not covered in the North Kingstown Hazard Mitigation Plan, however there are erosion maps created by the Rhode Island Coastal Resources Management Council for North Kingstown are available at http://www.crmc.ri.gov/maps/maps_shorechange.html. See section 2.5 of this report for more information.

Table 1. Rhode Island State Hazard Mitigation Plan, Section 3.4

Wind Related Hazards	Winter Related Hazards	Flood Related Hazards	Geologic Related Hazards	Additional Hazards
Storm Surge	Snow	Riverine Flooding	Earthquakes	Wildfire
Hurricanes	Ice	Flash Flooding		Drought
Tornadoes	Extreme Cold	Urban Flooding		Extreme Heat
High winds		Coastal Flooding		
		Climate Change and Sea Level Rise		
		Coastal Erosion		
		Dam Breach		

Table 2 Past hazard events in North Kingstown, RI (Source: 2014 North Kingstown Hazard Mitigation Plan).

Flood Related Hazards (7)	2012 (October), "Superstorm Sandy" 2011 (August), Tropical Storm Irene 2010 (March), 500-Year Flood 1991, Hurricane Bob 1985, Hurricane Gloria 1954, Hurricane Carol 1938, Hurricane (Most extreme on record)
Wind Related Hazards (6)	2012 (October), "Superstorm Sandy" 2011 (August), Tropical Storm Irene 1991, Hurricane Bob 1985, Hurricane Gloria 1954, Hurricane Carol 1938, Hurricane (Most extreme on record)
Winter Related Hazards (2)	2013 (February), Winter Storm "Nemo" 1978, Blizzard
Geologic Related Hazards (1)	1951, Earthquake, 4.6 Richter Scale, Epicenter in Kingston, RI
Additional Hazards (5)	2002, Statewide seasonal drought event 1999, Statewide seasonal drought event 1975, Wildfire 1969, Wildfire Mid-1960s, Statewide long-term drought

3.2. MAPPING SEA LEVEL RISE PROJECTIONS

There are several coastal flooding hazards that impact communities today, and which are anticipated to increase as sea levels continue to rise at an accelerated rate due to climate change. Coastal shorelines will experience increased daily high tides; increased storm surge levels such as during Nor'easters; and increased storm related flooding. Table 3 is a description of the five scenarios mapped through this project. One, three and five feet of sea level rise were chosen for this analysis to correspond with the projections of the Rhode Island Coastal Resources Management Council (see

section 2.2. of this report). Three different sea level rise scenarios were examined, as well as the flooding from the 1938 Hurricane event. The 1938 Hurricane was mapped because it represents the most extreme storm event on record for the town of North Kingstown (see the North Kingstown Hazard Mitigation Plan for more details).

The mapping process was initiated in 2009 to illustrate sea level rise scenarios across Rhode Island's coastal communities. This process used the most recent digital elevation models (DEM) to conduct a "bathtub analysis" on baseline water levels that show the extent of sea level scenarios inland from the coastline of Narragansett Bay. This effort produced an atlas of individual maps for the entire town of North Kingstown which illustrates real property, facilities and infrastructure that are likely to be exposed to future sea level rise.¹³ For a detailed description of mapping methodology used during this project see Appendix A.

Table 3. Sea level rise projections and storm events mapped.

Scenario	Description
Mean Higher High Water (MHHW) *Represents current conditions	Mean higher high water (MHHW) is the mean elevation of the higher of the two daily high tides over a nineteen year period, in comparison to the mean high water (MHW), which is the average elevation of all high tides over the same period. MHHW is the chosen baseline for this study, since it reflects a realistic average tidal elevation that communities will experience regularly.
MHHW plus 1 foot sea level rise	Historically, sea level has already risen about eight inches in the past 100 years at North Kingstown based on data from the Newport tide gauge. With accelerated sea level rise already being observed in RI, models show that global sea levels are likely to rise one foot in the next twenty years to fifty years. <i>MHHW plus 1' sea level rise scenario depicts: areas inundated at mean high tide levels with one foot of sea level rise, or areas inundated at spring high tide today.</i>
MHHW plus 3 foot sea level rise	Models show that global sea levels may rise three feet by 2065. <i>MHHW plus 3' sea level rise scenario depicts: areas inundated at mean high tide at 2065 or beyond, or areas inundated at during extra-tropical storms that strike at spring high tide.</i>
MHHW plus 1 foot sea level rise and 3 foot storm surge	Extra-tropical storms, often referred to as Nor'easters, typically have storm surges of three feet above the predicted tide height as experienced in Rhode Island. <i>MHHW plus 1' sea level rise and 3' storm surge scenario depict: areas inundated during extra-tropical storms with a one foot sea level rise, or areas inundated during extra-tropical storms that strike at spring tide today.</i>
MHHW plus 5 foot sea level rise	Models show that global sea levels may rise as much as five feet by 2100. <i>MHHW plus 5' sea level rise scenario depicts: areas inundated at mean high tide at 2100 or beyond, or areas inundated during extra-tropical storms that strike at spring high tide with a one foot sea level rise.</i>
Hurricane 1938 Surge Height	<i>This inundation surface estimates flood elevations of the 1938 hurricane, as recorded at the Newport tide gauge.</i> Elevations do not include wave heights or run-up. It should be noted that inundation levels were higher in upper Bay coastal communities as the storm surge traveled north into Narragansett Bay.

¹³ Mapping Assets Vulnerable to Sea Level Rise in North Kingstown, RI, May 2011
<http://northkingstown.org/climate-change-adaptation>

3.3. TIMEFRAMES & PLANNING HORIZONS

To effectively implement strategies that work toward community resilience, municipalities must define what goals they are planning for and the length of time different categories of buildings, infrastructure and other assets are designed to last at the time of construction. This can also be referred to as the “design life” of a structure. For North Kingstown’s transportation network of roads, bridges and stormwater management structures, the design, repair, and maintenance schedules of present one type of planning horizon, while the lifespan of a septic system on an individual residential lot presents a different scale of planning horizon. Defining clear planning horizons will be critical as phasing plans are developed for implementation and funding is pursued from federal/state grants, as well as from within the municipal budget through the municipal Capital Improvement Program (CIP).

Accurately predicting timeframes for rising sea levels in Rhode Island has been and will continue to be an ongoing challenge for scientists, decision makers and regulators in the state. As mentioned in Chapter Two, the Rhode Island coastline must work to adapt to two related coastal hazards in the coming years – (1) coastal storm events that will bring storm surge and wave run-up along the coastline, and (2) rising sea levels which will bring two high tides each day at a higher level than is currently seen along the Rhode Island coast. Decisions on how to build, rebuild, or retrofit existing coastal properties to adapt to more frequent and intense storm events, as well as incremental sea level rise over the coming decades will fall to the municipal decision makers in coordination with state regulatory agencies.

To determine the approximate timeframes for when North Kingstown can expect to see one, three or five feet of sea level rise and how these projections should inform municipal planning and decision making, several models were consulted. There are several “sea level rise curves” that estimate the rate of sea level change in the coming century, and the slope of the curve can differ based on the assumptions made when running these models. For municipal planning purposes, it is important to understand the range of projections available and consider the available data that enable the town decision makers to make the best informed policy decisions as the town moves forward with adaptation strategies.

For this project the U.S. Army Corps of Engineers (USACE) and the National Oceanographic and Atmospheric Administration (NOAA) Sea Level Change Calculator was used to provide timeframe estimates for possible sea level rise (available online at: www.corpsclimate.us/ccaceslcurves.cfm). This site is offered through the USACE and is intended to evaluate all Army Corps’ engineering projects for sea level change impacts, with the expert science for the site and online calculator provided by NOAA and the US Geological Survey. The site allows the user to enter parameters for their location and project start date, and provides a table and curves that illustrate the best available projections of sea level rise over time. Figure 1 shows the interface from the USACE website, where the Newport Tide Gauge was entered to estimate the levels in North Kingstown. This entry form also allows you to compare the USACE curves being applied at the time of use to those being used by NOAA.

Figure 1. USACE Online Sea Level Change Curve Calculator
(www.corpsclimate.us/ccaceslcurves.cfm)

EC 1165-2-212, Equation 2: $E(t) = 0.0017t + bt^2$

This on-line Sea Level Change Calculator produces the amount of predicted sea level change from 1992 forward.

USACE SLC Coefficients:	0.0000000	0.0000271	0.0001130
Base Year (Mid Point of NTDE):	1992		
Enter Project Start Year:	2010		
Rate of Eustatic Sea Level Rise per year in mm:	1.7		
Rate of Subsidence per year in mm:	0.880		
or Select closest NOAA gauge station to the right: 	RI, Newport 77 yrs		
Enter Advisory Base Flood Elevation (ft):	0		
Enter Project End Year:	2100		
Enter Interval:	5		
Include NOAA Curves: NOAA Technical Report OAR CPO-1	☒		
Units:	☒ Feet ☐ Meters		
Chart Size:	Height: 500	Width: 800	
Compute Curves Based on:	☒ EC 1165-2-212 ☐ EC 1165-2-211 (superseded)		
Calculate Curves Reset Fields Summary			

The output provides both a table and a graph illustrating both the USACE and NOAA curves. The table, taken from the website and presented here as Figure 2 and Figure 3, shows the USACE and NOAA sea level rise projection values for the Newport Tide Gauge through 2100, in five-year increments. In Rhode Island, planners who are looking at scenarios for the years 2030, 2050, and 2100 can use this table to get USACE's and NOAA's best estimates for sea level change at these points in time. For 2030, the low range is 0.32 feet (3.8 inches) of sea level rise from the base year 1992, and the high end of the range is 1.06 feet (12.7 inches). Projecting out to 2050, this table estimates that the low end is 0.49 feet (5.8 inches), and the high end is 2.21 feet (26.5 inches). Out to 2100, the numbers range from 0.91 (10.9 inches) at the low end, up to 6.87 feet (82.4 inches) at the high end.

The curves that correspond to this table are automatically generated from the USACE website, and illustrated in Figure 3.3c. Note where the 1-foot sea level rise intersects approximately with the 2030 timeframe, the 3-foot with the 2050 timeframe, and the 5-foot with the 2100 timeframe. These data are invaluable to assist local planners and decision makers estimate future actions for roads and parcels that intersect with these areas.

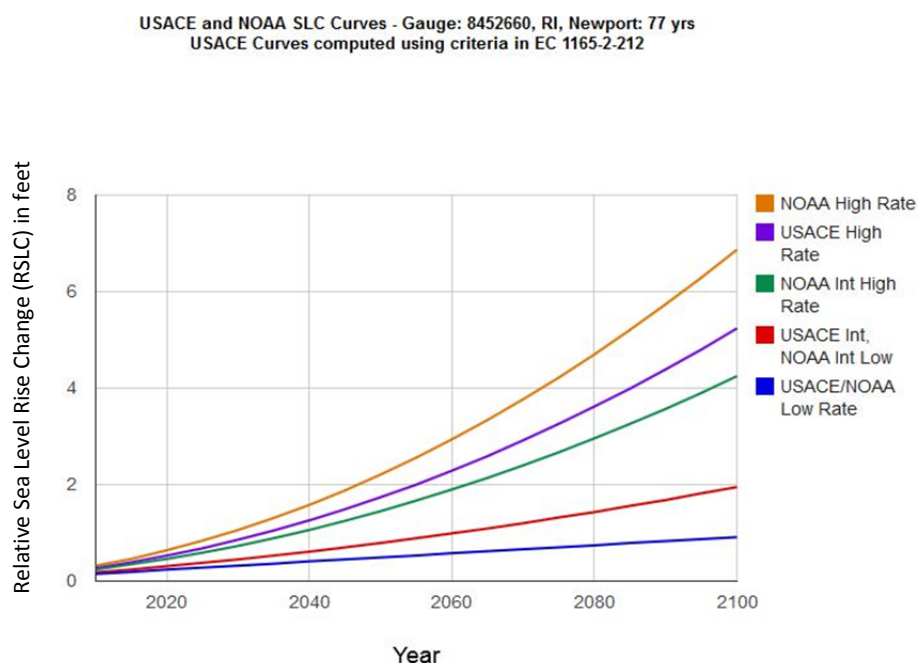
Figure 2. USACE Online Sea Level Change Curve Calculator
(www.corpsclimate.us/ccaceslcurves.cfm)

USACE Curves computed using criteria in USACE EC 1165-2-212

NOAA Curves computed using criteria in NOAA SLR Report
06-Dec-2012

Gauge: 8452660, RI, Newport: 77 yrs All values are in feet							
Year	NOAA Low	USACE Low	NOAA Int Low	USACE Int	NOAA Int High	USACE High	NOAA High
2010	0.15	0.15	0.18	0.18	0.24	0.27	0.32
2015	0.19	0.19	0.24	0.24	0.35	0.39	0.46
2020	0.24	0.24	0.31	0.31	0.46	0.53	0.64
2025	0.28	0.28	0.38	0.38	0.59	0.68	0.84
2030	0.32	0.32	0.45	0.45	0.73	0.86	1.06
2035	0.36	0.36	0.53	0.53	0.89	1.05	1.31
2040	0.41	0.41	0.61	0.61	1.06	1.26	1.58
2045	0.45	0.45	0.70	0.70	1.25	1.49	1.88
2050	0.49	0.49	0.79	0.79	1.45	1.74	2.21
2055	0.53	0.53	0.89	0.89	1.67	2.00	2.56
2060	0.58	0.58	0.99	0.99	1.90	2.29	2.94
2065	0.62	0.62	1.09	1.09	2.14	2.59	3.34
2070	0.66	0.66	1.20	1.20	2.40	2.92	3.77
2075	0.70	0.70	1.32	1.32	2.67	3.26	4.22
2080	0.74	0.74	1.43	1.43	2.96	3.62	4.70
2085	0.79	0.79	1.56	1.56	3.26	3.99	5.21
2090	0.83	0.83	1.68	1.68	3.57	4.39	5.74
2095	0.87	0.87	1.82	1.82	3.90	4.80	6.29
2100	0.91	0.91	1.95	1.95	4.25	5.24	6.87

Figure 3 USACE and NOAA Sea Level Rise Curves



There are several models that project accelerated rates of sea level rise, and we are able to see first-hand in the landscape the increased reaches of sea level today under circumstances that include annual extreme high tides, nor'easters, storm surge and hurricanes. With the reality of these conditions at the doorstep of municipalities, communities have the opportunity to begin taking a “no regrets” adaptation approach to reduce impacts experienced today, and minimize those which are likely to occur more frequently in the future.

To effectively implement strategies that work toward community resilience, municipalities must define what goals they are planning for and the length of time different categories of buildings, infrastructure and other assets are designed to last at the time of construction. This can also be referred to as the “design life” of a structure. For North Kingstown’s transportation network of roads, bridges and stormwater management structures, the design, repair, and maintenance schedules of present one type of planning horizon, while the lifespan of a septic system on an individual residential lot presents a different scale of planning horizon. Defining clear planning horizons will be critical as phasing plans are developed for implementation and funding is pursued from federal/state grants, as well as from within the municipal budget through the municipal Capital Improvement Program (CIP).

Accurately predicting timeframes for rising sea levels in Rhode Island has been and will continue to be an ongoing challenge for scientists, decision makers and regulators in the state. As mentioned in Chapter Two, the Rhode Island coastline must work to adapt to two related coastal hazards in the

coming years – (1) coastal storm events that will bring storm surge and wave run-up along the coastline, and (2) rising sea levels which will bring two high tides each day at a higher level than is currently seen along the Rhode Island coast. Decisions on how to build, rebuild, or retrofit existing coastal properties to adapt to more frequent and intense storm events, as well as incremental sea level rise over the coming decades will fall to the municipal decision makers in coordination with state regulatory agencies.

4. Vulnerable Sectors and Assets in North Kingstown

“IF WICKFORD WENT AWAY, HOW WOULD RESIDENTS FEEL THE IMPACT?”

STAKEHOLDER MEETING PARTICIPANT, TOWN OF NORTH KINGSTOWN

4.1. OVERVIEW OF MUNICIPAL SECTORS

To ensure that all populations, assets, activities, and resources of North Kingstown were adequately addressed in this vulnerability assessment, a review of other local adaptation plans and resources was conducted (CAEMA et al. 2012; ICLEI, 2012; Snover et al. 2007). Based on this review of existing plans in the U.S., as well as brainstorming sessions with planning officials in the Town of North Kingstown, the following list of municipal sectors was created:

1. Land Use (LU)
2. Transportation and Circulation (TC)
3. Building Stock (B)
4. Municipal Properties and Facilities (MP)
5. Emergency Management Facilities (EM)
6. Wastewater (WW)
7. Stormwater (SW)
8. Drinking Water (DW)
9. Groundwater (GW)
10. Wetlands (W)
11. Historic and Cultural Resources (HC)
12. Contaminated Sites (CS)
13. Open Space, Recreation, and Public Access (OS)
14. Vulnerable Populations (VP)
15. Greenhouse Gas Reduction (GR)
16. Utilities and Other Infrastructure (U)

17. Communications (C)

18. Municipal Operations (MO)

These eighteen sectors represent all topic areas and components of the local comprehensive plan that needed to be addressed in the development of adaptation strategies. While the impact of natural hazards and climate change on each of these municipal sectors varies, with some being highly impacted and others only affected slightly, adaptation strategies were created for all eighteen (see Chapter 5 of this report). Table 4 shows how each municipal sector and the adaptation strategies presented in Chapter 5 relate to the elements of the North Kingstown Comprehensive Community Plan.

Table 4. Relationship between the elements of the North Kingstown Comprehensive Community Plan and the municipal sectors examined in this vulnerability assessment.

North Kingstown Comprehensive Community Plan Element	Adaptation Strategy Sector from Chapter 5
Land Use	5.1 – Land Use (LU) 5.12 – Contaminated Sites (CS)
Housing	5.3 – Building Stock (B)
Circulation	5.2 – Transportation and Circulation (TC)
Community Services and Facilities	5.4 – Municipal Properties and Facilities (MP) 5.5 – Emergency Management Facilities (EM) 5.6 – Wastewater (WW) 5.7 – Stormwater (SW) 5.8 – Drinking Water (DW) 5.14 – Vulnerable Populations (VP) 5.15 – Greenhouse Gas Reduction (GR) 5.16 – Utilities and Other Infrastructure (U) 5.17 – Communications (C) 5.18 – Municipal Operations (MO)
Economic Development	5.1 – Land Use (LU) 5.2 – Transportation and Circulation (TC) 5.3 – Building Stock (B)
Natural and Cultural Resources	5.9 – Groundwater (GW) 5.10 – Wetlands (W) 5.11 – Historic and Cultural Resources (HC)
Open Space and Recreation	5.13 – Open Space, Recreation, and Public Access (OS)

4.2. EXPOSED ASSETS IN NORTH KINGSTOWN

After the preliminary mapping was completed as explained in Chapter 3 (and Appendix A), the parcel data was used to further identify which municipal assets, properties, and infrastructure are likely to be exposed to existing and future coastal hazards, including sea level rise scenarios. The tables in this section provide a summary of the data available through the town of North Kingstown's 2009 parcel database and the RI Geographic Information System (RIGIS), and offer a baseline format to update this information as land uses, infrastructure upgrades, or property assessment values change over time.

Each table is organized with columns indicating a different coastal inundation scenario: 1938 Hurricane storm surge level; and one column each for mean higher high water (MHHW) plus 1-foot, 3-foot, and 5-foot sea level rise projections.

The tables are organized into the following categories:

Land use and parcel data, Table 5

This table uses the 2009 North Kingstown parcel database to summarize number of parcels exposed to the coastal inundation scenarios, and breaks them down into groups indicating if the land uses are residential, business, civic, or undeveloped. Additionally, publicly owned properties within each scenario are highlighted, as are the number of properties within the town's historic district.

Building stock, Table 6

Data points from the statewide emergency-911 (e-911) RIGIS database are used to identify occupied structures within the coastal inundation scenarios.

Transportation and circulation, Table 7

Roadways that intersect with the coastal inundation scenarios are highlighted and quantified to provide a summary of linear feet of roadway within each coastal inundation scenario across the town. Bridges, culverts, and RIPTA bus routes were mapped but require additional information to clearly determine the relationship of coastal inundation scenarios to existing conditions.

Infrastructure, public safety and facilities, Table 8

The list of infrastructure included in this table was identified through the process to ensure all public services are considered in long-term municipal adaptation planning. Public works facilities, wastewater infrastructure, public safety locations, and community facilities were identified and a summary of data gaps were noted and/or discussed with stakeholders during the public process to better understand the implications for moving forward with adaptation action planning.

Table 5. Land Use and Parcel Data: exposed assets considering storm and sea level rise simulations created using a GIS-based bathtub model.

