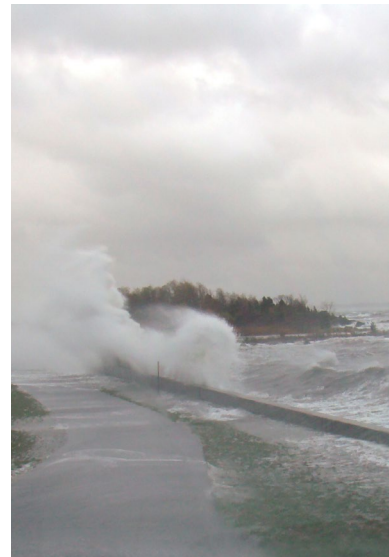
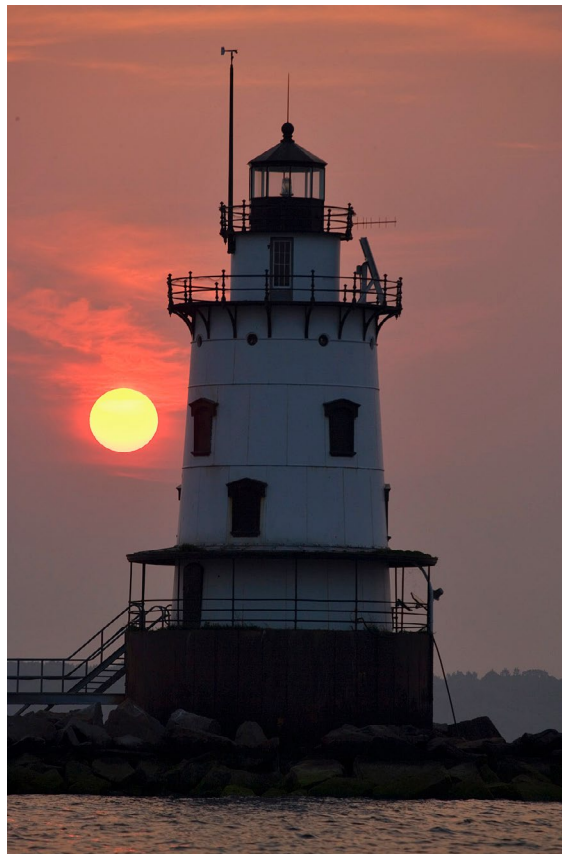




2019

City of Warwick Hazard Mitigation Plan Update



PREPARED FOR
City of