Land Use	Coastal Storm Scenario (single event)	Future Sea Level Rise Scenarios (Daily tides)		
Scenario	1938 Hurricane Flood Levels: Mean Higher High Water (MHHW) + 9.5ft	Sea level rise (SLR) at 1 foot above MHHW	SLR at 3 feet above MHHW	SLR at 5 feet above MHHW
Exposed Assets (Properties)*	1564 properties are within or adjacent to the boundary of the storm surge	500 properties are within or adjacent to the boundary of MHHW +1 foot	772 properties are within or adjacent to the boundary of MHHW +3 feet	1041 properties are within or adjacent to the boundary of MHHW +5 feet
Property Categories By Parcel Tax Code*	72% Residential 6% Business 9% Civic 12% Undeveloped 2% Other	63% Residential 7% Business 14% Civic 14% Undeveloped 2% Other	69% Residential 6% Business 10% Civic 13% Undeveloped 2% Other	70% Residential 6% Business 10% Civic 12% Undeveloped 2% Other
Owned by	Publicly Owned Properties*			
Federal	9	6	8	9
State	65	25	28	37
Municipality	27	17	19	21
Total	101	48	55	67
	Historic District Properties Among Exposed Assets*			
Historic District Properties	87	38	64	86
<i>*Refer to Appendix E for property and parcel data for North Kingstown.</i>				

Table 6. Building stock: exposed assets considering storm and sea level rise simulations created using a GIS-based bathtub model.

Building stock	Coastal Storm Scenario (single event)	Future Sea Level Rise Scenarios (Daily tides)		
Scenario	1938 Hurricane Flood Levels: Mean Higher High Water (MHHW) + 9.5ft	Sea level rise (SLR) at 1 foot above MHHW	SLR at 3 feet above MHHW	SLR at 5 feet above MHHW
Exposed Assets (Structures)	649 structures are within or adjacent to the inland boundary of the storm surge	2 structures are within or adjacent to the boundary of MHHW +1 foot	18 structures are within or adjacent to the boundary of MHHW +3 foot	116 structures are within or adjacent to the boundary of MHHW +5 foot
Community Facilities	- Town Hall - Senior Center - Community Center - Quonset Fire Station - Quonset Wastewater Treatment Plant & Pump Station	None	None	Town Hall Annex
Source: RIGIS e-911 data layer; <i>Mapping Assets Vulnerable to Sea Level Rise in North Kingstown, RI</i> , May 2011 http://northkingstown.org/climate-change-adaptation				

Table 7. Transportation and circulation: exposed assets considering storm, and sea level rise simulations created using a GIS-based bathtub model.

Transportation & Circulation	Coastal Storm Scenario (single event)	Future Sea Level Rise Scenarios (Daily tides)		
Scenario	1938 Hurricane Flood Levels: Mean Higher High Water (MHHW) + 9.5ft	Sea level rise (SLR) at 1 foot above MHHW	SLR at 3 feet above MHHW	SLR at 5 feet above MHHW
Exposed Transportation Assets	73,774 linear feet (13.97 miles) of ROADWAY	91 linear feet (< 0.10 of a mile) of ROADWAY	4,463 linear feet (0.85 miles) of ROADWAY	22,009 linear feet (4.17 miles) of ROADWAY
	3,285 linear feet (0.62 miles) of EVACUATION ROUTE	5 linear feet (< 0.10 of a mile) of EVACUATION ROUTE	436 linear feet (< 0.10 of a mile) of EVACUATION ROUTE	1,473 linear feet (0.28 miles) of EVACUATION ROUTE
	7,906 linear feet (1.50 miles) of RAIL	0 linear feet (0 miles) of RAIL	0 linear feet (0 miles) of RAIL	1,309 linear feet (0.25 miles) of RAIL
Source: Inundation Summary Tables, <i>Mapping Assets Vulnerable to Sea Level Rise in North Kingstown, RI</i> , May 2011 http://northkingstown.org/climate-change-adaptation				

Table 8. Infrastructure, Public Safety and Facilities: exposed assets considering storm and sea level rise simulations created using a GIS-based bathtub model.

Infrastructure Public Safety Facilities	Coastal Storm Scenario (single event)	Future Sea Level Rise Scenarios (Daily tides)		
Scenario	1938 Hurricane Flood Levels: Mean Higher High Water (MHHW) + 9.5ft	Sea level rise (SLR) at 1 foot above MHHW	SLR at 3 feet above MHHW	SLR at 5 feet above MHHW
Sewers	The wastewater treatment plant and pump station in Quonset are both within the 1938 Hurricane flood levels, MHHW +9.5-feet. Because North Kingstown did not provide active town sewers prior to the release of this report, it is assumed that the building stock numbers from Table 4-2B can be used to estimate the number of OWTs/ISDS at risk from coastal storms. Future sewer construction is proposed for some areas of North Kingstown where storm surge and/or sea level rise is anticipated (i.e., Wickford Village).			
On-site Wastewater Treatment Systems	649 structures are within or adjacent to the inland boundary of the storm surge. Because North Kingstown does not offer town sewers, it is assumed that this is the estimated number of OWTs/ISDS at risk from coastal storms.	2 structures are within or adjacent to the boundary of MHHW +1 foot. <u>Data need:</u> water table monitoring for future permitting and identification of system engineering requirements. Documentation of cesspools is needed.	18 structures are within or adjacent to the boundary of MHHW +3 foot. <u>Data need:</u> water table monitoring for future permitting and identification of system engineering requirements. Documentation of cesspools is needed.	116 structures are within or adjacent to the boundary of MHHW +5 foot. <u>Data need:</u> water table monitoring for future permitting and identification of system engineering requirements. Documentation of cesspools is needed.
Stormwater Management	Data showing locations of culverts, stormwater catchment areas, drains & outfalls are available but additional assessment data, including spot elevations of culverts and drain/outfall pipes are needed to determine the level of potential exposure and vulnerability of these locations to coastal storms and tidal inundation. Additional data and analysis are needed to assess the extent of flooding in areas where stormwater intersects with coastal inundation scenarios presented in this report. For example, during a extratropical storm “nor’easter” at a time of a lunar high tide, floodwaters may rise to higher elevations when precipitation drains into areas with coastal surge during a high tide. These data were not available at the time of this study.			

Public Safety	The Quonset Fire Station was the only public safety facility identified within the 1938 Hurricane surge area. No police stations, schools, or emergency shelters are located within coastal inundation areas.
Municipal Facilities	As indicated in Table 4-2B, Town Hall, Town Hall Annex, the Senior Center, and Community Center are within a coastal inundation area, but only Town Hall Annex is shown to be vulnerable to the 5-foot sea level rise scenario. There are no libraries or schools located within any coastal inundation scenario, but transportation access to the North Kingstown Free Library and the unoccupied Wickford Elementary School are exposed to future coastal inundation scenarios.
Source: Inundation Summary Tables, <i>Mapping Assets Vulnerable to Sea Level Rise in North Kingstown, RI</i>, May 2011 http://northkingstown.org/climate-change-adaptation	

4.3. STAKEHOLDER AND PUBLIC INPUT

After preliminary analysis of the map data, the planning team shared the results of the map analysis in several public forums within North Kingstown. These public forums were critical to begin “ground-truthing” the maps and identifying data needs and enabling conditions for future adaptation actions.

North Kingstown was chosen as pilot community for adaptation to natural hazards and climate change due to the town’s diversity of landscapes along the coast, as well as an interest by municipal staff and decision makers to explore the potential impacts of climate change and coastal flooding. In addition, the Brown Street municipal parking lot in Wickford Village is flooded with salt water during periodic high tides several times each year and ultimately obstructs parking in the village center. This frequent flooding condition helped raise the issue of climate change impacts and coastal flooding at the forefront for many residents and business owners. Throughout this project, public involvement and stakeholder engagement was viewed as a critical piece of this planning effort. Many meetings, events and presentations were held to both share the process and results of this project and to gather input and feedback (see Table 9). As a result of this emphasis on stakeholder and public involvement, this project was able to:

- Educate and share findings with local decision makers and residents on issues related to hazards from coastal storms and projected sea level rise;
- Ground truth maps with municipal staff, boards and commissions, as well as residents;
- Share maps and adaptation strategies with municipal boards and commissions to inform decision making;
- Hear stories from residents on personal experiences with storm events and extreme high tides;

- Engage in focused roundtable discussions on particular topics of interest (business, property impacts, etc.); and
- Connect project work and findings to everyday life through walking tours, community events and local interest groups.

Table 9. Summary of meetings and events held over the course of this project to engage stakeholders and receive public input into the process.

Municipal Meetings (multiple meetings with each department over course of project)	• North Kingstown Planning Department • North Kingstown Boards & Commissions • Town Council • Planning Commission • Conservation Commission • Historic District Commission • North Kingstown Technical Review Committee • Public Works Department • Engineering Department • Quonset Development Corporation • North Kingstown Chamber of Commerce • Wickford Merchants Association • Wickford Plan Committee
Project Sponsored Events (public & stakeholder focused events to gain input into project)	• Public Presentations & Community Meetings • Public Library Events • Community Center Presentations • Roundtable Discussions • Transportation Roundtable • Natural Systems Roundtable • Business Roundtable • Property Impacts Roundtable • North Kingstown Open House Event • Presentations • Surveys • Tell Us Your Story Questionnaire • Input into Flooding and Sea Level Rise Maps
Special Events (invited presentation and outreach events focused on sharing project process and results)	• Cedarhurst Condominium Association Annual Meeting • North Kingstown Environmental Fair • Wickford Yacht Club • North Kingstown Harborfest
State Agency Reviews (reviewed analysis and adaptation strategy development over the course of the project)	• RI State Agency Climate/Hazard Coordination Group • Project Review by: • RI Coastal Resources Management Council • RI Department of Transportation • RI Division of Planning • RI Emergency Management Agency

4.4. LESSONS LEARNED FROM OTHER PLACES

Since many other communities in the United States are struggling with how to adapt to sea level rise and storm surge, it was important to learn from what others have tried and tailor these strategies for Rhode Island. Many planning processes and adaptation techniques were consulted throughout this project. A few prime examples that helped inform the development of strategies for North Kingstown outlined in Chapter 5 are summarized below.

Table 10. Summary of examples used to inform the North Kingstown Climate Adaptation Project.

Data Sources and Case Examples Examined		Examples Used to Inform the North Kingstown Climate Adaptation Project
Georgetown Climate Center Adaptation Clearinghouse		Searchable clearinghouse of adaptation plans and actions taken around the U.S. http://www.georgetownclimate.org/adaptation/clearinghouse
ICLEI Local Governments for Sustainability		A network of over 1,000 cities, towns and metropolises which develops and shares resources on issues such as climate mitigation and adaption, disaster risk reduction, food security, policy making and financing to help local leaders build resilience at all government levels. http://www.iclei.org/
Case Examples From Around the United States	Annapolis, Maryland	Sea Level Rise Overlay concept paper
	Broward County, Florida	Example of developing a sea level rise overlay/zone. Established an “Adaptation Action Area” or special planning district to focus adaptation best practices in areas most in need of early actions, and create a long-term master plan for this area. Southeast Florida Climate Action Plan http://southeastfloridaclimatecompact.org/
	Boston, Massachusetts	Resilience Checklist for assessing property vulnerability to sea level rise and coastal hazards. Boston’s Climate Plan: http://www.cityofboston.gov/climate/bostonsplan/
	Guilford, Connecticut	Town of Guilford Community Coastal Resilience Plan http://www.ci.guilford.ct.us/pdf/Coastal%20Resilience%20Plan,%20Report%20&%20Options.pdf Options to Increase Coastal Resilience: Management of coastal real estate and structures Building Codes (freeboard, V zone standards in A zones) Acquisition of damaged properties Zoning overlays & amendments Coastal realignments through any of the above Shoreline protection and management of coastal and near - shore lands Buffers for flood protection

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		Land acquisition and/or conservation for tidal marsh migration Roadway alterations, elevation of roadways, abandonment of roads Re - evaluation of emergency routes Alternate egress Vacate properties
	Pacifica, California	Example of managed retreat in vulnerable areas. http://coastalmanagement.noaa.gov/initiatives/shoreline_ppr_retreat.html
	San Francisco, California	Require developers to integrate sea level rise into plans proposed for development or redevelopment. Define a clear municipal review process for all developments proposed within area at risk to sea level rise. http://www.adaptingtorisingtides.org/

In addition to researching other local case examples of climate adaptation initiatives, the Rhode Island Shoreline Change Special Area Management Plan (Beach SAMP, see Section 2.5 of this report) has compiled adaptation strategies and techniques from around the country and the world (e.g. Denmark, the Netherlands, the United Kingdom, etc.) to inform resiliency planning and implementation going forward in Rhode Island. This research also helped to inform the adaptation strategies developed for North Kingstown. Table 11 summarizes the policy, planning and regulatory strategies that incorporate climate adaptation into state or local decision-making and management, as well as physical adaptation strategies that have been applied elsewhere.

Table 11. Summary table of adaptation techniques used in the U.S. and internationally including physical adaptation strategies, as well as policy, planning or regulatory strategies to incorporate climate adaptation into state or local decision-making and management.

Policy and Planning		• Master/Comprehensive Planning or Land Use Plans at State or Local Level • Water Resources Policies, Planning and Management • Special Area Management Plans • Acquisition, Buyouts or Managed Retreat in High-Risk Areas • Incentives for Relocation • Allowing High-Risk Areas to Be Used for Natural Preserves/Open Space • Financial Incentives/Mechanisms to Encourage Risk-Reduction Measures • Building Resilience, Economic/Private Sectors (e.g. Business Contingency Planning) • Local Emergency Permitting Procedures • Adapting Municipal Standard Operating Procedures or Emergency Management and Response Procedures to better deal with changing shoreline conditions
Regulations		• Coastal Zoning or Local Ordinances (e.g. Sea Level Rise Overlay Zones with added criteria or restrictions for development; Areas of Critical Erosion; Downzoning following a storm event) • Coastal Buffers and Buffer Zones • Shoreline Setback and Enforcement • Public Infrastructure Siting Regulations • Design, Construction and Performance Standards for Buildings and Infrastructure • Environmental Impact Assessment Procedures • Rolling and Conservation Easements • Use of vulnerability Assessment Maps in Permitting or Variance Decision Making
Physical Adaptation	Nature-Based Adaptation	• Conservation and Restoration of coastal ecosystems to reduce impact (e.g. Dune Restoration, Wetland or Marsh Creation) • Beach Protection, Nourishment or Creation • Beneficial Use of Dredge Materials (e.g. Beach Nourishment or Wetland/Marsh Accretion) • Stormwater Management Through Rain Gardens/Green Infrastructure Techniques • Reef Building or Restoration to Counteract Wave Action (e.g. oyster reefs)

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		• Designated Control Flooding Areas (e.g. farmland in the floodplain that is purposefully allowed to flood) • Beach grading for a more dissipative slope
	Engineered Adaptation	• Dykes • Geo-textile flood walls • Tide or flood gates • Hurricane Barriers • Fortifying, Raising or Elongating Existing Shoreline Hardening Structures • Retrofitting Building/Infrastructure (e.g. Elevating, Breakaway Walls, Flood Vents) • Multi-Purpose Floodwater Retention or Reservoirs (e.g. Courtyards & Underground Parking Garages that Store Flood Waters) • Natural Fiber Sand Filled Coir Logs to Stabilize Shoreline
	Hybrid (Nature-based & Engineered) Adaptation	• Living Shorelines • Hardened Shoreline Protection Plus Beach Nourishment

These strategies and techniques used elsewhere were reviewed and their applicability to North Kingstown was examined. Ultimately, these examples provided a starting off point from which the adaptation strategies developed for North Kingstown (provided in Chapter 5). Extensive stakeholder engagement across many North Kingstown departments helped to further refine the adaptation strategies and provide more detailed actions most fitting for the town.

5. Municipal Adaptation Strategies by Sector

“SIMILAR TO INDIVIDUAL BRICKS THAT MAKE UP A WALL, RHODE ISLAND NEEDS TO START IMPLEMENTING SITE-SCALE SOLUTIONS IN OUR CITIES AND TOWNS THAT BUILD INCREMENTALLY, SO OUR STATE AS A WHOLE IS MORE RESILIENT TO COASTAL HAZARDS.”

GROVER FUGATE, EXECUTIVE DIRECTOR, RHODE ISLAND COASTAL RESOURCES MANAGEMENT COUNCIL

The strategies presented in this chapter offer North Kingstown a menu of options in response to the science and data presented in this report for both short-term storm surge/coastal flooding events as well as longer-term sea-level rise projections that can be considered for incorporation into plans, regulations, municipal operations, and local decision-making processes to ultimately result in a more resilient coastal environment. These are recommended strategies based on emerging state regulations, “no regrets” approaches to planning, and best practices explored elsewhere in the United States that focus on protecting public health, safety and welfare. Many of the strategies listed below will be most effective with rigorous coordination with state, regional, and non-governmental organization (NGO) partners in Rhode Island. North Kingstown is encouraged to consider these strategies voluntarily as it moves forward with future projects, updates its Comprehensive Community Plan, zoning regulations and Hazard Mitigation Plan, but also should be aware that state regulations may someday require the town to adopt one or more of these strategies.

North Kingstown is encouraged to review each of the items below and consider its potential for implementation and/or incorporation into planning and budgeting processes. It is recognized that many suggestions below will require careful consideration and public review at the local level, as well as a thorough investigation into the differing implications of storm surge versus incremental sea level rise, the design life of infrastructure at risk, the costs/benefits of implementing design or management solutions, and legal issues, especially those regarding the individual rights of property owners in town. Additionally, it will be important for town staffers and officials to continue coordination with state partners to identify specific triggers or catalysts that may require the town to consider different or new solutions or strategies in the face of future natural hazard events.

5.1. LAND USE

What are the concerns with land use and natural hazards in North Kingstown?

- Public health, safety and welfare is at risk within coastal flood zones, and development within these areas may increase potential losses with storm events.

- Structures in high hazard areas could contribute to the volume of debris during and after storm events.
- Maintaining/reconstructing buildings or infrastructure in high hazard areas is costly, and may not be financially sustainable over the long term.
- Property taxes collected by the municipality on coastal properties could be compromised if the structures are damaged and abruptly removed from municipal tax rolls. Conversely, coastal properties tend to have higher property values resulting in larger tax revenues for the town.
- Flood insurance premiums collected on properties in the Special Flood Hazard Area are likely to increase in the future, therefore the overall cost of owning a coastal property is likely to increase.

Potential land use-related adaptation strategies for consideration:

LU1. When revising the town's Future Land Use Map in the next Comprehensive Community Plan rewrite or in future updates, direct high-density development away from flood-prone areas, and implement use restrictions within the Special Flood Hazard Area (SFHA) as well as in coastal areas projected to be inundated by future sea level rise scenarios.

LU2. Create a Sea Level Rise Overlay Zone in a defined area along the coast of North Kingstown, applying guidance from other places in the U.S. who have explored this concept, such as Maryland and Florida. This overlay would require future development or site plans to show how new land uses and structures will address flooding from projected sea level rise scenarios and coastal storm surge (i.e. debris management, removal requirements of damaged/abandoned structures, etc.) over the design-life of that land use or structure. The boundary of this Sea Level Rise Overlay zone could be set at Mean Higher High Water (MHHW) plus 5-feet of sea level rise in the near term, based on the current CRMC Sea Level Rise Policy (Section 145 of RI Coastal Resources Management Plan) and establish a process to reexamine the science and estimated timeframes for sea level rise projections to maximize protection of assets and public safety within this area. For more information on where this concept is emerging, please see examples from [Maryland](http://dnr.state.md.us/ccs/publications.asp)¹⁴ and [Florida](http://southeastfloridaclimatecompact.org/)¹⁵.

LU3. As this Sea Level Rise Overlay concept is addressed by the town staff and decision makers, it will be important to consider many factors, including: (1) how incremental sea level rise in the future may impact the boundaries of the coastal zone, property rights, and jurisdictional setbacks, such as the CRMC jurisdiction, which is set at 200-feet inland from the coastal high water mark; (2) If the town wants to limit or prohibit change of permitted development and use, or expansion of uses within the SLR overlay zone; (3) How regulations may need to be changed or strengthened to protect public health, safety, and welfare before or after future storm events; (4) Municipal operations to manage post-storm rebuilding, and how the building code & zoning regulations relate; (5) How to best track information and data

¹⁴ <http://dnr.state.md.us/ccs/publications.asp>

¹⁵ <http://southeastfloridaclimatecompact.org/>

on the financial tradeoffs and any legal questions, particularly related to property rights and takings.

LU4. Coordinate with RICRMC and RIDEM to establish clear and consistent setback requirements for new development changes in land use from inland boundaries of projected sea level rise scenarios or salt marsh migration areas for any structure proposed within the SFHA.

LU5. Explore the feasibility of structuring a Purchase of Development Rights (PDR) program specific to the SFHA to reduce density in the flood-prone areas of town and the potential to offer qualified property owners a “buyout option”. While North Kingstown has implemented a Transfer of Development Rights (TDR) program, considering a similar strategy for coastal areas is more complex than a traditional TDR for protecting inland farmland properties. Coastal properties tend to have higher assessed values than inland properties, and desirable/unique features that are not found inland. Consideration of a TDR program for coastal areas, however, should continue to be addressed with state agency, university, and NGO partners in future years as shifts in the coastal real estate market are noted, and/or coastal neighborhoods sustain damage from future storm events and express desires to relocate to another area in town.

LU6. In order to reduce long-term financial losses during storm events as well as volume of debris that could cause damage to adjacent properties or municipalities in Rhode Island, evaluate policy options (i.e., PDR, downzoning, or TDR) for properties in coastal hazard areas and conduct a feasibility assessment/cost-benefit analysis to phase out or reduce density of coastal properties determined to be at risk from frequent inundation with future sea level rise scenarios. (EXAMPLE: [Managed Coastal Retreat Case Studies in California](#)¹⁶)

LU7. Require developers to present preliminary design plans illustrating they have accounted for sea level rise projections and required setbacks from the inland boundaries of these areas for any parcels proposed for development or redevelopment. (EXAMPLE: [San Francisco Bay Conservation and Development Commission](#)¹⁷)

LU8. Define a clear municipal review process for all developments proposed within the Sea Level Rise Overlay Zone, following RIGL Section 45-23-35. Require that preliminary development proposals exceeding a threshold defined by the town, within the SFHA be reviewed in an interagency pre-application meeting of the Town staff and state agency permitting/technical staff (i.e. RICRMC, RIDEM, RIEMA, etc.) before a full development plan is submitted to the town. (EXAMPLE: [San Francisco Bay Conservation and Development Commission](#)¹⁸)

LU9. Provide property owners within the SFHA options and incentives for establishing proactive voluntary recorded easements on their properties to dedicate the land on their property as “coastal wetland migration areas,” where identified on state SLAMM maps.

¹⁶ http://coastalmanagement.noaa.gov/initiatives/shoreline_ppr_retreat.html

¹⁷ <http://www.adaptingtorisingtides.org/>

¹⁸ <http://www.adaptingtorisingtides.org/>

LU10. For areas of North Kingstown with municipal services that are vulnerable to sea level rise scenarios, consider the cost of maintaining this infrastructure and the feasibility of enacting a special tax district (similar to a fire district or sewer district) or impact fee assessed to the users of the vulnerable infrastructure or municipal services to cover cost of emergency response, future armoring, or otherwise flood-proofing these areas over the long term.

LU11. Define tax incentives for property owners who voluntarily implement and document accepted measures for their parcel and structure to be more resilient to storm impacts and projected sea level rise.

LU12. Update Wickford Village Plan to apply adaptation strategies and require future neighborhood plans to evaluate and address adaptation strategies. Require that these plans clearly address all natural hazards and address potential impacts from storm surge and incremental effects from projected sea level rise scenarios.

LU13. Evaluate all vacant and undeveloped properties within the SFHA for their potential to be merged with adjacent parcels in order to maintain open space within the SFHA. Maintaining and preserving open space within the flood zones reduces the assets exposed to coastal flooding, minimizes the volume of debris distributed during storm events, and adds to the town's FEMA Community Rating System score.

LU14. Establish a defined "Adaptation Action Area" special planning district in town to focus adaptation best practices in areas most in need of early actions, and create a long-term master plan for this area. (EXAMPLE: [Southeast Florida Climate Action Plan](#)¹⁹) Test this strategy in specific study areas and apply policies in a pilot study to test the SLR overlay concept and identify the aspects of the overlay that are easily implementable, "no regrets", versus those that might be challenging from a legal or enforcement perspective. Address the potential to implement Low-Impact Development, green infrastructure, total maximum daily load (TMDL) management, groundwater protection, and CRMC's 200-foot setback jurisdiction within the SLR overlay.

LU15. Explore options for long-term managed retreat of properties and neighborhoods exposed or vulnerable to damage from natural hazards or flooding from storm events or projected sea level rise. Continue coordinating with state agencies and educational institutions to identify new or innovative strategies that have been successfully implemented in other places. (EXAMPLE: [Managed Coastal Retreat Case Studies in California](#)²⁰)

5.2. TRANSPORTATION & CIRCULATION

What are the concerns with transportation and natural hazards in North Kingstown?

- Evacuation routes within coastal high hazard areas in Wickford are projected to be partially inundated with future sea level rise scenarios, and likely will be impassable during storm events with high levels of surge or inundation onshore.

¹⁹ <http://southeastfloridacclimatecompact.org/>

²⁰ http://coastalmanagement.noaa.gov/initiatives/shoreline_ppr_retreat.html

- The overall safety of the transportation system connecting neighborhoods and commercial centers to evacuation routes have the potential to be disrupted.
- Bridges will be under increased stress and perhaps structurally undermined from rising sea levels and flood events.
- Culverts connecting stormwater systems to tidal systems could be overwhelmed and increase flooding of roadways.
- Stormwater drainage flow will likely be impeded by higher tides with rising sea levels, resulting in an increase of temporary flooding where streams or stormwater basins intersect with tidal inundation.
- Before public funds are spent to upgrade any transportation infrastructure in town, whether through the state Transportation Improvement Program (TIP) or the municipal Capital Improvement Program (CIP), North Kingstown has an opportunity to ensure that funds are spent wisely on solutions that are designed to be resilient to storm surge events as well as projected sea level rise scenarios.

Potential transportation-related adaptation strategies for consideration:

- TC1. Identify strategies for upgrades or improvements to the segments of identified evacuation routes that are identified as being inundated by rising sea levels and storm surge.
- TC2. Specifically, pursue planning feasibility studies and design strategies for the two vulnerable evacuation routes leading into and out of Wickford Village to ensure all residents in adjacent neighborhoods have safe and reliable methods of evacuation before storm events and are able to return to their properties immediately following storms.
- TC3. For each state road currently or potentially impacted by a sea level rise or coastal flooding scenario, include and prioritize these roads for inclusion on the state Transportation Improvement Program (TIP). Evaluate each project to determine the priority and design requirements to meet transportation goals for evacuation, service to densely populated areas or commercial districts, and for those areas where alternate routes are limited or not available.
- TC4. Coordinate closely with RIDOT to evaluate long-term strategies for the segments of state roads in North Kingstown that are projected to be inundated by rising sea levels, and consider impacts from dynamic storm events that could result in erosion of the roads base material and supporting drainage infrastructure.
- TC5. For town roads that intersect sea level rise scenarios identified in Chapter 5 of this plan, evaluate the long-term viability of town roads that are projected to be inundated by two high tides per day. Develop feasibility assessments and cost estimates for priority areas to determine what would be required to redesign and maintain this infrastructure over clearly defined planning horizons of at least 20 years or longer to address the design life of specific structures being considered. For alternate routes that are identified in these efforts, define a strategy to maintain and monitor these alternate routes for average daily traffic numbers to

ensure the roads are meeting the demand over the long term. Coordinate all prioritized projects on the state TIP and incorporate those activities in the municipal CIP.

- TC6. Invest in a cost-benefit or tradeoff analysis for each town road identified and prioritized for improvements in Chapter 5 of this plan to determine the long-term costs of maintaining or reconstructing each road, against the tax revenues generated by all the properties contained in the road's service area. Document the cost of maintaining this infrastructure and explore the feasibility of enacting a special tax district (similar to a fire district or sewer district) or impact fee assessed to the users of the roadway. Require that this be addressed each year in the municipal Capital Improvement Program (CIP).
- TC7. Restrict development of new roads in areas experiencing coastal erosion, as well as in areas projected to be inundated from sea level rise by 2100. Evaluate zoning, construction costs and long-term maintenance costs of any new roads or access drives proposed for parallel alignment along the existing coastline. Maintain roads that are perpendicular to the coast, offering access to Narragansett Bay, and design the area of the road within flood zones to withstand periodic flooding from storms and increased frequency of flooding resulting from projected sea level changes.
- TC8. Work with RIDOT and Quonset Development Corporation to monitor the stability of the surface and foundation materials for the bike path in Davisville, and include provisions for any segments of the path that are directly or indirectly impacted by projected sea level rise scenarios or coastal flooding.
- TC9. Coordinate closely with Quonset Development Corporation and the Army National Guard to assess the need for improvements at Quonset airport to prevent or mitigate flood damage from coastal storms.
- TC10. Coordinate closely with Quonset Development Corporation to assess need for improvements along the rail lines within Quonset Business Park to prevent or mitigate flood damage from stormwater runoff and coastal storms.
- TC11. Continue to implement all actions defined within the town's Hazard Mitigation Plan, "Strategy for Reducing Risks From Natural Hazards in North Kingstown, RI", including: town Roads and streets (Keep roads passable during a hazard event and extreme tides).

5.3. BUILDING STOCK

What are the concerns with building stock and natural hazards in North Kingstown?

- Concern about the long-term viability of properties intersecting areas where sea levels are projected to increase, and the ability of owners to safely inhabit these properties.
- Concern over the town's ability to provide municipal services to properties that are projected to be inundated with future sea level rise, or subject to periodic flooding from storm events.
- Options that have previously been available to coastal property owners, such as hardening the shoreline, may not be feasible over the long term.

- Elevating or otherwise storm-proofing coastal structures could be a successful strategy to reduce losses and protect public health, safety, and welfare, but the town's zoning policies, along with the state building code, must support these efforts.
- Historic properties within the coastal high hazard area are likely to have restrictions that could make it more difficult to protect these structures from coastal flooding.

Potential building stock-related adaptation strategies for consideration:

- B1. For parcels identified in the risk assessment as within the sea level rise areas (or Sea Level Rise Overlay Zone, as described in Section 5.1, LU2) at MHHW + 1-foot, +3-feet, and +5-feet, evaluate the long-term viability of properties within the SFHA and projected sea level rise areas. Notify the property owners of parcels within these areas of the town-wide sea level rise vulnerability assessment, and establish procedures to apply long-term maintenance plans for their individual properties and related structures, including clear triggers or indicators that action is needed when future storm events or projected sea level rise could cause flooding on their parcel. In addition, maintain a separate database of building permits and elevation certificates for all properties within the SFHA and the projected sea level rise areas, or flag these properties as part of these zones.
- B2. Building on experience from other Rhode Island municipalities (i.e. Town of Westerly), and state agencies (i.e. CRMC), implement an emergency permit process in North Kingstown to expedite permit approvals for predetermined repairs or reconstruction immediately following a storm event. In addition, work closely with state agency partners to define, evaluate, and communicate rebuilding restrictions in these areas.
- B3. Create incentives for homeowners to elevate their homes and offer clearly defined and enforceable height variances if the elevation of the structure will exceed the local maximum height restriction. Model this process after North Kingstown's existing "modification permit" allowed under zoning section 21-18. Require property owners to evaluate other weatherization criteria as a condition of the permit to maximize protection of their property from natural hazards.
- B4. For new construction throughout North Kingstown, create a weatherization requirement as well as incentives for builders to design and build structures that are resilient to storm impacts both within and outside of flood zones. Create incentives for developers of new structures to design buildings with freeboard above Base Flood Elevation (BFE), beyond requirements of the RI State Building Code (BFE+1 foot). In coordination with private sector stakeholders (Rhode Island Builders Association, private insurers, etc.) explore incentive programs that highlight the tradeoff between increased freeboard in construction projects and savings on insurance premiums.
- B5. For existing structures on parcels in the SFHA and the Sea Level Rise Overlay Zone, define areas that fall within these categories: Protection Zones that may be hardened to prevent or minimize floodwater intrusion, Accommodation Zones that are designed to be temporarily flooded with a high tide or storm event, Preservation Zones that have an established management plan for natural or cultural resource preservation, and consider future Retreat Zones that have a master plan for managed retreat of structures and residents permanently out of the area (Grannis,

2011) Link each of these categories to a defined post-disaster rebuilding program with the town and state agencies.

- B6. Consider creating local incentives and guidelines for property owners who voluntarily elevate a structure above requirements of the RI State Building Code (BFE+1 foot). or otherwise flood-proof their property so as to not unfairly penalize property owners who are investing in their parcels to meet the goals of climate resilience in North Kingstown. These incentives could include waiving the building permit fee(s) at the time of application/approval, or clearly-defined tax credits at the time of improvement to ensure owners are credited for their investment in their property to meet resiliency goals as the value of the property increases after improvements are made.
- B7. Coordinate with the State Historic Preservation Officer and the local Historic District Commission to provide resources and design standards for owners of historic homes or homes within historic districts who may desire to elevate or otherwise flood-proof their property or structure. Direct the local Historic Preservation Committee to ensure North Kingstown is able to maintain the integrity of its historic district while becoming more resilient.
- B8. Coordinate with Rhode Island Emergency Management Agency (RIEMA) and owners of properties that are categorized as repetitive loss properties to consider long-term options for flood-proofing, elevating, or relocating the structures. Offer property owners updates and training related to changes or amendments to the local Flood Insurance Rate Maps (FIRMs) and the National Flood Insurance Program (NFIP).
- B9. Within the SFHA, require or incentivize new development to meet standards for certified disaster-resilient structures (i.e., IBHS's FORTIFIED or U.S. Department of Homeland Security Resilience STAR programs).
- B10. Consider requiring the building official or other municipal staff to become certified inspector/evaluator for a resiliency program that rates new construction projects based on techniques that result in improved resilience to hazards. The Insurance Institute for Business and Home Safety (IBHS) offers a suite of programs that seek to reduce risks from natural hazards through its [FORTIFIED Program](http://www.disastersafety.org/fortified)²¹.
- B11. Participate in the US Department of Homeland Security [Resilience STAR](http://www.disastersafety.org/resilience-star/)²² pilot program that seeks to build and retrofit homes to be more disaster resistant.

5.4. MUNICIPAL PROPERTIES & FACILITIES

What are the concerns with municipal properties and natural hazards in North Kingstown?

- Several publicly-owned properties are within both the existing special flood hazard area and projected future sea level rise scenarios.

²¹ <http://www.disastersafety.org/fortified>

²² <http://www.disastersafety.org/resilience-star/>

- Before any future public funds are spent on developments within the special flood hazard area, consideration of exposure to natural hazards must take place to protect public health, safety, and welfare.

Potential municipal property/facility-related adaptation strategies for consideration:

- MP1. Require future construction of town-owned facilities within the projected sea level rise areas to demonstrate how the project will address flooding from storm surge events and projected sea level rise, and evaluate existing public lands and structures within the SFHA for function and design life resiliency to storm surge events and incremental sea level rise.
- MP2. Maintain a database with record of flood impacts on municipal properties and structures.
- MP3. Prepare long-range plans for all municipal properties and related structures that are identified as potentially inundated under future sea level rise scenarios or coastal flood conditions, implementing a variety of strategies outlined throughout this report, as appropriate.
- MP4. Continue to implement all actions defined within the town's Hazard Mitigation Plan, "Strategy for Reducing Risks From Natural Hazards in North Kingstown, RI", including: Town Hall (investigate vulnerability and retrofit, post-disaster relocation); Town Hall Annex (investigate vulnerability and retrofit, post-disaster relocation); Senior Center, Cold Spring Community Center, Art Association Building (investigate vulnerability and retrofit); North Kingstown Free Library (investigate vulnerability and retrofit, protect library resources); and Highway Department Facilities Building (contain hazardous materials).

5.5. EMERGENCY MANAGEMENT FACILITIES

What are the concerns with emergency management facilities and natural hazards in North Kingstown?

- North Kingstown's residents expect municipal emergency responders to be both proactive and reactive to hazards that pose a threat to the town's neighborhoods, commercial areas, and public facilities.
- Emergency management facilities must support public health, safety, and welfare across North Kingstown, while preventing unnecessary exposure of facilities or staff to unsafe conditions prior to, during, and after storm events.
- Mandatory evacuations of residents in high hazard areas must be clearly communicated and enforced to prevent first responders from unnecessarily being put in harm's way.

Potential emergency management facility-related adaptation strategies for consideration:

- EM1. Require future construction of emergency management facilities within SFHA and projected sea level rise areas to demonstrate how the project will address flooding from projected future sea level rise and storm surge events (See also, MP1).

- EM2. Continue to implement all actions defined within the town's Hazard Mitigation Plan, "Strategy for Reducing Risks From Natural Hazards in North Kingstown, RI", including: evacuation routes (evacuation route markers, maintain viable evacuation routes, publish evacuation routes, coordinate evacuation plans with neighboring towns); emergency shelters; town Emergency Operations Center and Public Safety Complex; town fire stations; Rhode Island Air and Army National Guard; and post-disaster plans (Debris Management Plan, Recovery and Reconstruction Ordinance)
- EM3. Employ a town-wide emergency communications system, such as reverse 911, to notify residents of required and recommended actions before, during, and after storms. Ensure vulnerable coastal neighborhoods receive proper communications before, during, and after storms.

5.6. WASTEWATER

What are the concerns with wastewater and natural hazards in North Kingstown?

- Septic systems in the special flood hazard area have been damaged during past storm events, and could continue to be compromised during and after future storm or flood events, risking contamination of properties and water bodies, and limiting occupation of the structure.
- The new sewer/wastewater treatment system proposed for the North Kingstown proposes pipelines and pump stations within the special flood hazard area and projected sea level rise boundaries.
- The decision to sewer neighborhoods or commercial centers in the special flood hazard area should be made with storm surge and sea level rise impacts in mind as the design-life of the infrastructure is considered and maintenance costs are calculated for the life of the system.

Potential wastewater-related adaptation strategies for consideration:

- WW1. For areas that are susceptible to storm surge and projected sea level rise, evaluate the long-term viability of maintaining OWTS in these areas and if installing sewers are a feasible option over the long-term. Consider the stability of Onsite Wastewater Treatment Systems (OWTS) during storm surge events, and the number of systems that are currently within the boundaries of sea level rise projections.
- WW2. Maintain a record or database of damage and/or improvements of OWTS in the SFHA and consider long-term viability of OWTS systems on properties that are projected to be inundated by sea level rise scenarios over the design life of the system.
- WW3. Review the Wastewater Management Plan phases for sewer construction proposals in North Kingstown and evaluate potential impacts of coastal flooding, storm surge events, and sea level rise scenarios.
- WW4. Incorporate sea level rise conditions into the decision making process to build sewers within the SFHA and proposed Sea Level Rise Overlay. Conduct a feasibility assessment and cost-benefit analysis

- WW5. Implement a periodic review of permits for OWTS systems on repetitive loss properties and/or on parcels that are within the projected sea level rise scenario areas.
- WW6. In coordination with RIDEM, evaluate any Total Maximum Daily Load (TMDL) issues in Narragansett Bay related to OWTS systems within the SFHA.
- WW7. Investigate new technologies for toilets (i.e., low-flow, composting toilets, or “eco-toilets”) that could be installed in public facilities or in private residences that reduce the volume of water required and waste output.
- WW8. Continue to implement all actions defined within the town’s Hazard Mitigation Plan, “Strategy for Reducing Risks From Natural Hazards in North Kingstown, RI”, including: QDC Wastewater Facility (investigate vulnerability and retrofit as necessary); Town Sewage Pumping Facilities (shutting off service, flood-proofing, emergency pumping); Town Sewer Lines. For properties within the proposed Sea Level Rise overlay,
- WW9. Coordinate with RIDEM to locate new/repared OWTS beyond the projected 30 year sea level rise scenarios and identify strategies for homeowners to take action and make informed decisions regarding the long-term viability of their OWTS system.

5.7. STORMWATER MANAGEMENT

What are the concerns with stormwater management and natural hazards in North Kingstown?

- Stormwater drainage flow will be impeded by higher tides with rising sea levels, resulting in an increase of temporary flooding where streams or stormwater basins intersect with tidal inundation.
- Culverts connecting stormwater systems to tidal systems could be overwhelmed and increase flooding of roadways
- Maintenance and evaluation of the stormwater management system across town will be critical to identify and design proactive, long-term solutions for future stormwater management problems.
- New technologies promoting “green infrastructure” solutions are available and could be applied to increase stormwater infiltration upstream and reduce runoff.

Potential stormwater management-related adaptation strategies for consideration:

- SW1. Create a database of storm drains in town that are located within the projected sea level rise scenarios and monitor during flood events and/or extreme high tides.
- SW2. Pursue funding for a comprehensive stormwater management study for Wickford Village, and focus efforts on identifying strategies to increase infiltration in the drainage basins/watersheds. Direct drainage to areas for stormwater to be contained, treated, and directed to recharge groundwater. Require that Low Impact Development (LID) standards and techniques are built into development requirements to facilitate stormwater management.

- SW3. Pursue funding to develop a green infrastructure strategy for Wickford Village to manage both stormwater volumes and pollutant transport during and after storm events, while ensuring the strategies are designed to account for storm surge events as well as projected sea level rise scenarios, and are evaluated regularly to update the design-life of the system. Through this, explore the feasibility of replacing standard stormwater outlet pipes within the SFHA with green infrastructure improvements. As defined by the [U.S. Environmental Protection Agency](#)²³, green infrastructure “...is an approach that communities can choose to maintain healthy waters, provide multiple environmental benefits, and support sustainable communities. Unlike single-purpose gray stormwater infrastructure, which uses pipes to dispose of rainwater, green infrastructure uses vegetation and soil to manage rainwater where it falls. By weaving natural processes into the built environment, green infrastructure provides not only stormwater management, but also flood mitigation, air quality management, and much more.”

5.8. DRINKING WATER

What are the concerns with drinking water and natural hazards in North Kingstown?

- The town’s water delivery system provides drinking water to many homes within the special flood hazard area; it is important to ensure the integrity of these systems are not compromised by salt water intrusion from storm events or projected sea level rise.
- Properties with private wells must be monitored to ensure the water source does not become contaminated by salt water from changing coastal conditions, including sea level rise and coastal erosion.

Potential drinking water-related adaptation strategies for consideration:

- DW1. Evaluate town water lines within the SFHA and projected sea level rise areas for long-term viability.
- DW2. Encourage coordination between the town water department, RIDEM, and the RI Department of Health to establish procedures for well monitoring for sodium and other pollutants that might contaminate water supplies on individual properties within the SFHA and proposed Sea Level Rise Overlay Zones.
- DW3. Continue to implement all actions defined within the town’s Hazard Mitigation Plan, “Strategy for Reducing Risks From Natural Hazards in North Kingstown, RI”, including: All town and QDC wells (Protect town wells from flood waters, Protect the Town water supply from contamination and drought); and the Water Distribution System

5.9. GROUNDWATER

What are the concerns with groundwater and natural hazards in North Kingstown?

- While many properties within the SFHA in town didn’t experience overland flooding during “Superstorm Sandy” in 2012, several properties did report groundwater seepage into their basements, pointing to a need to better understand the groundwater dynamics from storm surge events and projected future sea level rise scenarios.

²³ <http://water.epa.gov/infrastructure/greeninfrastructure/>

- As the water table is likely to rise in coastal areas from increasing sea levels, onsite wastewater treatment system's leaching fields may not have adequate porous soil in which to discharge leachate from the system, thereby compromising the treatment of wastewater effluent.

Potential groundwater-related adaptation strategies for consideration:

- GW1. Compile data from local OWTS permits for properties within projected sea level rise areas to better understand groundwater systems in areas exposed to coastal flooding and projected sea level rise, and maintain a record of damage or impacts after coastal flood events or other tidal inundation.
- GW2. Maintain record of properties within the SFHA and proposed Sea Level Rise Overlay Zone that report groundwater seepage into their basements.
- GW3. Coordinate with state and federal entities, as well as academic institutions, to encourage study and research into the groundwater dynamics in coastal neighborhoods, and the impacts of storm surge and incremental sea level rise on the water table in neighborhoods and overall groundwater systems. Explore the impact of coastal flooding and sea level rise on the viability of long-term residences and support facilities (OWTS, water distribution systems) in exposed neighborhoods, and identify contamination concerns.

5.10. WETLANDS

What are the concerns with wetlands and natural hazards in North Kingstown?

- Coastal wetlands / tidal salt marshes are important ecosystems that provide habitat for wildlife forage, nesting, nursery, and offer migratory stopovers for birds; serve as a carbon sink; clean water by trapping sediments that would otherwise make their way into coastal waters; and absorbs erosional energy from storm events by reducing wave height.
- Rhode Island has lost 53% of its salt marshes over the last 200 years due to man-made alterations (i.e., ditching and filling), resulting in a loss of approximately 4,000 acres statewide (Bromberg and Bertness, 2005)

Potential wetland-related adaptation strategies for consideration:

- W1. Using the Sea Level Affecting Marshes Model (SLAMM) maps produced by RI CRMC, the University of Rhode Island, and The Nature Conservancy for North Kingstown (NOTE, these maps will be finalized in 2014), define applicable policies, regulations, and strategies that could be incorporated within municipal operations to manage salt marsh migration areas. This could include prioritizing areas for future conservation by the town or local land conservancy, or providing clear actions or policies for homeowners to meet the goals set forth in the town and state initiative to protect Rhode Island's salt marsh complexes.
- W2. Where property owners may have limitations on expansion, rebuilding, or options to sell parts of their land projected to be future wetland areas, prioritize these areas for focus by municipal staff, boards, land trusts and other conservation groups. Use partnerships to identify strategies to work in coordination with property owners to protect these areas. Consider other models for similar land use incentive programs, such as the Farm and Open Space Tax Abatement Program.

- W3. Incorporate sea level rise projections and salt marsh migration data into criteria for acquisition, easements, protection and restoration. In coordination with state agencies, NGOs, and local conservation groups, establish targets for defining natural buffers around wetland complexes, promote and advance use of appropriate vegetation for transition zones, encourage use of native species and control of invasive species in and around wetland complexes, and protect migration corridors for wildlife.
- W4. Work with state and non-governmental organization (NGO) partners to develop management plans which could include easements, acquisition, preservation, restoration, or management for tidal wetlands to preserve the ecological integrity and functionality of the natural systems. Work with state agencies and NGO partners to identify restoration opportunities to ensure long term viable habitats, including the local Land Conservancy, The Nature Conservancy, North Kingstown's Conservation Commission, Save the Bay, and the Narragansett Bay Estuarine Research Reserve.
- W5. Identify new areas for conservation in North Kingstown that provide an ecosystem services function. Evaluate ecosystem services to reduce impacts from flooding and increase habitat function, terrestrial and aquatic, for marine fisheries and water quality and implement conservation actions.
- W6. Create a checkbox on development plan/site plan review applications for wetlands when property owners submit an application to develop, redevelop, or propose additions to their parcel. Require owners to verify if: (1) Wetlands exist on their property; and (2) if there property intersects a projected salt marsh migration area as indicated in CRMC's SLAMM maps.

5.11. HISTORIC & CULTURAL RESOURCES

What are the concerns with historic and cultural resources and natural hazards in North Kingstown?

- North Kingstown's historic district is concentrated in Wickford, and the majority of the district is within the SFHA. With the threat of increased coastal flooding and projected sea level rise scenarios, this district will continue to be in harm's way.
- Owners of historic properties are in need of guidance to assist them with the long-term management of their property, balancing the preservation of the structure's historic integrity with protection of the property from future flood damage.

Potential historic and cultural resource-related adaptation strategies for consideration:

- HC1. Maintain a database of parcels within North Kingstown's Historic District, the SFHA, and within the projected sea level rise areas to monitor impacts to these areas and coordinate with property owners on potential strategies to protect historic assets in town.
- HC2. Coordinate with the State Historic Preservation Officer (SHPO), the Rhode Island Historic Preservation and Heritage Commission (RIHPHC) and the municipal Historic District Commission (HDC) to identify funding and resources to assist owners of historic buildings to

flood-proof or elevate their property while preserving the historic integrity of the property and district.

- HC3. Establish local incentives and guidelines for historic property owners who voluntarily propose to elevate a structure above BFE or otherwise flood-proof their property so as to not unfairly penalize owners of historically-significant properties who are actively working to meet the goals of climate resilience in North Kingstown. These incentives could include waiving fee(s) at the time of application/approval, up to providing clearly-defined tax credits at the time of improvement to allow owners to be credited for their investment in their property as the value of the property increases after improvements are made. Require the tax assessor to define an assessment process that incentivizes historic property owners to make improvements, and credits these actions over a defined time period.

5.12. CONTAMINATED SITES

What are the concerns with contaminated sites and natural hazards in North Kingstown?

- The stability of capped landfills located in Allen's Harbor and Calf Pasture Point may be compromised with future storm events and projected sea level rise, thereby risking release of waste materials into Narragansett Bay.

Potential contaminated site-related adaptation strategies for consideration:

- CS1. Coordinate with state and federal agencies to monitor the stability of the landfills at Allen's Harbor and Calf Pasture Point and work with state and NGO partners to assess short-term risk from storm events and long-term risk from projected sea level rise.

5.13. OPEN SPACE, RECREATION, & PUBLIC ACCESS

What are the concerns with open space/recreation/public access and natural hazards in North Kingstown?

- Public access to North Kingstown's shoreline may be impeded with future sea level rise scenarios.
- Recreational facilities, including public parks, boat launches, moorings, and support facilities may be altered by flooding from storm surge events or future sea level rise scenarios.
- Acquisition of properties within the special flood hazard area could serve a dual purpose to preserve open space within coastal flood zones while providing recreational opportunities for residents.

Potential open space/recreation/public access-related adaptation strategies for consideration:

- OS1. Maintain a database of open space parcels, public parks, boat launches, and beaches within the SFHA and projected sea level rise areas to monitor impacts to these areas from storm events and incremental sea level rise, and develop strategies to preserve the availability of these areas for continued public use in town.

- OS2. Encourage open space in surge area by evaluating existing unbuilt vacant properties and work with partners to acquire/purchase/establish perpetual easements.
- OS3. Incorporate sea level rise projections and data into criteria for acquisition, easements, protection and restoration of open space, recreation, and public access areas. (See also W3 above.)
- OS4. Continue to implement all actions defined within the town's Hazard Mitigation Plan, "Strategy for Reducing Risks From Natural Hazards in North Kingstown, RI", including: Town Harbors and Moorings (storm preparedness plan, Wickford Harbor breakwater); Town Beach, concession and restrooms (beach maintenance), Ryan Park, Rome Point, Wilson Park, Cocumscussoc State Park, and Calf Pasture Point (fire protection), and the Municipal Golf Course (investigate vulnerability to storms and sea level rise and retrofit).

5.14. VULNERABLE POPULATIONS

What are the concerns with vulnerable populations and natural hazards in North Kingstown?

In addition to the responsibility of the municipality to protect public health, safety, and welfare of its residents, the town's Hazard Mitigation Plan clearly prioritizes protecting coastal neighborhoods, commercial districts, elderly housing, mixed-income housing, schools, and day care centers from hazards.

Potential vulnerable population-related adaptation strategies for consideration:

- VP1. Continue to implement all actions defined within the town's Hazard Mitigation Plan, "Strategy for Reducing Risks From Natural Hazards in North Kingstown, RI", including:
 - Coastal neighborhoods: Open space acquisition; Volunteer disaster assistance program; Building code compliance enforcement; Hazard mitigation in Technical Review Committee meetings; Hazard Mitigation web page; Evacuation of tourists; Reduce and manage storm water; Post-disaster hazard mitigation opportunities; Encourage OWTS upgrades
 - Wickford commercial districts: Business continuation; Protection of repetitive flood loss properties
 - Elderly housing: Protecting coastal facilities; Ensuring the safety of elderly housing and nursing homes; Elderly and handicapped residents
 - Wickford Village housing: Protecting Wickford Village housing from flooding and storm surge
 - North Cove Landing, Intrepid Drive : Protect housing from flooding and storm surge
 - Town Schools: Protecting schools in the flood zone; Safety procedures for school children; Post-disaster relocation
 - Day Care Centers: Protecting day-care centers in the flood zone

- VP2. Ensure vulnerable coastal populations receive proper communications before, during, and after storms and are aware of evacuation procedures, location of shelters, and transportation options. Vulnerable populations, for the purpose of this report, includes all residents of the categories listed in VP1.
- VP3. Target communications and outreach efforts to low- to moderate-income populations, densely populated neighborhoods, condominium complexes, multi-family properties, and renters to be appropriately informed of municipal procedures. Require all owners of rental properties to include this information in the lease agreements with tenants, and encourage condominium associations to inform residents in annual meetings or through collection of annual fees.

5.15. GREENHOUSE GAS REDUCTION (CO₂ MITIGATION)

What are the concerns with greenhouse gas reduction and natural hazards in North Kingstown?

The State of Rhode Island participates in the Regional Greenhouse Gas Initiative (RGGI), and while this currently does not require municipalities to comply with state goals, North Kingstown has the opportunity to “lead by example” and consider implementing energy efficiency measures to reduce greenhouse gas emissions at the municipal scale.

Potential greenhouse gas reduction-related adaptation strategies for consideration:

- GR1. Encourage reduction of carbon emissions in North Kingstown through improved transportation efficiency, reduction of traffic congestion, encouragement of alternative transportation options (rail, bike, pedestrian infrastructure), and implementation of an anti-idling ordinance for trucks, buses, and other vehicles.
- GR2. Integrate green building strategies into existing municipal facilities, and require green building standards as defined by the U.S. Green Building Council (USGBC) for future construction and/or building retrofits.
- GR3. Coordinate with the Rhode Island Office of Energy Resources (RI OER) and the University of Rhode Island Energy Center to explore alternative energy solutions, including solar, wind and hydropower, and energy efficiency techniques for all municipal operations. Consider optimal locations in town to install electric vehicle support infrastructure.

5.16. UTILITIES & OTHER INFRASTRUCTURE

What are the concerns with utilities and natural hazards in North Kingstown?

Electrical grid and communications infrastructure are imperative for operations before, during, and after storm events, and can compromise public safety when systems are damaged or otherwise offline.

Potential utility-related adaptation strategies for consideration:

- U1. Continue to implement all actions defined within the town’s Hazard Mitigation Plan, “Strategy for Reducing Risks From Natural Hazards in North Kingstown, RI”, including: Dams: (dam inspection and classification); Town Bridges, with and without utilities (bridge inspection; emergency procedure for gas lines running on bridges (Hussey Bridge, Brown Street Bridge); emergency procedure for water lines running on bridges; Electric Utility Lines

and Facilities (tree trimming); Wind Energy Systems and Meteorological Tower; Phone Lines and Cell Towers (protecting land line phone service); Wickford / Boston Neck Road Service Station (contain hazardous materials, Investigate vulnerability and retrofit).

- U2. Coordinate with National Grid to evaluate power lines and other electrical grid infrastructure (transformers, underground or over-bridge utilities) within the SFHA and projected sea level rise areas, and develop an action plan to define the design life of this infrastructure and strategies to either harden existing facilities to withstand effects of natural hazards, including wind and storm surge, or relocate vulnerable facilities to areas less exposed to these hazards.

5.17. COMMUNICATIONS

What are the concerns with communications and natural hazards in North Kingstown?

Facilitating community preparedness and response is dependent on maintaining open channels of communications between emergency managers, first responders, town staff, and the residents of North Kingstown, and ensuring municipal staff, emergency responders, and related officials are well-trained and stay current on emerging trends that can be efficiently relayed to the public.

Potential communication-related adaptation strategies for consideration:

- C1. Ensure all North Kingstown residents receive proper communications before, during, and after storms and projected sea level rise scenarios, and are aware of evacuation procedures, location of shelters, and transportation options. Consider implementing new methods of notification through reverse-911 alert system, smartphone technology, e-mail or social media to target specific neighborhoods and harder-to-reach residents.
- C2. For parcels identified within the sea level rise areas at MHHW + 1-foot, +3-feet, and +5-feet, contact the property owners and ensure they are notified of the assessment and work with them to establish long-term management plans for their individual properties. Provide outreach to property owners on best practices.
- C3. Coordinate with RIEMA to offer property owners updates and training related to changes or amendments to the local Flood Insurance Rate Maps (FIRMs) and the National Flood Insurance Program (NFIP).
- C4. Require the building official and tax assessor to remain informed of any policy changes related to coastal hazards and national trends. Establish a mechanism to transfer this information to property owners so they are well informed of any changes to their property rights and property values.
- C5. Coordinate with relevant state agencies and educational institutions to provide outreach to property owners on best practices and latest techniques supported by state and local regulatory authorities.
- C6. Require the town include an annual update/progress report of parcel, road, stormwater, OWTS, sewers, historic/cultural resources, open space and recreation impacts from climate change or flooding from storm events or other tidal inundation in the town's Annual Report, and address any shifting priorities or criteria that result from lessons learned in each fiscal year.

5.18. MUNICIPAL OPERATIONS

What are the concerns with municipal operations and natural hazards in North Kingstown?

Municipal regulations and standard operating procedures all serve to protect the public health, safety, and welfare of North Kingstown's citizens. Ensuring the town staff, boards, and commissions are well-informed and kept up-to-date on emerging strategies to address changing conditions will result in a sustainable program that promotes community resilience.

Potential municipal operations-related adaptation strategies for consideration:

- MO1. Integrate adaptation strategies presented in this chapter into daily municipal operations and Standard Operating Procedures within multiple town departments, particularly in Public Works, Planning, and Code Enforcement.
- MO2. Require each department in town government to contribute their activities to an annual update/progress report of parcel, road, stormwater, OWTS, sewers, historic/cultural resources, open space and recreation impacts from climate change or flooding from storm events or other tidal inundation in the town's Annual Report, and address any shifting priorities or criteria that result from lessons learned in each fiscal year.
- MO3. Require that municipal board and commission members participate in some form of annual training for hazard mitigation and coastal resilience to ensure consistent code enforcement and continued implementation of hazard mitigation and climate adaptation actions.
- MO4. Require ongoing staff training, particularly the planning director, building official and tax assessor, to remain informed and up to date on any policy changes related to coastal hazards and national trends.
- MO5. Require all municipal Capital Improvement Program projects be evaluated for exposure to storm surge and projected sea level rise, and work with state to include this evaluation its review process for state Transportation Improvement Program (TIP) projects in coastal areas. Ensure all projects address impacts from storm events, upland flooding, and coastal storm surge scenarios, as well as sea level rise projections and overall SFHA resilience.
- MO6. Continue North Kingstown's involvement in FEMA's Community Rating System (CRS). Ensure staff time is dedicated for maintenance of the town's rating in the CRS program and continue to implement actions to achieve a lower CRS rating to secure increased savings on flood insurance rates for all property owners in North Kingstown.
- MO7. Maintain a database of building permits for all properties as well as roadways within the SFHA and the projected sea level rise areas and review for surge impacts annually and after each major storm event. Update GIS to include SLR scenarios and database of parcels and roadways within each scenario.
- MO8. Maintain a database of impacts and costs and monitor public expenditures on adaptation-related projects to assess effectiveness and impacts. Require the finance director to evaluate the impact of storm-related structural losses on local municipal tax revenues in the annual budget, and communicate this in a meeting with town council.

- MO9. Evaluate the municipal development plan review procedures, the site plan review process and zoning variance parameters related to properties within SFHA and sea level rise areas to formalize adaptation strategies and implementation actions into local regulations. Update as appropriate when new revised state policies are adopted (i.e., from the Beach SAMP process).
- MO10. Evaluate the Sea Level Rise Overlay Zone recommendation to determine if the Sea Level Rise Overlay should be a stand-alone overlay zone or included in the SFHA. This will require coordination among the Planning Department, Planning Commission, RIEMA, and possibly RICRMC.
- MO11. Update the Hazard Mitigation Plan and Comprehensive Community Plan with best available science as updates or rewrites as guided by state agencies, academic institutions, and through the Governor’s Executive Council on Climate Change.
- MO12. Explore inter-jurisdictional partnerships and regional support either through the Washington County Regional Planning Commission Council of Governments or local watershed councils.
- MO13. Work with state government to promote adoption of a “Fortified” program that rates new construction projects based on techniques that result in improved resilience to hazards. The Insurance Institute for Business and Home Safety (IBHS) offers a suite of programs that seek to reduce risks from natural hazards through its [FORTIFIED Program](http://www.disastersafety.org/fortified)²⁴.
- MO14. Explore opportunities for implementing or testing solutions through grant-supported pilot programs that can then inform public policy and private investment. Encourage state leaders to continue conversations with lending institutions and insurance agencies to ensure municipalities can stay current on impact of natural hazards on mortgages and property insurance, including flood insurance. Explore the financial implications if the lending institutions or insurance agencies drop policies or programs to support property owners.

²⁴ <http://www.disastersafety.org/fortified>

6. Neighborhood Analysis and Prioritization

“YOU CAN PAY NOW, OR YOU CAN PAY LATER. AND IF YOU CHOOSE TO PAY LATER, THE PRICE IS GOING TO BE VERY, VERY HIGH.”

PROFESSOR JOHN KING, URI GRADUATE SCHOOL OF OCEANOGRAPHY, WWW.RICLIMATECHANGE.ORG

Recognizing that the severity of impacts posed by natural hazards and climate change will vary based on location within the town, and that the priority of adaptation actions will be based on the implications to lives, infrastructure and property, a neighborhood analysis and prioritization process was conducted in North Kingstown, focusing on vulnerable neighborhoods, parcels and roadways. While Chapter 5 describes adaptation strategies by municipal sector, this chapter describes how different neighborhoods and business districts in North Kingstown are impacted from projected future tidal inundation, storm surge, and flooding and prioritize transportation improvement projects. The methodology presented here may be applied to other infrastructure assets, such as stormwater infrastructure and other municipal services, to prioritize areas in need of upgrade, maintenance, or longer-term management practices.

6.1. IDENTIFICATION OF NEIGHBORHOOD STUDY AREAS IN NORTH KINGSTOWN

Using the “bathtub model” sea level scenarios to identify the parcels and roadways included within the projected tidal limits, the town was separated into 12 Study Areas (see **Figure 4** and **Table 12**) to better understand the specific conditions and concerns within each area of town, and conduct a prioritization exercise to determine which areas of town have the most assets at risk within the various scenarios. Study areas were not delineated based on size, but rather to represent an area (e.g. neighborhood, historic or business district) where it made sense to examine impacts and adaptation strategies as a whole. In addition, by tailoring the study area sizes to a neighborhood or district, existing neighborhood or stakeholder groups within those areas can be involved long term to facilitate focused and efficient communications and community input for implementing adaptation strategies.

Detailed maps of each neighborhood study areas are found in Appendix D. Each study area has seven (7) maps illustrating the FEMA Flood Insurance Rate Map categories and extents, and three sea level rise scenarios with an identification of the parcels/roadways exposed to these conditions.

Figure 4. North Kingstown study areas.

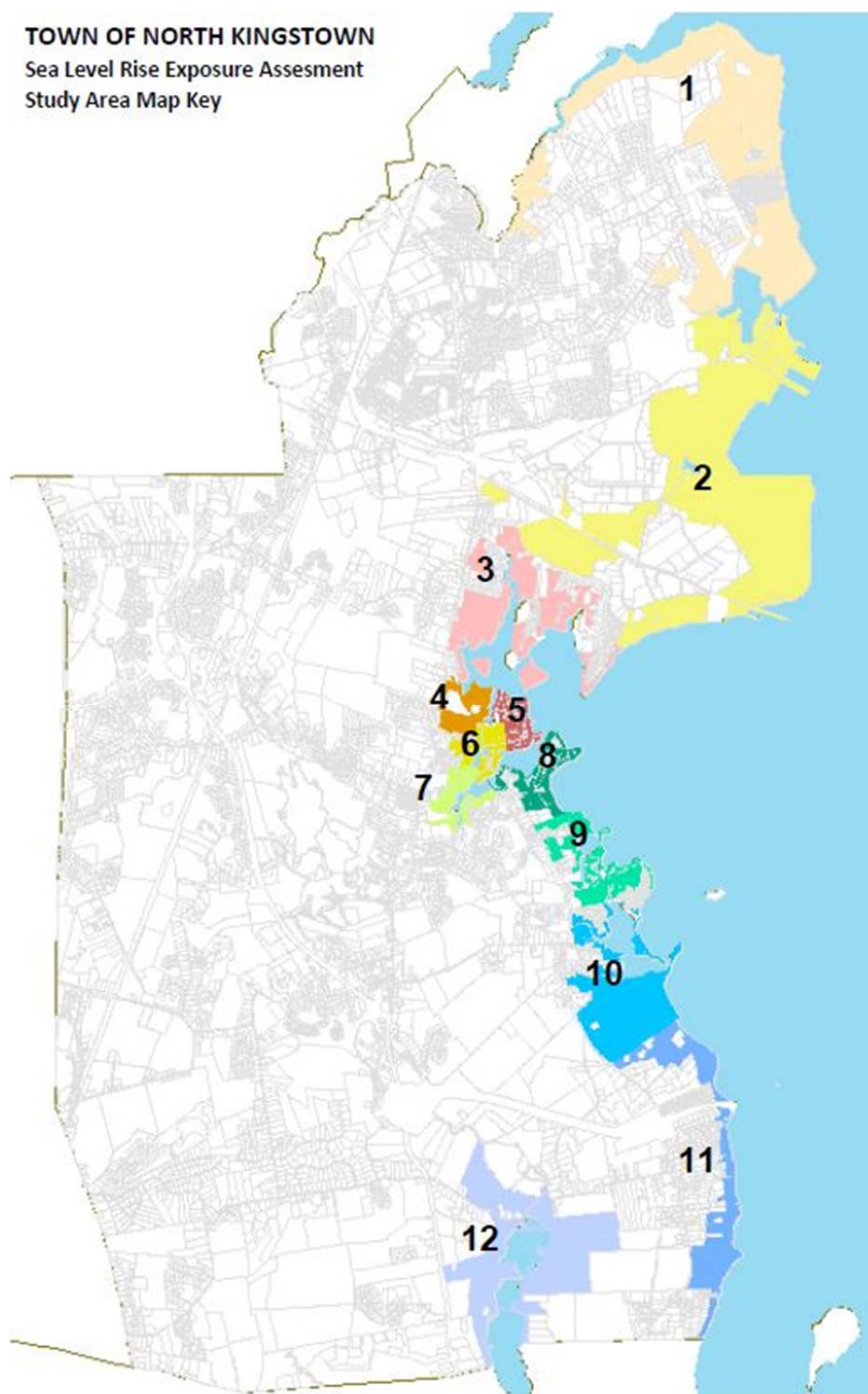


Table 12. Description of 12 Study Areas defined for sea level rise assessment²⁵

Study Area #	Study Area Name	Zoning Classifications of parcels within SLR areas	Streets w/Parcels within SLR areas	Description
1	Pojac Point / Mount View	Residential (NR, PPR, RR, VR) Waterfront Business (WB) Open Space (OS)	Atlantic Ave Davisville Rd N. Quidnessett Rd Sunnybrook Dr	These neighborhoods lie along the northernmost coastline of North Kingstown.
2	Quonset / Davisville	Business (GB, WB) Industrial (GI, LI, WI) Public (P) Post Road District (PR) Planned Village Development (PVD) Residential (VR) Open Space (OS)	Camp Ave Davisville Rd Macnaught St Roger Williams Way	Quonset Development Corporation manages this industrial/port complex of statewide significance. It is bounded inland by a mix of residential and commercial development.
3	Mill Cove / Shore Acres	Residential (VR, NR, MFR) Business (WB) Industrial (WI) Public (P) Post Road District (PR) Planned Village Development (PVD) Open Space (OS)	Camp Ave Fishing Cove Road Richard Smith Dr Sauga Ave Seabreeze Dr Shore Acres Ave Walnut Rd Wickford Point Rd	This residential area sits along the north side of Wickford Cove, bounded to the north by Quonset Industrial Park.
4	Intrepid Drive	Residential (VR) Planned Village Development (PVD) Open Space (OS)	Intrepid Drive	This mixed-income residential area is accessed from Post Road. A town-owned boat launch/fishing area site offers public access to Wickford Cove and Narragansett Bay.
5	Wickford Historic	Residential (VR) Business (WB) Industrial (GI) Public (P)	Bay St Church Lane Enfield Ave Esmond Ave Fowler St Main St Ocean Ave Pleasant St Washington St	North Kingstown's Historic District is concentrated in this study area. Colonial-era homes and water-dependent businesses co-exist in this peninsula connected to Wickford Village Center.
6	Wickford Commercial	Residential (VR) Business (GB) Wickford Village Center (WVC) Public (P)	Boone St Brown St Church Lane Elam St Main St Phillips St West Main St	Wickford is an iconic New England waterfront village that offers a mix of retail/commercial, residences, marinas, and water dependent business. Wickford Village is a destination for locals and visitors and home to notable special events, such as the Wickford Art Festival.

²⁵ Please see Appendix D for maps of each neighborhood study area.

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7	Phillips / Loop	Residential (VR) Public (P)	Atherton Ave Boone St Loop Drive Phillips St	This area sits to the south of Wickford Village and includes the old Wickford Elementary School. Salt marshes adjacent to the Phillips/Loop intersection have prevented gaps in the residential and commercial development along this corridor.
8	Poplar Point	Residential (VR) Business (WB) Public (P) Open Space (OS)	Beach St Boston Neck Rd Concord Ave Lawton Ave Lexington Ave Oakland Ave Poplar Ave Reynolds St Steamboat Ave Wright Lane	This residential neighborhood is on a peninsula just to the north of North Kingstown Town Beach that serves as a boundary between Narragansett Bay and Wickford Cove. Several marinas are located on the northwest edge of this neighborhood.
9	Duck Cove / Earle Drive	Residential (VR)	Boston Neck Road Buena Vista Dr Clinton Dr Duck Cove Rd Earle Dr Elm Dr Johnson Ave Russell Dr Waldron Ave William St Winsor Ave	This residential neighborhood is located to the south of North Kingstown Town Beach and is characterized by residential development on peninsulas surrounded by salt marsh complexes. Two main roadways, Earle Drive and Waldron Avenue, provide vehicular access to these neighborhoods.
10	Hamilton / Bissell Cove	Residential (VR, VLDR, MFR) Business (NB) Industrial (GI) Open Space (OS)	Bates Ave Boston Neck Rd Terre Mar Dr Waldron Ave Web Ave Winsor Ave Worsley Ave	This residential neighborhood is bounded by Route 1A to the west, and organized around Bissel Cove. It includes a mix of single-family homes and condominiums, and several large tracts of land just to the south of Bissel Cove.
11	Plum Point / Plum Beach	Residential (VR, LDR, NR) Open Space (OS)	Boston Neck Rd Riptide Dr	This stretch of residential properties and open space sits to the north and south of Route 138 and the approach to the Jamestown Bridge.
12	Gilbert Stuart / Walmsley Lane	Residential (RR, VLDR) Public (P) Open Space (OS)	Gilbert Stuart Rd	This residential and open space area sits along the Narrow River, which is a estuarine ecosystem with its inlet to Narragansett Bay located to the south of the North Kingstown municipal boundary with the town of Narragansett. It is the only inland area in North Kingstown influenced by tidal waters.

6.2. PRIORITIZATION OF NEIGHBORHOODS

For each of the study areas described above, the tax assessment information was compiled for the parcels that are expected to intersect with the sea level scenarios outlined in Chapters 3 and 4. The parcels included within each of the 12 study areas were identified through a conversation with the town planning staff, and are meant to offer a broad snapshot of the relative values of property within each area of North Kingstown that is expected to be inundated with salt water twice a day, every day, under future sea rise scenarios. The following table provides the property values within each neighborhood study area:

Table 13. Assessed property value of parcels exposed to sea level rise.

Assessed property value of parcels exposed to projected sea level rise scenarios by Study Area							
Source: 2009 North Kingstown Property Tax Assessment data from GIS Parcel Database							
Study Area #	Study Area Name	Sea level rise (SLR) at 1 foot above MHHW (linear feet)		SLR at 3 feet above MHHW (linear feet)		SLR at 5 feet above MHHW (linear feet)	
		QTY	Assess Value (\$)	QTY	Assess Value (\$)	QTY	Assess Value (\$)
1	Pojac Point / Mount View	48	\$ 82,658,725.00	54	\$ 86,258,625.00	68	\$ 91,474,625.00
2	Quonset / Davisville	32	\$ 124,344,720.00	39	\$ 142,729,920.00	57	\$ 177,176,620.00
3	Mill Cove / Shore Acres	84	\$ 64,846,660.00	138	\$ 101,968,230.00	181	\$ 127,382,480.00
4	Intrepid Drive	1	\$ 3,420,900.00	2	\$ 3,442,100.00	4	\$ 3,696,200.00
5	Wickford Historic	58	\$ 40,331,500.00	95	\$ 61,017,400.00	129	\$ 78,383,000.00
6	Wickford Commercial	47	\$ 27,375,900.00	63	\$ 34,335,500.00	107	\$ 54,474,000.00
7	Phillips / Loop	39	\$ 13,117,100.00	49	\$ 16,715,100.00	54	\$ 17,949,800.00
8	Poplar Point	39	\$ 44,462,700.00	67	\$ 69,956,200.00	103	\$ 87,454,200.00
9	Duck Cove / Earle Drive	46	\$ 25,814,600.00	98	\$ 54,106,800.00	150	\$ 74,003,000.00
10	Hamilton / Bissell Cove	46	\$ 19,998,670.00	69	\$ 28,947,370.00	79	\$ 32,666,270.00
11	Plum Point / Plum Beach	24	\$ 40,862,870.00	56	\$ 69,327,470.00	14	\$ 81,525,270.00
12	Gilbert Stuart / Walmsley Lane	32	\$ 19,052,790.00	38	\$ 22,747,990.00	65	\$ 23,428,490.00
TOTAL		496	\$ 506,287,135.00	768	\$ 691,552,705.00	1011	\$ 849,613,955.00

These values represent a snapshot of the study area values and can be multiplied by the property tax rates to further understand how much the town of North Kingstown collects from these areas in

property taxes. The costs of municipal services to these areas can also be evaluated by the town staff and decision makers to better understand if long term investment in these neighborhoods makes fiscal sense in the municipal capital improvement plan, or if special tax districts may be needed long term to support infrastructure to high hazard areas.

Using a similar approach, the roadway segments that intersect the sea level rise scenarios were identified and quantified for each of the neighborhood study areas to begin understanding the relationship of future sea water patterns to the coastal transportation network in North Kingstown. These roadway segments are illustrated in the Study Area maps contained in Appendix D.

Table 14. Roadway segments exposed to sea level rise.

Roadway segments exposed to projected sea level rise scenarios (linear feet) by Study Area					
Study Area #	Study Area Name	TOTAL (linear feet)	Sea level rise (SLR) at 1 foot above MHHW (linear feet)	SLR at 3 feet above MHHW (linear feet)	SLR at 5 feet above MHHW (linear feet)
1	Pojac Point / Mount View	1,332.57	-	-	1,332.57
2	Quonset / Davisville	2,994.53	-	-	2,994.53
3	Mill Cove / Shore Acres	227.78	5.08	48.27	227.78
4	Intrepid Drive	281.70	-	0.33	281.70
5	Wickford Historic	4,863.48	-	977.00	4,863.48
6	Wickford Commercial	2,720.78	32.95	515.35	2,720.78
7	Phillips / Loop	1,793.31	-	482.62	1,793.31
8	Poplar Point	3,860.26	-	969.90	3,860.26
9	Duck Cove / Earle Drive	2,895.16	-	849.38	2,895.16
10	Hamilton / Bissell Cove	899.92	-	521.14	899.92
11	Plum Point / Plum Beach	180.45	48.00	69.03	180.45
12	Gilbert Stuart / Walmsley Lane	53.92	4.56	29.76	53.92
TOTAL		22,103.87	90.59	4,462.78	22,103.87

The linear feet of road segments identified above were then analyzed to determine all state and municipal transportation infrastructure exposed to sea level rise in each of the 12 Study Areas, summarized in Table 14.

Table 15. Transportation infrastructure impacted by sea level rise in each study area.

Study Area #	Study Area Name	Streets w/Parcels w/in SLR areas	Transportation Network Within SLR areas STATE INFRASTRUCTURE	Transportation Network Within SLR areas MUNICIPAL INFRASTRUCTURE
1	Pojac Point / Mount View	Atlantic Ave Davisville Rd N. Quidnessett Rd Sunnybrook Dr	<i>No state infrastructure affected by SLR scenarios in this area.</i>	Bike Path from Davisville to Calf Pasture Point/ Mount View neighborhood Southwest corner of Mount View neighborhood
2	Quonset / Davisville	Camp Ave Davisville Rd Macnaught St Roger Williams Way	Roger Williams Way & Zarbo Avenue – serving businesses at southernmost point in Quonset Development Park Quonset Airport Railroad corridors	Patrol Road at northernmost point at Davisville / Little Allens Harbor
3	Mill Cove / Shore Acres	Camp Ave Fishing Cove Road Richard Smith Dr Sauga Ave Seabreeze Dr Shore Acres Ave Walnut Rd Wickford Point Rd	<i>No state infrastructure affected by SLR scenarios in this area.</i>	Rogers Street to the west of Shore Acres Ave, serving fewer than six residential parcels
4	Intrepid Drive	Intrepid Drive	<i>No state infrastructure affected by SLR scenarios in this area.</i>	Intrepid Drive Boat Launch
5	Wickford Historic	Bay St Church Lane Enfield Ave Esmond Ave Fowler St Main St Ocean Ave Pleasant St Washington St	Intersection of West Main Street / Brown Street / Main Street provides the only ingress/egress to this neighborhood. No alternate routes are available into or out of this area.	Fowler Street provides only access to properties at Esmond and Enfield Avenues. Washington Street and its connectors to Main Street are almost completely inundated under the 5-foot sea level rise scenario.

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Study Area #	Study Area Name	Streets w/Parcels w/in SLR areas	Transportation Network Within SLR areas	Transportation Network Within SLR areas
			STATE INFRASTRUCTURE	MUNICIPAL INFRASTRUCTURE
6	Wickford Commercial	Boone St Brown St Church Lane Elam St Main St Phillips St West Main St	West Main Street is an evacuation route and one of three routes providing access into Wickford Village. Brown Street Bridge is exposed within the 1-foot sea level rise scenario and was overtopped during Superstorm Sandy in 2012. Intersection of West Main Street / Brown Street / Main Street provides the only ingress/egress to the Wickford Historic neighborhood. No alternate routes are available into or out of this area. Intersection of Phillips Street / Route 1A and the Hussey Bridge are exposed at the 5-foot sea level rise scenario.	Newtown Street provides access approximately 10 parcels, and the intersection of Newtown and West Main Street is inundated in the 3-foot sea level rise scenario.
7	Phillips / Loop	Atherton Ave Boone St Loop Drive Phillips St	Phillips Street is an evacuation route and one of three routes providing access into Wickford Village. Phillips Street is exposed to the 3-foot sea level rise scenario in several locations from the intersection of Loop Drive eastward to the Hussey Bridge.	Loop Drive provides access to fewer than 20 residences across Wickford Cove. Ingress/egress to these residences will be exposed in the 3-foot sea level rise scenario. No alternate route is available for these residents. Boone Street provides access to the North Kingstown Free Library and the neighborhood to the north of Phillips Street. An alternate route is available to residents for evacuation through the road network that connects to Route 1 to the west.

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Study Area #	Study Area Name	Streets w/Parcels w/in SLR areas	Transportation Network	Transportation Network
			Within SLR areas STATE INFRASTRUCTURE	Within SLR areas MUNICIPAL INFRASTRUCTURE
8	Poplar Point	Beach St Boston Neck Rd Concord Ave Lawton Ave Lexington Ave Oakland Ave Poplar Ave Reynolds St Steamboat Ave Wright Lane	<i>No state infrastructure affected by SLR scenarios in this area.</i>	The intersection of Steamboat Avenue and Wright Lane provides the only access into and out of the Poplar point neighborhood. This intersection is exposed in the 5-foot scenario. Local roads in the northeastern section of Poplar Point are exposed to 3-feet of sea level rise at the intersection of Lexington and Concord Avenues.
9	Duck Cove / Earle Drive	Boston Neck Road Buena Vista Dr Clinton Dr Duck Cove Rd Earle Dr Elm Dr Johnson Ave Russell Dr Waldron Ave William St Winsor Ave	<i>No state infrastructure affected by SLR scenarios in this area.</i>	Earle Drive provides access to 64 residences along Narragansett Bay. Access to these residences will be exposed in the 3-foot sea level rise scenario. No alternate route is available for these residents. Intersection of Waldron Avenue and Clinton Drive is exposed in the 5-foot sea level rise scenario. Access to the residences to the east of this intersection will potentially be affected. No alternate route is available for these residents.
10	Hamilton / Bissell Cove	Bates Ave Boston Neck Rd Terre Mar Dr Waldron Ave Web Ave Winsor Ave Worsley Ave	<i>No state infrastructure affected by SLR scenarios in this area.</i>	Only roadways that dead end at the edge of Bissell Cove are exposed to sea level rise.
11	Plum Point / Plum Beach	Boston Neck Rd Riptide Dr	<i>No state infrastructure affected by SLR scenarios in this area.</i>	<i>No municipal infrastructure affected by SLR scenarios.</i>
12	Gilbert Stuart / Walmsley Lane	Gilbert Stuart Rd	<i>No state infrastructure affected by SLR scenarios in this area.</i>	The Walmsley Lane URI Boat Launch is exposed to future sea level rise but this does not intersect with any ingress/egress to parcels in this area.

Using this list of projected impacts, a prioritization process was conducted by asking a series of eight (8) questions related to: impacts to evacuation routes; state or local road segments; barriers to ingress/egress; the number and value of parcels impacted; and if there are impacts to historic districts or public facilities. A listing of the 8 evaluation criteria are provided in Table 16. These questions were developed in conjunction with North Kingstown municipal staff. Every 'yes' response would receive a

value of one, and the study area with the largest total score was given the greatest priority. Moreover, because the impact to evacuation routes, ingress/egress and public facilities was determined to be especially important, these 3 questions were given double weight compared to the other questions within the list, therefore an answer of ‘yes’ to any of these questions would receive a score of 2 instead of 1.

Table 16. Evaluation criteria used to prioritize study areas by transportation vulnerability.

NORTH KINGSTOWN STUDY AREA PRIORITIZATION EXERCISE EVALUATION CRITERIA DESCRIPTIONS	
Each Category is structured for a yes/no response – YES receives a value of (1), NO receives a value of (0)	
(1) Evacuation Route Impacted by Sea Level Rise (SLR) scenario.	Does any part of a documented evacuation route intersect a sea level rise scenario? <i>***received double weight due to importance***</i>
(2) State Roads impacted by 1' OR 3' SLR.	Do any segments of state roadways intersect the 1-foot or 3-foot sea level rise scenario?
(3) State Roads impacted by 5' SLR.	Do any segments of state roadways intersect the 4-foot or 5-foot sea level rise scenario?
(4) Local Roads impacted by 1' OR 3' SLR >0.1mi.	Are more than 0.1 miles of local roads in a given study area intersected by the 1-foot or 3-foot sea level rise scenario?
(5) Local Roads impacted by 5' SLR >0.1mi.	Are more than 0.1 miles of local roads in a given study area intersected by the 4-foot or 5-foot sea level rise scenario?
(6) Barrier to Ingress/Egress.	Do any sea level rise scenarios intersect with roadways and cause blocked access to that area without an alternate route available? <i>***received double weight due to importance***</i>
(7) Historic District Impacted.	Is there a historic district designated in this study area?
(8) Public Facilities Impacted.	Are there publicly owned facilities in this study area? <i>***received double weight due to importance***</i>

The full results of this prioritization are summarized in Appendix C and illustrate that the highest priority areas based on transportation system vulnerability are:

Table 17. Results: Priority study areas by transportation vulnerability.

SCORE	North Kingstown neighborhood study areas
10	Wickford Commercial – Study Area 6
7	Wickford Historic – Study Area 5 Phillips Street / Loop Drive – Study Area 7
4	Poplar Point – Study Area 8 Duck Cove / Earle Drive – Study Area 9
1	Pojac Point / Mount View – Study Area 1 Quonset / Davisville – Study Area 2 Hamilton / Bissell Cove – Study Area 10
0	Mill Cove / Shore Acres – Study Area 3 Intrepid Drive – Study Area 4 Plum Point / Plum Beach – Study Area 11 Gilbert Stuart / Walmsley Lane – Study Area 12

6.3. TRANSPORTATION PRIORITIES

Using the prioritization described in Section 6.2, the following transportation improvement projects related to state roads were identified for recommendation to the Rhode Island Department of Transportation- Transportation Improvement Program (see Table 18).

Table 18. Recommended Transportation Projects for the State Transportation Improvement Program

Study Area	Recommended Projects for the State Transportation Improvement Program
Wickford Commercial- Study Area 6	- West Main Street is an evacuation route and one of three routes providing access into Wickford Village. - Brown Street Bridge is exposed within the 1-foot sea level rise scenario and was overtopped during Superstorm Sandy in 2012. - Intersection of West Main Street / Brown Street / Main Street provides the only ingress/egress to the Wickford Historic neighborhood. No alternate routes are available into or out of this area. - Intersection of Phillips Street / Route 1A and the Hussey Bridge are exposed at the 5-foot sea level rise scenario.
Wickford Historic- Study Area 5	Intersection of West Main Street / Brown Street / Main Street provides the only ingress/egress to this neighborhood. No alternate routes are available into or out of this area.
Phillips/Loop- Study Area 7	Phillips Street is an evacuation route and one of three routes providing access into Wickford Village. Phillips Street is exposed to the 3-foot sea level rise scenario in several locations from the intersection of Loop Drive eastward to the Hussey Bridge.
Quonset/Davisville- Study Area 2	- Roger Williams Way & Zarbo Avenue – serving businesses at southernmost point in Quonset Development Park. - Evaluate all critical infrastructure for the operations of Quonset Airport. - Study railroad corridors within Quonset to withstand flooding from stormwater runoff and ensure protection from flooding from future sea level rise or storm events.

6.4. CAPITAL IMPROVEMENT CONSIDERATIONS

Using the prioritization described in Section 6.2, the following transportation improvement projects related to local roads were identified for recommendation for consideration through the North Kingstown Capital Improvement Program (see Table 19).

Table 19. Recommended transportation projects for the Town of North Kingstown Capital Improvement Program.

Study Area	Recommended Projects for the Town of North Kingstown Capital Improvement Program
Wickford Commercial- Study Area 6	Newtown Street provides access approximately 10 parcels, and the intersection of Newtown and West Main Street is inundated in the 3-foot sea level rise scenario.
Wickford Historic- Study Area 5	- Fowler Street provides only access to properties at Esmond and Enfield Avenues. - Washington Street and its connectors to Main Street are almost completely inundated under the 5-foot sea level rise scenario.
Duck Cove / Earle Drive- Study Area 9	- Earle Drive provides access to 64 residences along Narragansett Bay. Access to these residences will be exposed in the 3-foot sea level rise scenario. No alternate route is available for these residents. - Intersection of Waldron Avenue and Clinton Drive is exposed in the 5-foot sea level rise scenario. Access to the residences to the east of this intersection will potentially be affected. No alternate route is available for these residents.
Poplar Point- Study Area 8	- The intersection of Steamboat Avenue and Wright Lane provides the only access into and out of the Poplar point neighborhood. This intersection is exposed in the 5-foot scenario. - Local roads in the northeastern section of Poplar Point are exposed to 3-feet of sea level rise at the intersection of Lexington and Concord Avenues.
Phillips/Loop- Study Area 7	- Loop Drive provides access to fewer than 20 residences across Wickford Cove. Ingress/egress to these residences will be exposed in the 3-foot sea level rise scenario. No alternate route is available for these residents. - Boone Street provides access to the North Kingstown Free Library and the neighborhood to the north of Phillips Street. An

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	alternate route is available to residents for evacuation through the road network that connects to Route 1 to the west.
Mill Cove / Shore Acres- Study Area 3	Rogers Street to the west of Shore Acres Ave, serving fewer than six residential parcels
Hamilton / Bissell Cove- Study Area 10	Only roadways that dead end at the edge of Bissell Cove are exposed to sea level rise.
Pojac Point / Mount View- Study Area 1	- Bike Path from Davisville to Calf Pasture Point/ Mount View neighborhood - Southwest corner of Mount View neighborhood
Quonset/Davisville- Study Area 2	Patrol Road at northernmost point at Davisville / Little Allen's Harbor
Intrepid Drive- Study Area 4	Intrepid Drive Boat Launch
Gilbert Stuart / Walmsley Lane- Study Area 12	The Walmsley Lane URI Boat Launch is exposed to future sea level rise but this does not intersect with any ingress/egress to parcels in this area.

These projects described above can be reviewed and considered by North Kingstown's staff and decision makers as conditions change and/or funding becomes available to complete feasibility assessments or design studies in these areas.

7. Comprehensive Community Plan: Adaptation to Natural Hazards & Climate Change

“AVOID OR MINIMIZE THE EFFECTS THAT NATURAL HAZARDS POSE TO LIVES, INFRASTRUCTURE, AND PROPERTY.”

RHODE ISLAND COMPREHENSIVE COMMUNITY PLAN GUIDEBOOK, NATURAL HAZARDS REQUIREMENT

North Kingstown is embarking on a full rewrite of its Comprehensive Community Plan in 2015-2016. This chapter provides an overview of the new requirements to address natural hazards in Rhode Island municipal Comprehensive Plans, and proposed goals, objectives and strategies North Kingstown can pursue to fulfill these requirements and ensure the Comprehensive Plan adequately addresses future planning needs of the town. It also provides a relative timeframe and responsible party for each adaptation action.

7.1. RHODE ISLAND STATEWIDE PLANNING PROGRAM – STATE COMPREHENSIVE PLAN GUIDANCE HANDBOOKS

The Rhode Island Division of Planning’s Statewide Planning Program is currently developing ***Comprehensive Planning Guidance Handbook #12: Planning for Natural Hazards & Climate Change*** on incorporating natural hazards and climate change into local comprehensive plans. This guidance is still in draft stage but is anticipated to be available in the fall of 2015. This guidance handbook clarifies how the local comprehensive plan natural hazard and climate change component differs from the local hazard mitigation plan. The two definitely feed off and complement one another but they serve different purposes. It is important to emphasize that **simply inserting the local hazard mitigation plan into the comprehensive plan may not address all the requirements for State approval.**

The Rhode Island Statewide Planning Program’s DRAFT ***Comprehensive Planning Guidance Handbook #12: Planning for Natural Hazards & Climate Change*** states:

“A NOTE ON THE RELATIONSHIP TO THE LOCAL HAZARD MITIGATION PLAN

All communities that wish to avail themselves of Federal Emergency Management Agency (FEMA) money after a disaster occurs must adopt a local hazard mitigation plan, which is a different and distinct document from the local comprehensive plan. The purpose of a local hazard mitigation plan is to “identify policies and actions that can be implemented over the long term to reduce risk and future losses.” While this is also one of the purposes of including natural hazards within a comprehensive plan, the local comprehensive plan is used to guide development and infrastructure decisions at the municipal level. Therefore, discussions of natural hazards and climate change impacts within a comprehensive plan must take a more

holistic view and should align land use, transportation, infrastructure and other goals and policies with natural hazards considerations.

The comprehensive plan should consider different aspects of natural hazards and climate change than what is typically found in a local hazard mitigation plan. As you'll see throughout this chapter, there are some things that are typically found in a local hazard mitigation plan that the comprehensive plan doesn't need to discuss and there are some areas where a more detailed or thoughtful discussion of vulnerabilities are warranted. **Therefore, simply inserting the local hazard mitigation plan into the comprehensive plan may not address all the requirements for State approval.**

However, comprehensive plans and hazard mitigation plans can benefit each other. If your municipality has a hazard mitigation plan, the information contained within it can serve as the basis for addressing natural hazards in the comprehensive plan. Conversely, the goals, policies, and implementation program of the comprehensive plan can reinforce the strategies detailed within the hazard mitigation plan."

Table 20. Comparison of the Natural Hazards & Climate Change Component of Local Comprehensive Plans and Local Hazard Mitigation Plans. The green section lists how the two may overlap in content

Natural Hazards & Climate Change Component of Local Comprehensive Plan	VS.	Local Hazard Mitigation Plan
- Used to guide local development and infrastructure decisions - Must take a more holistic view - Should align land use, transportation, infrastructure and other goals and policies with natural hazards considerations - Should consider different aspects of natural hazards and climate change than what is typically found in a local hazard mitigation plan	- Both "identify policies and actions to reduce risk and future losses." - Info contained within HAZ MIT PLAN can serve as the basis for addressing natural hazards in the comprehensive plan - Goals, policies, and implementation program of the comprehensive plan can reinforce the strategies detailed within the hazard mitigation plan.	- FEMA focused - More detailed in emergency response & post storm recovery

The town's Hazard Mitigation Plan identifies the following implementation measures that have relevance for the goals, objectives, and strategies being considered for the Comprehensive Community Plan. Those relevant measures from the Hazard Mitigation Plan include:

- Land use – further development will be directed away from hazard areas, such as the flood zones, as well as away from groundwater recharge areas.

- Transportation and circulation – Evacuation routes and bridge maintenance
- Economic development – locate development away from hazard areas
- Economic development – Form cooperative agreements with businesses to ensure that adequate supplies are available to the town in the event of an emergency
- Community services and facilities – Through outreach, inform and prepare residents for natural hazards
- Community services and facilities – Incorporate hazard mitigation requirements into building and site plan review processes
- Community services and facilities – retrofit town facilities to protect structures, public safety, and important records from damage or destruction during a natural hazard
- Natural and cultural resources – develop plans for park clean-up after a storm
- Natural and cultural resources – protect historic buildings
- Open space, conservation and recreation element – preserve open space in hazard vulnerable areas
- Open space, conservation and recreation element – develop storm hazard plans for the towns harbors
- Post Road Corridor – implement stormwater management techniques
- Post Road Corridor – encourage underground utility lines
- Quonset Point – ensure new construction is built to avoid and resist storm damage, retrofit existing structures

Table 21 summarizes how the adaptation strategies provided in Chapter 5 fit into each element of the 2008 North Kingstown Comprehensive Plan. Because some municipal sectors (e.g. land use or building stock) are contained in multiple comprehensive plan elements, this table outlines which adaptation strategies correspond to each element within the plan.

Table 21. Elements of the North Kingstown Comprehensive Community Plan and the corresponding adaptation strategy sectors from Chapter 5 of this document.

North Kingstown Comprehensive Community Plan Element	Adaptation Strategy Sector from Chapter 5
Land Use	5.1 – Land Use (LU) 5.12 – Contaminated Sites (CS)

North Kingstown Comprehensive Community Plan Element	Adaptation Strategy Sector from Chapter 5
Housing	5.3 – Building Stock (B)
Circulation	5.2 – Transportation and Circulation (TC)
Community Services and Facilities	5.4 – Municipal Properties and Facilities (MP) 5.5 – Emergency Management Facilities (EM) 5.6 – Wastewater (WW) 5.7 – Stormwater (SW) 5.8 – Drinking Water (DW) 5.14 – Vulnerable Populations (VP) 5.15 – Greenhouse Gas Reduction (GR) 5.16 – Utilities and Other Infrastructure (U) 5.17 – Communications (C) 5.18 – Municipal Operations (MO)
Economic Development	5.1 – Land Use (LU) 5.2 – Transportation and Circulation (TC) 5.3 – Building Stock (B)
Natural and Cultural Resources	5.9 – Groundwater (GW) 5.10 – Wetlands (W) 5.11 – Historic and Cultural Resources (HC)
Open Space and Recreation	5.13 – Open Space, Recreation, and Public Access (OS)

The following sections provide a vision statement, goals, objectives, and action items for each element of the Comprehensive Community Plan that can be considered as the town pursues its full rewrite of the Plan in 2015. The list of actions provided here are meant to be used as a menu for town staff and decision makers to consider, and is not intended to require that the town follow up on all of these strategies in the near term. As these adaptation strategies and other land use planning decisions are made at the local level, and as additional scientific research and data become available, these strategies will require update to ensure they represent the best course of action to achieve and maintain long-term resilience throughout North Kingstown.

7.2. LAND USE – ADAPTATION TO NATURAL HAZARDS & CLIMATE CHANGE

Vision Statement, Land Use Element

“The community of North Kingstown seeks to protect and enhance its natural beauty and scenic assets, its traditional New England character, and its natural resources within healthy ecosystems, *particularly in the face of a changing climate and natural hazards.*”

Goals & Objectives, Land Use Element

Land Use, Goal 1. Maintain character of North Kingstown while adapting to climate change conditions, including consideration of the impact current and projected future tidal inundation, coastal erosion, storm surge, and flooding may have on future land use patterns, while preserving and enhancing scenic beauty, natural resources, and cultural heritage.

- Land Use, Objective 1. Direct future growth in North Kingstown to areas outside of current and potential future flood zones.
- Land Use, Objective 2. Maintain North Kingstown’s Special Flood Hazard Overlay District and monitor its effectiveness.
- Land Use, Objective 3. Propose a Sea Level Rise Overlay District to provide a vehicle for evaluating future land use proposals in areas of Town exposed to projected future tidal variation and coastal flooding.
- Land Use, Objective 4. Prevent undeveloped properties within the SFHA and Sea Level Rise Overlay District from development that would put residents in harm’s way or contribute to debris that could be carried by floodwaters.
- Land Use, Objective 5. Consider elevation, retreat, or shoreline engineering solutions for various properties along North Kingstown’s coastline to accommodate floodwaters or protect assets from current and future tidal inundation, coastal erosion, storm surge and flooding.

Actions & Implementation Plan, Land Use Element

Table 22. Actions related to Land Use and anticipated timeframes.

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Revise Future Land Use Map to reflect use restrictions proposed for properties within the SFHA and projected sea level rise areas	LU1	0 – 5 years	Planning
Create a Sea Level Rise Overlay Zone	LU2	0 – 5 years	Planning
Establish setback requirements from inland boundaries of projected sea level rise or salt marsh migration areas	LU3	0 – 5 years	Planning
Establish a Purchase of Development Rights (PDR) program	LU4	0 – 5 years	Planning
Require development plans to include documentation of SFHA and projected sea level rise scenarios and design/construction strategies to protect public safety from natural hazards	LU6	0 – 5 years	Planning
Create clear municipal review process for the Sea Level Rise Overlay Zone, following RIGL 45-23-35	LU7	0 – 5 years	Planning/ Municipal Departments
Establish a process for property owners to define conservation easements on their property to protect areas that are projected to be inundated by sea level rise scenarios or salt marsh migration	LU8	0 – 5 years	Planning
Develop tax incentives for property owners who implement accepted measures for coastal property resilience	LU10	0 – 5 years	Planning/ Economic Development/ Town Council/ Assessor
Conduct an assessment of all vacant parcels within the SFHA and identify strategies to protect these parcels from development	LU12	0 – 5 years	Planning/ Economic Development/ Assessor
Establish a defined “Adaptation Action Area” special planning district in Wickford Village to pilot implementation strategies.	LU13	0 – 5 years	Planning

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Conduct a feasibility study to explore costs/benefits and legal issues of policies that result in decreased density of development within the SFHA	LU5	5 – 10 years	Planning
Conduct a feasibility study to evaluate neighborhoods particularly vulnerable to storm surge or projected sea level rise, and consider long-term municipal services and financing options for these areas (i.e., special tax district, impact fees, etc.)	LU9	5 – 10 years	Planning
Update the Wickford Village Plan to include relevant adaptation strategies as presented in this report	LU11	5 – 10 years	Planning/Local Boards and Commissions
Coordinate with state and federal agencies to set up a program to monitor the stability and erosion rates of coastal landfill sites at Allen’s Harbor and Calf Pasture Point	CS1	5 – 10 years	Planning/Engineering/Conservation Commission
Explore options and strategies for long-term managed retreat of properties and neighborhoods within the SFHA to areas less exposed to natural hazards in North Kingstown	LU14	10 – 20 years ongoing	Planning

7.3. HOUSING – ADAPTATION TO NATURAL HAZARDS & CLIMATE CHANGE

Vision Statement, Housing Element

“The Town of North Kingstown will continue to promote the construction, reuse and maintenance of housing that serves all socio-economic levels and age groups and improve sustainability *and resiliency* with low impact development practices *and techniques to adapt to natural hazards and climate change impacts*. Affordability, sustainability *and resiliency* will be especially important considerations when and where the town decides to provide new services and facilities to support new housing.”

Goals & Objectives, Housing Element

Housing, Goal 1. Maintain a residential development pattern that reflects the small town setting with rural flavor and historic village centers while protecting lives, infrastructure and property from coastal hazards.

- Housing, Objective 1. Improve and maintain the town’s existing housing stock while notifying homeowners of their exposure and risk to coastal hazards.
- Housing, Objective 2. Avoid or minimize the exposure of future higher density development proposals including multi-family housing, senior housing, or mixed income housing to coastal hazards and direct these developments out of the projected sea level rise areas.
- Housing, Objective 3. Promote more resilient housing stock through “code-plus” techniques that serve to reduce damage and debris from structures during a storm or flooding event.

Action & Implementation Plan, Housing Element

Table 23. Actions related to Housing and their anticipated timeframes

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Notify property owners within the SFHA of their exposure to projected sea level rise scenarios	B1	0 – 5 years	Planning
Establish procedures to apply long-term management / maintenance plans, identifying clear triggers to initiate actions	B1	0 – 5 years	Building Official
Maintain a database of building permits and elevation certificates within the SFHA	B1	0 – 5 years	Planning
Implement an emergency permit process that can be put into effect immediately following storm events so homeowners can make necessary repairs	B2	0 – 5 years	Building Official

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Revise zoning to include a clearly defined height variance for property owners who propose voluntary elevation of their property above base flood elevation (See Zoning, Section 21-18)	B3	0 – 5 years	Planning
Offer guidance to property owners and builders to voluntarily implement strategies that go beyond the RI State Building Code, such as weatherization techniques or increased freeboard (see definition in Glossary) for new construction projects or retrofits that increase resilience to natural hazards	B4	0 – 5 years	Building Official
Implement a long-term categorization with strategies for structures on parcels within the SFHA to address protection, accommodation, preservation, and retreat	B5	5-10 years	Planning
Define financial benefits in the form of fee waivers or tax credit for property owners who voluntarily implement accepted adaptation strategies on their property	B6	5-10 years	Building Official
Offer resources and strategies for owners of historic properties or for the historic district to implement adaptation measures in coordination with RIHPHC and the local Historic District Commission	B7	5-10 years	Planning
Evaluate and define long-term strategies for all parcels identified as repetitive loss properties	B8	5-10 years	Building Official
Define incentives for property owners and builders to participate in the IBHS FORTIFIED or US Department of Homeland Security Resilience STAR™ program for structures	B9	5-10 years	Planning
Require the building official to complete training on the IBHS FORTIFIED program for structures. Call for state government to offer training so that inspectors can be trained and certified in Rhode Island.	B10	5-10 years	Building Official
Participate in Department of Homeland Security Resilience STAR™ program	B11	5-10 years	Planning

7.4. CIRCULATION – ADAPTATION TO NATURAL HAZARDS & CLIMATE CHANGE

Vision Statement, Circulation Element

“The circulation system in North Kingstown is a well-maintained network of transportation options that provides for safe and adequate traffic flow, allows movement of through-traffic on a regional basis, provides adequate local traffic movement, and connects regional and local transportation facilities; provides transportation for all sectors of the population, actively encourages use of mass transit and non-automotive alternatives; **and is resilient to natural hazard and climate change impacts including projected future tidal inundation, coastal erosion, storm surge, and flooding.**”

Goals & Objectives, Circulation Element

Circulation, Goal 1. Ensure public roadways are maintained with consideration of the impact current and projected future tidal inundation, coastal erosion, storm surge, and flooding may have on the transportation network within Town.

- Circulation, Objective 1. Maintain evacuation routes in North Kingstown.
- Circulation, Objective 2. Evaluate transportation infrastructure for potential impacts within areas subject to current and future tidal inundation, coastal erosion, storm surge, and flooding.
- Circulation, Objective 3. Monitor roads that are known to flood both during/after storm events, and from periodic tidal inundation.
- Circulation, Objective 4. Consider current and future flood potential in all maintenance and construction projects at the 10% design phase, before road designs are advanced.
- Circulation, Objective 5. Reduce greenhouse gas emissions in North Kingstown.

Actions & Implementation Plan, Circulation Element

Table 24. Actions related to Circulation and their anticipated timeframes.

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Request RIDOT to conduct a feasibility study to identify strategies/alternatives to protect evacuation routes from storm damage and projected sea level rise inundation	TC1	0-5 years	Planning
Evaluate all neighborhoods within the SFHA to ensure residents have safe and reliable methods of ingress/egress before and after storm events occur	TC2	0- 5 years	Planning
Compile transportation projects identified in the coastal vulnerability assessment for inclusion on the state Transportation Improvement Program (TIP)	TC3	0-5 years	Planning
Coordinate with RIDOT and other state/federal partners to identify technologies or strategies to protect state roadways from storm or sea level rise damage	TC4	0-5 years	Planning
Develop feasibility assessments and cost estimates for town-owned roads that are projected to be most impacted in the short term by storm surge or projected sea level rise and include in the municipal capital improvements program	TC5	5-10 years	Planning
Pursue a cost-benefit or tradeoff analysis for each vulnerable town-owned road and prepare long-term management, maintenance, and financing programs for roads exposed to storm surge and projected sea level rise	TC6	5-10 years	Planning
Adopt criteria for evaluating new road projects within the SFHA to meet resiliency objectives	TC7	5-10 years	Planning
Monitor the stability and maintenance requirements of the bike path in Davisville, partnering with RIDOT and Quonset Development Corporation	TC8	5-10 years	Building Official
Continue coordination with Quonset Development Corporation to assess adaptation strategies to protect assets in Quonset Business Park, including coastal hardening projects and stormwater management to prevent or mitigate flood damage from future storms or projected sea level rise	TC9, TC10	5-10 years	Planning

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
From Hazard Mitigation Plan, explore management and operational requirements to implement, “Keep roads passable during a hazard event and extreme tides.”	TC11	0- 5 years	Planning
Encourage reduction of carbon emissions in North Kingstown through improved transportation efficiency, reduction of traffic congestion, encouragement of alternative transportation options (rail, bike, pedestrian infrastructure), and implementation of an anti-idling ordinance for trucks, buses, and other vehicles.	GR1	5-10 years	Planning, Engineering, Boards and Commissions, State

7.5. COMMUNITY SERVICES & FACILITIES – ADAPTATION TO NATURAL HAZARDS & CLIMATE CHANGE

Vision Statement, Community Services & Facilities Element

“The Town of North Kingstown, in order to adequately provide for the health, welfare, education, and safety of its citizens now and in the future, must develop and implement a systematic approach to the provision of services, development of facilities, protection of assets and long-term planning for growth management which will ensure that necessary municipal services will be available as growth and population shifts occur. ***Investment in community services and facilities will be informed by assessment of natural hazards and the potential impacts of climate change including projected future tidal inundation, coastal erosion, storm surge, and flooding.***”

Goals & Objectives, Community Services & Facilities Element

Community Services and Facilities, Goal 1. Ensure adequate public safety before, during, and after a natural hazard event.

- Community Services and Facilities, Objective 1. Evaluate all Capital Improvement Program projects for potential impact from current and projected future tidal inundation, coastal erosion, storm surge, and flooding.
- Community Services and Facilities, Objective 2. Ensure Emergency services will be operational before, during, and after a natural disaster, per the Town’s Hazard Mitigation Plan.
- Community Services and Facilities, Objective 3. Maintain adequate plans and procedures to expedite recovery after a natural disaster, including an emergency permit process that outlines clear procedures in the days after storm damage.

Community Services and Facilities, Goal 2: Evaluate the Town’s Facilities Plans in the context of current and projected future tidal inundation, coastal erosion, storm surge, and flooding.

- Community Services and Facilities, Objective 4. Consider areas that are proposed for future sewer infrastructure and evaluate the feasibility of constructing sewers in flood prone areas.
- Community Services and Facilities, Objective 5. Evaluate tradeoffs between Onsite Wastewater Treatment Systems (OWTS) and construction of sewer infrastructure in areas of town identified to be susceptible to projected sea level rise scenarios and coastal flood damage.
- Community Services and Facilities, Objective 6. Consider long-term viability of drinking water, wastewater, stormwater, and utilities in areas with high exposure to coastal hazards.

Community Services and Facilities, Goal 3: Reduce greenhouse gas emissions across municipal departments and operations to “lead by example” as a model for residents and businesses to follow.

- Community Services and Facilities, Objective 7. Assess opportunities to increase energy efficiency throughout town operations and reduce North Kingstown’s overall carbon footprint.

Action & Implementation Plan, Community Services & Facilities Element

Table 25. Actions related to Community Services and Facilities and their anticipated timeframes.

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Municipal Properties			
Create requirements for all publicly-owned properties within the SFHA that must be met before future developments are considered for approval	MP1	0-5 years	Planning
Maintain a database of flood impacts on municipal properties and structures	MP2	0-5 years	Planning/ Building
Prepare long-range plans for existing properties and facilities within SFHA or projected sea level rise areas	MP3	5-10 years	Planning
Continue to implement actions from Hazard Mitigation Plan pertaining to Town Hall, Town Hall Annex, Senior Center, Cold Spring Community Center, Art Association Building, North Kingstown Free Library, and Highway Department Facilities Building	MP4	0- 5 years	Planning

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Emergency Management			
Create requirements for all emergency management facilities within the SFHA that must be met before future developments are considered for approval	EM1	0-5 years	Planning/ NK EMA/DPW
Continue to implement actions from Hazard Mitigation Plan pertaining to evacuation routes, emergency shelters, town Emergency Operations Center and Public Safety Complex, town fire stations, Rhode Island Air and Army National Guard, and post-disaster plans	EM2	0- 5 years	Planning
Design and launch a town-wide emergency communications system, such as reverse-911	EM3	5-10 years	Town Council
Wastewater			
Evaluate design life of OWTS systems in SFHA and projected sea level rise areas	WW1	0-5 years	Planning/ Engineering/ Building
Maintain a database of damage or repairs of OWTS in SFHA	WW2	0-5 years	Building
Evaluate the Wastewater Management Plan to incorporate resilient design principles for adaptation to storm surge and projected sea level scenarios	WW3	0-5 years	Planning/ Engineering/ DPW
Include analysis of storm surge and projected sea level rise scenarios in the decision making process for expansion of the sewer system	WW4	0-5 years	Planning
Enact a wastewater evaluation/feasibility study for repetitive loss properties and parcels within projected sea level rise areas	WW5	0-5 years	Planning
Coordinate with RIDEM to keep records of TMDL monitoring adjacent to coastal neighborhoods	WW6	0-5 years	Planning/ Engineering
Evaluate potential of newer toilet technology to reduce volumes of wastewater output	WW7	0-5 years	Planning/ Water
Continue to implement actions from Hazard Mitigation Plan pertaining to QDC's wastewater facility, management of sewer pump stations and future town sewer lines	WW8	0- 5 years	Planning
Coordinate with RIDEM to develop design criteria and strategies for future OWTS upgrades on properties within the SFHA and projected sea level rise areas	WW9	0- 5 years	Planning/ Technical Review Committee

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Stormwater Management			
Create and maintain a database of storm drains in town within the SFHA and projected sea level rise areas for monitoring during storms and/or high tide events	SW1	0-5 years	Engineering
Pursue a Comprehensive Stormwater Management Study for Wickford Village	SW2	0-5 years	Planning/ Engineering/ DPW
Pursue funding to develop a town-wide comprehensive green infrastructure strategy for North Kingstown, focusing on Wickford Village and other commercial districts or neighborhoods in North Kingstown susceptible to flooding	SW3	0-5 years	Planning/TRC/ Boards/ Commissions/ Building
Drinking Water			
Evaluate town water lines within the SFHA and projected sea level rise areas to verify long-term viability and potential impacts	DW1	0-5 years	Planning/ Engineering/ Water
Establish procedures for residential well monitoring within the SFHA and projected sea level rise areas	DW2	0-5 years	Water Department
Continue to implement actions from Hazard Mitigation Plan pertaining to town and QDC wells, and the town water distribution system	DW3	0- 5 years	Water Department
Vulnerable Populations			
Continue to implement actions from Hazard Mitigation Plan pertaining to coastal neighborhoods, Wickford commercial districts, elderly housing, Wickford Village housing, North Cove Landing (Intrepid Drive), schools, and day care centers	VP1	0- 5 years	Planning
Ensure vulnerable coastal populations receive proper communications before, during, and after storms and are aware of evacuation procedures, location of shelters, and transportation options.	VP2	0- 5 years	Planning/ Town Council
Target communications and outreach efforts to low- to moderate-income populations, densely populated neighborhoods, condominium complexes, multi-family properties, and renters to be appropriately informed of municipal procedures.	VP3	0-5 years	Planning/ Town Council

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Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Greenhouse Gas Reduction (CO ² Mitigation)			
Integrate green building strategies into existing municipal facilities, and require green building standards as defined by the U.S. Green Building Council (USGBC) for future construction and/or building retrofits.	GR2	0- 5 years	Planning/ DPW/ Building/ Town Council
Coordinate with the Rhode Island Office of Energy Resources (RI OER) and the University of Rhode Island Energy Center to explore alternative energy solutions, including solar, wind and hydropower, and energy efficiency techniques for all municipal operations. Consider optimal locations in town to install electric vehicle support infrastructure.	GR3	0- 5 years	Planning
Utilities and Other Infrastructure			
Continue to implement all actions defined within the town's Hazard Mitigation Plan, pertaining to: Dams, Town Bridges, with and without utilities (bridge inspection; emergency procedure for gas lines running on bridges (Hussey Bridge, Brown Street Bridge); emergency procedure for water lines running on bridges; Electric Utility Lines and Facilities (tree trimming); Wind Energy Systems and Meteorological Tower; Phone Lines and Cell Towers (protecting land line phone service); Wickford / Boston Neck Road Service Station (contain hazardous materials, Investigate vulnerability and retrofit).	U1	0- 5 years	Engineering
Coordinate with National Grid to evaluate power lines and other electrical grid infrastructure (transformers, underground or over-bridge utilities) within the SFHA and projected sea level rise areas, and develop an action plan	U2	0- 5 years	Planning/ Engineering
Communications			
Ensure all North Kingstown residents receive proper communications before, during, and after storms and projected sea level rise scenarios, and are aware of evacuation procedures, location of shelters, and transportation options. Consider implementing new methods of notification through reverse-911 alert system, smartphone technology, e-mail or social media to target specific neighborhoods and harder-to-reach residents.	C1	0- 5 years	Town Council

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
For parcels identified within the sea level rise areas at MHHW + 1-foot, +3-feet, and +5-feet, contact the property owners and ensure they are notified of the assessment and work with them to establish long-term management plans for their individual properties. Provide outreach to property owners on best practices.	C2	0- 5 years	Planning
Coordinate with RIEMA to offer property owners updates and training related to changes or amendments to the local Flood Insurance Rate Maps (FIRMs) and the National Flood Insurance Program (NFIP).	C3	0- 5 years	Planning
Require the building official and tax assessor to remain informed of any policy changes related to coastal hazards and national trends. Establish a mechanism to transfer this information to property owners so they are well informed of any changes to their property rights and property values.	C4	0-5 years	Building Official & Tax Assessor
Coordinate with relevant state agencies and educational institutions to provide outreach to property owners on best practices and latest techniques supported by state and local regulatory authorities.	C5	0- 5 years	Planning
Require the town include an annual update/progress report of parcel, road, stormwater, OWTS, sewers, historic/cultural resources, open space and recreation impacts from climate change or flooding from storm events or other tidal inundation in the town's Annual Report, and address any shifting priorities or criteria that result from lessons learned in each fiscal year.	C6	0- 5 years	Planning/ Technical Review Committee
Municipal Operations			
Integrate adaptation strategies presented in this chapter into daily municipal operations and Standard Operating Procedures within multiple town departments, particularly in Public Works, Planning, and Code Enforcement.	MO1	0- 5 years	Planning, Public Works & Code Enforcement
Require each department in town government to contribute their activities to an annual update/progress report of parcel, road, stormwater, OWTS, sewers, historic/cultural resources, open space and recreation impacts from climate change or flooding from storm events or other tidal inundation in the town's Annual Report, and address any shifting priorities or criteria that result from lessons learned in each fiscal year.	MO2	0-5 years	Town Council/ Technical Review Committee/ NK EMA

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Require that municipal board and commission members participate in some form of annual training for hazard mitigation and coastal resilience to ensure consistent code enforcement and continued implementation of hazard mitigation and climate adaptation actions.	MO3	0-5 years	Town Council
Require ongoing staff training, particularly the planning director, building official and tax assessor, to remain informed and up to date on any policy changes related to coastal hazards and national trends.	MO4	0-5 years	Town Council/ Management
Require all municipal Capital Improvement Program projects be evaluated for exposure to storm surge and projected sea level rise, and work with state to include this evaluation its review process for state Transportation Improvement Program (TIP) projects in coastal areas. Ensure all projects address impacts from storm events, upland flooding, and coastal storm surge scenarios, as well as sea level rise projections and overall SFHA resilience.	MO5	0- 5 years	Asset Management/ DPW/ Planning/ Engineering
Continue North Kingstown's involvement in FEMA's Community Rating System (CRS). Ensure staff time is dedicated for maintenance of the town's rating in the CRS program and continue to implement actions to achieve a lower CRS rating to secure increased savings on flood insurance rates for all property owners in North Kingstown.	MO6	0- 5 years	Planning/ Building Official
Maintain a database of building permits for all properties as well as roadways within the SFHA and the projected sea level rise areas and review for surge impacts annually and after each major storm event. Update GIS to include SLR scenarios and database of parcels and roadways within each scenario.	MO7	0- 5 years	Building Official
Maintain a database of impacts and costs and monitor public expenditures on adaptation-related projects to assess effectiveness and impacts. Require the finance director to evaluate the impact of storm-related structural losses on local municipal tax revenues in the annual budget, and communicate this in a meeting with town council.	MO8	0- 5 years	Planning/ Finance
Evaluate the municipal development plan review procedures, the site plan review process and zoning variance parameters related to properties within SFHA and sea level rise areas to formalize adaptation strategies and implementation actions into local regulations. Update as appropriate when new revised state policies are adopted (i.e., from the Beach SAMP process).	MO9	0- 5 years	Planning/ Planning Commission/ Technical Review Committee

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Evaluate the Sea Level Rise Overlay Zone recommendation to determine if the Sea Level Rise Overlay should be a stand-alone overlay zone or included in the SFHA. This will require coordination among the Planning Department, Planning Commission, RIEMA, and possibly RICRMC.	MO10	0- 5 years	Planning
Update the Hazard Mitigation Plan and Comprehensive Community Plan with best available science as updates or rewrites as guided by state agencies, academic institutions, and through the Governor’s Executive Council on Climate Change.	MO11	0- 5 years	Planning
Explore inter-jurisdictional partnerships and regional support either through the Washington County Regional Planning Commission Council of Governments or local watershed councils.	MO12	0- 5 years	Planning
Work with state government to promote adoption of a “Fortified” program that rates new construction projects based on techniques that result in improved resilience to hazards. The Insurance Institute for Business and Home Safety (IBHS) offers a suite of programs that seek to reduce risks from natural hazards. (See www.disastersafety.org/fortified).	MO13	0- 5 years	Planning/ Building Official
Explore opportunities for implementing or testing solutions through grant-supported pilot programs that can then inform public policy and private investment. Encourage state leaders to continue conversations with lending institutions and insurance agencies to ensure municipalities can stay current on impact of natural hazards on mortgages and property insurance, including flood insurance. Explore the financial implications if the lending institutions or insurance agencies drop policies or programs to support property owners.	MO14	0- 5 years	Planning

7.6. ECONOMIC DEVELOPMENT – ADAPTATION TO NATURAL HAZARDS & CLIMATE CHANGE

Vision Statement Economic Development Element:

“Resilience to natural hazards and climate change will be mainstreamed into economic development planning and decision making to ensure future development and investments will be resilient in the face of changing environmental conditions. Well-structured, working relationships between Town and State agencies and the local community will be established to accomplish the Plan’s vision.”

Goals & Objectives, Economic Development Element

Economic Development, Goal 1. Promote economic resilience in the face of coastal hazards and projected sea level rise in the commercial and job centers of North Kingstown.

- Economic Development, Objective 1. Evaluate vulnerability of economic systems and indicators in North Kingstown to coastal hazards and climate change.

Actions & Implementation Plan, Economic Development Element

Table 26. Actions and Work Plans for Economic Development

Action	Strategy Code	Timeframe	Responsible Agent
Economic development plans will integrate the impacts of natural hazards and climate change to ensure productivity and business continuity are resilient to changing environmental conditions.		0-5 years	Economic Development/ Planning

7.7. NATURAL & CULTURAL RESOURCES – ADAPTATION TO NATURAL HAZARDS & CLIMATE CHANGE

Vision Statement, Natural & Cultural Resources Element

“The Town of North Kingstown holds a wide variety of natural and cultural resources that provide both environmental and socio-economic benefits to its residents. *Identifying those resources for preservation, management, and restoration will be informed by the impacts posed by climate change including projected future tidal inundation, coastal erosion, storm surge, and flooding.*”

Goals & Objectives, Natural & Cultural Resources Element

Natural and Cultural Resources, Goal: Identify, expand, protect, preserve, and where possible, restore the natural and cultural resources in North Kingstown to promote resilience and adaptation to a changing climate.

- Natural and Cultural Resources, Objective 1. Preserve and protect existing salt marsh complexes and floodplains, and accommodate migration of wetlands with future sea level rise projections.
- Natural and Cultural Resources, Objective 2. Ensure new construction or upgrade of stormwater management systems considers updated climate trend data and projected sea level rise scenarios.
- Natural and Cultural Resources, Objective 3. Protect the integrity of groundwater resources from increased sea levels along the coastline.
- Natural and Cultural Resources, Objective 4. Evaluate historic districts, landscapes and properties for exposure to current and future tidal inundation, coastal erosion, storm surge and flooding.

Action & Implementation Plan, Natural & Cultural Resources Element

Table 27. Action pertaining to Natural and Cultural Resources and anticipated timeframes

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Groundwater			
Compile data from local OWTS permits to better understand susceptibility of groundwater systems within the SFHA to changing coastal conditions and salt water intrusion	GW1	0- 5 years	Building Official
Maintain a record of properties within the SFHA or projected sea level rise areas that report groundwater seepage into their basements	GW2	0- 5 years	Building Official
Coordinate with state and academic entities to support research into groundwater dynamics of coastal areas, including the SFHA and projected sea level rise areas	GW3	0- 5 years	Planning/ Water Department/ Conservation Commission
Wetlands			
Define policies, regulations and strategies for municipal operations to manage salt marsh migration areas	W1	0- 5 years	Planning/ Conservation Commission
Prioritize focus areas within salt marsh migration paths for further study and monitoring	W2	0- 5 years	Planning/ Conservation Commission
Include projections for salt marsh migration and future sea level rise areas into criteria for acquisitions, easements, protection, and restoration	W3	0- 5 years	Planning/ Conservation Commission
Work with state and NGO partners to establish management plans for areas exposed to storm surge, projected sea level rise, and salt marsh migration	W4	0- 5 years	Planning/ Conservation Commission
Work with state and NGO partners to identify new areas for conservation based on the need for ecosystem services that reduce impacts from flooding and increase habitat function, as well as other defined criteria	W5	0- 5 years	Planning/ Conservation Commission
Require all future development proposals within the SFHA to show how projected wetland migration will be addressed on their property	W6	0- 5 years	Planning

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Historic and Cultural			
Maintain a database of properties within the SFHA or projected sea level rise areas with historic designation and keep record of storm damage or adaptation-related improvements	HC1	0- 5 years	Planning/HDC
Coordinate with SHPO/RIHPHC and municipal historic district commission (HDC) to identify funding and resources to assist owners of historic assets within identified hazard areas	HC2	0- 5 years	Planning/HDC
Establish financial incentives for owners of historic properties who voluntarily invest in adaptation strategies to flood-proof or otherwise protect vulnerable assets	HC3	0- 5 years	Planning/HDC

7.8. OPEN SPACE & RECREATION – ADAPTATION TO NATURAL HAZARDS & CLIMATE CHANGE

Vision Statement, Open Space & Recreation Element

“The Town recognizes that growth must be managed to preserve the rural and scenic heritage of North Kingstown through the preservation of open spaces, such as woodlands, wetlands, freshwater areas, groundwater resources, undeveloped waterfront, wildlife, wildlife habitats (especially rare and endangered species habitats), nesting areas, farmlands and areas of geological and archaeological significance. *Coastal areas at risk from the impacts of natural hazards and sea level rise will be assessed for potential acquisition in order to preserve public access and also to minimize the risk posed to lives, infrastructure and property. Monitoring of climate impacts from projected future tidal inundation, coastal erosion, storm surge, and flooding will be integrated into the management of open space.*”

Open Space and Recreation, Goal: Preserve open space in areas exposed to coastal hazards and promote resilient coastal recreation activities that contribute to quality of life and the public health, safety and welfare of North Kingstown’s residents.

- Open Space and Recreation, Objective 1. Preserve and protect existing beaches, harbors, boat launches, marina infrastructure and public access to the coastline.

Action & Implementation Plan, Open Space and Recreation Element

Table 28. Actions related to Open Space and Recreation and their anticipated timeframes

Action	Strategy Code from Ch. 5	Timeframe	Responsible Agent
Maintain a database of open space, public parks, boat launches, and beaches within the SFHA or projected sea level rise areas and keep record storm damage and tidal inundation	OS1	0-5 years	Planning
Evaluate vacant properties within the SFHA and identify opportunities to acquire, purchase, or establish perpetual conservation easements on these parcels	OS2	0-5 years	Planning/ Economic Development /Assessor
Incorporate sea level rise projections into criteria for acquisition, easements, protection and restoration of open space, recreation, and public access areas	OS3	0-5 years	Planning/ Town Council
Continue to implement actions from Hazard Mitigation Plan pertaining to town harbors and moorings, town beach concession and restrooms, Ryan Park, Rome Point, Wilson Park, Cocumscussoc State Park, Calf Pasture Point, and the municipal golf course	OS4	0-5 years	Planning

7.9. IMPLEMENTATION PROGRAM & EARLY ACTIONS

This section offers a compilation of all early actions identified in the tables from Sections 7.2 through 7.8 that can be considered by staff and decision makers in North Kingstown for follow up or implementation within the next five years.

Table 29. Early actions to be completed within the next five years.

Action	Strategy Code from Ch. 5	Responsible Agent
Land Use		
Revise Future Land Use Map to reflect use restrictions proposed for properties within the SFHA and projected sea level rise areas	LU1	Planning
Create a Sea Level Rise Overlay Zone	LU2	Planning
Establish setback requirements from inland boundaries of projected sea level rise or salt marsh migration areas	LU3	Planning
Establish a Purchase of Development Rights (PDR) program	LU4	Planning
Require development plans to include documentation of SFHA and projected sea level rise scenarios and design/construction strategies to protect public safety from natural hazards	LU6	Planning
Create clear municipal review process for the Sea Level Rise Overlay Zone, following RIGL 45-23-35	LU7	Planning/ Municipal Depts
Establish a process for property owners to define conservation easements on their property to protect areas that are projected to be inundated by sea level rise scenarios or salt marsh migration	LU8	Planning
Develop tax incentives for property owners who implement accepted measures for coastal property resilience	LU10	Planning/ Economic Development/ Town Council/ Assessor
Conduct an assessment of all vacant parcels within the SFHA and identify strategies to protect these parcels from development	LU12	Planning/ Economic Development/ Assessor
Establish a defined “Adaptation Action Area” special planning district in Wickford Village to pilot implementation strategies.	LU13	Planning
Housing		
Notify property owners within the SFHA of their exposure to projected sea level rise scenarios	B1	Planning/ Building Official
Establish procedures to apply long-term management / maintenance plans, identifying clear triggers to initiate actions	B1	Building Official

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Action	Strategy Code from Ch. 5	Responsible Agent
Maintain a database of building permits and elevation certificates within the SFHA	B1	Building Official
Implement an emergency permit process that can be put into effect immediately following storm events so homeowners can make necessary repairs	B2	Building Official
Revise zoning to include a clearly defined height variance for property owners who propose voluntary elevation of their property above base flood elevation (See Zoning, Section 21-18)	B3	Planning/PC/ Town Council
Offer guidance to property owners and builders to voluntarily implement strategies that go beyond the RI State Building Code, such as weatherization techniques or increased freeboard (see definition in Glossary) for new construction projects or retrofits that increase resilience to natural hazards	B4	Building Official
Circulation		
Request RIDOT to conduct a feasibility study to identify strategies/alternatives to protect evacuation routes from storm damage and projected sea level rise inundation	TC1	Planning/ Engineering
Evaluate all neighborhoods within the SFHA to ensure residents have safe and reliable methods of ingress/egress before and after storm events occur	TC2	Planning/ Engineering
Compile transportation projects identified in the coastal vulnerability assessment for inclusion on the state Transportation Improvement Program (TIP)	TC3	Planning/ Engineering
Coordinate with RIDOT and other state/federal partners to identify technologies or strategies to protect state roadways from storm or sea level rise damage	TC4	Planning/ Engineering
From Hazard Mitigation Plan, explore management and operational requirements to implement, "Keep roads passable during a hazard event and extreme tides."	TC11	Planning/ Engineering/ Asset Management
Municipal Properties		
Create requirements for all publicly-owned properties within the SFHA that must be met before future developments are considered for approval	MP1	Planning/ Town Council
Maintain a database of flood impacts on municipal properties and structures	MP2	Planning
Continue to implement actions from Hazard Mitigation Plan pertaining to Town Hall, Town Hall Annex, Senior Center, Cold Spring Community Center, Art Association Building, North Kingstown Free Library, and Highway Department Facilities Building	MP4	Planning

Action	Strategy Code from Ch. 5	Responsible Agent
Emergency Management		
Create requirements for all emergency management facilities within the SFHA that must be met before future developments are considered for approval	EM1	Planning
Continue to implement actions from Hazard Mitigation Plan pertaining to evacuation routes, emergency shelters, town Emergency Operations Center and Public Safety Complex, town fire stations, Rhode Island Air and Army National Guard, and post-disaster plans	EM2	Planning
Wastewater		
Evaluate design life of OWTS systems in SFHA and projected sea level rise areas	WW1	Planning/ Engineering/ Building
Maintain a database of damage or repairs of OWTS in SFHA	WW2	Building
Evaluate the Wastewater Management Plan to incorporate resilient design principles for adaptation to storm surge and projected sea level scenarios	WW3	Planning/ Engineering/ DPW
Include analysis of storm surge and projected sea level rise scenarios in the decision making process for expansion of the sewer system	WW4	Planning
Enact a wastewater evaluation/feasibility study for repetitive loss properties and parcels within projected sea level rise areas	WW5	Planning
Coordinate with RIDEM to keep records of TMDL monitoring adjacent to coastal neighborhoods	WW6	Planning/ Engineering
Evaluate potential of newer toilet technology to reduce volumes of wastewater output	WW7	Planning/ Water
Continue to implement actions from Hazard Mitigation Plan pertaining to QDC's wastewater facility, management of sewer pump stations and future town sewer lines	WW8	Planning
Coordinate with RIDEM to develop design criteria and strategies for future OWTS upgrades on properties within the SFHA and projected sea level rise areas	WW9	Planning/ Technical Review Committee
Stormwater Management		
Create and maintain a database of storm drains in town within the SFHA and projected sea level rise areas for monitoring during storms and/or high tide events	SW1	Engineering
Pursue a Comprehensive Stormwater Management Study for Wickford Village	SW2	Planning/ Engineering/ DPW

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Action	Strategy Code from Ch. 5	Responsible Agent
Pursue funding to develop a town-wide comprehensive green infrastructure strategy for North Kingstown, focusing on Wickford Village and other commercial districts or neighborhoods in North Kingstown susceptible to flooding	SW3	Planning/TRC/ Boards/ Commissions/ Building
Drinking Water		
Evaluate town water lines within the SFHA and projected sea level rise areas to verify long-term viability and potential impacts	DW1	Planning/ Engineering/ Water
Establish procedures for residential well monitoring within the SFHA and projected sea level rise areas	DW2	Water Department
Continue to implement actions from Hazard Mitigation Plan pertaining to town and QDC wells, and the town water distribution system	DW3	Water Department
Vulnerable Populations		
Continue to implement actions from Hazard Mitigation Plan pertaining to coastal neighborhoods, Wickford commercial districts, elderly housing, Wickford Village housing, North Cove Landing (Intrepid Drive), schools, and day care centers	VP1	Planning
Ensure vulnerable coastal populations receive proper communications before, during, and after storms and are aware of evacuation procedures, location of shelters, and transportation options.	VP2	Planning/ Town Council
Target communications and outreach efforts to low- to moderate-income populations, densely populated neighborhoods, condominium complexes, multi-family properties, and renters to be appropriately informed of municipal procedures.	VP3	Planning/ Town Council
Greenhouse Gas Reduction (CO ² Mitigation)		
Integrate green building strategies into existing municipal facilities, and require green building standards as defined by the U.S. Green Building Council (USGBC) for future construction and/or building retrofits.	GR2	Planning/ DPW/ Building/ Town Council
Coordinate with the Rhode Island Office of Energy Resources (RI OER) and the University of Rhode Island Energy Center to explore alternative energy solutions, including solar, wind and hydropower, and energy efficiency techniques for all municipal operations. Consider optimal locations in town to install electric vehicle support infrastructure.	GR3	Planning

Action	Strategy Code from Ch. 5	Responsible Agent
Utilities and Other Infrastructure		
Continue to implement all actions defined within the town's Hazard Mitigation Plan, pertaining to: Dams, Town Bridges, with and without utilities (bridge inspection; emergency procedure for gas lines running on bridges (Hussey Bridge, Brown Street Bridge); emergency procedure for water lines running on bridges; Electric Utility Lines and Facilities (tree trimming); Wind Energy Systems and Meteorological Tower; Phone Lines and Cell Towers (protecting land line phone service); Wickford / Boston Neck Road Service Station (contain hazardous materials, Investigate vulnerability and retrofit).	U1	Engineering
Coordinate with National Grid to evaluate power lines and other electrical grid infrastructure (transformers, underground or over-bridge utilities) within the SFHA and projected sea level rise areas, and develop an action plan	U2	Planning/ Engineering
Communications		
Ensure all North Kingstown residents receive proper communications before, during, and after storms and projected sea level rise scenarios, and are aware of evacuation procedures, location of shelters, and transportation options. Consider implementing new methods of notification through reverse-911 alert system, smartphone technology, e-mail or social media to target specific neighborhoods and harder-to-reach residents.	C1	Town Council
For parcels identified within the sea level rise areas at MHHW + 1-foot, +3-feet, and +5-feet, contact the property owners and ensure they are notified of the assessment and work with them to establish long-term management plans for their individual properties. Provide outreach to property owners on best practices.	C2	Planning
Coordinate with RIEMA to offer property owners updates and training related to changes or amendments to the local Flood Insurance Rate Maps (FIRMs) and the National Flood Insurance Program (NFIP).	C3	Planning
Require the building official and tax assessor to remain informed of any policy changes related to coastal hazards and national trends. Establish a mechanism to transfer this information to property owners so they are well informed of any changes to their property rights and property values.	C4	Building Official & Tax Assessor
Coordinate with relevant state agencies and educational institutions to provide outreach to property owners on best practices and latest techniques supported by state and local regulatory authorities.	C5	Planning

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Action	Strategy Code from Ch. 5	Responsible Agent
Require the town include an annual update/progress report of parcel, road, stormwater, OWTS, sewers, historic/cultural resources, open space and recreation impacts from climate change or flooding from storm events or other tidal inundation in the town's Annual Report, and address any shifting priorities or criteria that result from lessons learned in each fiscal year.	C6	Planning/ Technical Review Committee
Municipal Operations		
Integrate adaptation strategies presented in this chapter into daily municipal operations and Standard Operating Procedures within multiple town departments, particularly in Public Works, Planning, and Code Enforcement.	MO1	Planning, Public Works & Code Enforcement
Require each department in town government to contribute their activities to an annual update/progress report of parcel, road, stormwater, OWTS, sewers, historic/cultural resources, open space and recreation impacts from climate change or flooding from storm events or other tidal inundation in the town's Annual Report, and address any shifting priorities or criteria that result from lessons learned in each fiscal year.	MO2	Town Council/ Technical Review Committee/ NK EMA
Require that municipal board and commission members participate in some form of annual training for hazard mitigation and coastal resilience to ensure consistent code enforcement and continued implementation of hazard mitigation and climate adaptation actions.	MO3	Town Council
Require ongoing staff training, particularly the planning director, building official and tax assessor, to remain informed and up to date on any policy changes related to coastal hazards and national trends.	MO4	Town Council/ Management
Require all municipal Capital Improvement Program projects be evaluated for exposure to storm surge and projected sea level rise, and work with state to include this evaluation its review process for state Transportation Improvement Program (TIP) projects in coastal areas. Ensure all projects address impacts from storm events, upland flooding, and coastal storm surge scenarios, as well as sea level rise projections and overall SFHA resilience.	MO5	Asset Management/ DPW/ Planning/ Engineering
Continue North Kingstown's involvement in FEMA's Community Rating System (CRS). Ensure staff time is dedicated for maintenance of the town's rating in the CRS program and continue to implement actions to achieve a lower CRS rating to secure increased savings on flood insurance rates for all property owners in North Kingstown.	MO6	Planning/ Building Official
Maintain a database of building permits for all properties as well as roadways within the SFHA and the projected sea level rise areas and review for surge impacts annually and after each major storm event. Update GIS to include SLR scenarios and database of parcels and roadways within each scenario.	MO7	Building Official

Action	Strategy Code from Ch. 5	Responsible Agent
Maintain a database of impacts and costs and monitor public expenditures on adaptation-related projects to assess effectiveness and impacts. Require the finance director to evaluate the impact of storm-related structural losses on local municipal tax revenues in the annual budget, and communicate this in a meeting with town council.	MO8	Planning/ Finance
Evaluate the municipal development plan review procedures, the site plan review process and zoning variance parameters related to properties within SFHA and sea level rise areas to formalize adaptation strategies and implementation actions into local regulations. Update as appropriate when new revised state policies are adopted (i.e., from the Beach SAMP process).	MO9	Planning/ Planning Commission/ Technical Review Committee
Evaluate the Sea Level Rise Overlay Zone recommendation to determine if the Sea Level Rise Overlay should be a stand-alone overlay zone or included in the SFHA. This will require coordination among the Planning Department, Planning Commission, RIEMA, and possibly RICRMC.	MO10	Planning
Update the Hazard Mitigation Plan and Comprehensive Community Plan with best available science as updates or rewrites as guided by state agencies, academic institutions, and through the Governor's Executive Council on Climate Change.	MO11	Planning
Explore inter-jurisdictional partnerships and regional support either through the Washington County Regional Planning Commission Council of Governments or local watershed councils.	MO12	Planning
Work with state government to promote adoption of a "Fortified" program that rates new construction projects based on techniques that result in improved resilience to hazards. The Insurance Institute for Business and Home Safety (IBHS) offers a suite of programs that seek to reduce risks from natural hazards. (See www.disastersafety.org/fortified).	MO13	Planning/ Building Official
Explore opportunities for implementing or testing solutions through grant-supported pilot programs that can then inform public policy and private investment. Encourage state leaders to continue conversations with lending institutions and insurance agencies to ensure municipalities can stay current on impact of natural hazards on mortgages and property insurance, including flood insurance. Explore the financial implications if the lending institutions or insurance agencies drop policies or programs to support property owners.	MO14	Planning

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Action	Strategy Code from Ch. 5	Responsible Agent
Economic Development		
Economic development plans will integrate the impacts of natural hazards and climate change to ensure existing and future development is resilient to changing environmental conditions.		Economic Development/ Planning
Groundwater		
Compile data from local OWTS permits to better understand susceptibility of groundwater systems within the SFHA to changing coastal conditions and salt water intrusion	GW1	Building Official
Maintain a record of properties within the SFHA or projected sea level rise areas that report groundwater seepage into their basements	GW2	Building Official
Coordinate with state and academic entities to support research into groundwater dynamics of coastal areas, including the SFHA and projected sea level rise areas	GW3	Planning/ Water Department/ Conservation Commission
Wetlands		
Define policies, regulations and strategies for municipal operations to manage salt marsh migration areas	W1	Planning/ Conservation Commission
Prioritize focus areas within salt marsh migration paths for further study and monitoring	W2	Planning/ Conservation Commission
Include projections for salt marsh migration and future sea level rise areas into criteria for acquisitions, easements, protection, and restoration	W3	Planning/ Conservation Commission
Work with state and NGO partners to establish management plans for areas exposed to storm surge, projected sea level rise, and salt marsh migration	W4	Planning/ Conservation Commission
Work with state and NGO partners to identify new areas for conservation based on the need for ecosystem services that reduce impacts from flooding and increase habitat function, as well as other defined criteria	W5	Planning/ Conservation Commission
Require all future development proposals within the SFHA to show how projected wetland migration will be addressed on their property	W6	Planning
Historic and Cultural		
Maintain a database of properties within the SFHA or projected sea level rise areas with historic designation and keep record of storm damage or adaptation-related improvements	HC1	Planning/HDC

Action	Strategy Code from Ch. 5	Responsible Agent
Coordinate with SHPO/RIHPHC and municipal historic district commission (HDC) to identify funding and resources to assist owners of historic assets within identified hazard areas	HC2	Planning/HDC
Establish financial incentives for owners of historic properties who voluntarily invest in adaptation strategies to flood-proof or otherwise protect vulnerable assets	HC3	Planning/HDC
Open Space		
Maintain a database of open space, public parks, boat launches, and beaches within the SFHA or projected sea level rise areas and keep record storm damage and tidal inundation	OS1	Planning
Evaluate vacant properties within the SFHA and identify opportunities to acquire, purchase, or establish perpetual conservation easements on these parcels	OS2	Planning/ Economic Development/ Assessor
Incorporate sea level rise projections into criteria for acquisition, easements, protection and restoration of open space, recreation, and public access areas	OS3	Planning/ Town Council
Continue to implement actions from Hazard Mitigation Plan pertaining to town harbors and moorings, town beach concession and restrooms, Ryan Park, Rome Point, Wilson Park, Cocumscussoc State Park, Calf Pasture Point, and the municipal golf course	OS4	Planning

8. Afterword and Suggestions for Next Steps

As mentioned throughout this document, the goals, objectives and strategies presented here are intended as a menu that can be used by the town of North Kingstown in its future decision making related to land use policy and investment in capital improvements along the coastline. The strategies are NOT meant to be prescriptive, but rather a collection of options that are being pursued across the U.S. to prepare for changing coastal conditions that North Kingstown can draw from and tailor to its needs.

It is important that the town of North Kingstown staff and decision making bodies revisit this plan in coming years to monitor ongoing efforts and consider future priorities for making informed land use decisions. In the short term, the following action items can be considered by the town staff and decision making bodies as a first step to get adaptation actions moving in North Kingstown:

- Produce a letter or other form of correspondence to inform property owners of the lots listed in Appendix E about their level of exposure to future sea level rise scenarios and confirm their risk based on FEMA's current Flood Insurance Rate Maps.
- Coordinate discussion with the Rhode Island Department of Transportation (RIDOT), Rhode Island Statewide Planning Program (RISPP), and the North Kingstown Technical Review Committee (NK TRC) to discuss all roadways and supporting transportation infrastructure that are identified in this report as exposed to future sea level rise and current storm surge scenarios. Begin to identify long term planning options for these roadways based on the priorities outlined in this report as well as the RISPP "Vulnerability of Transportation Assets to Sea Level Rise." Confirm priority projects, identify timeframes and planning horizons, and establish monitoring programs for these areas.
- Identify ONE of the 12 neighborhood study areas to be designated as an "Adaptation Action Area" for further study and identification of implementation projects. Work with state and university partners to secure funding to develop an Adaptation Action Area implementation program.
- Conduct a stormwater analysis in priority neighborhoods. Field verify and record spot elevations of drainage infrastructure within the areas projected to be inundated by future sea level rise scenarios and clearly identify hydraulic connectivity within these areas where stormwater and sea water are likely to converge.

- Complete North Kingstown’s Community Rating System application requirements to secure a lower rating for the town’s flood insurance policy holders, and strive for a new rating of “7” to provide 15% savings for all property owners who are required to have flood insurance. Work with staff at Rhode Island Emergency Management Agency (RIEMA) and the CRS Users Group forum to quantify and communicate the financial/economic benefits of this program to the town decision makers and taxpayers.
- Consider identifying 5-10 “hot spots” in North Kingstown as monitoring indicators to trigger future implementation action planning. Because sea level rise is expected to gradually increase over time, it will be important to keep up with the latest science and also field monitor areas of concern throughout North Kingstown to ensure sound planning practices are in place to protect lives, infrastructure, and property over time. Some areas that might be considered:
 - Brown Street Bridge
 - West Main Street / Newtown Avenue intersection
 - Phillips Street / Loop Drive / Boone Street intersection
 - The salt marsh complex along the north edge of West Main Street business parcels on north side of street between Newtown Ave. and Brown Street (Wickford Package, Art Gallery, Antique Store, Wickford Gourmet Factory Outlet)
 - Brown Street Municipal Parking Lot and Town Hall Annex
 - Town Dock
 - Poplar Point, southeast edge to Town Beach
 - Washington Street historic neighborhood
 - Town Beach municipal structures
 - Condominium complexes at Cedarhurst and Hamilton Harbor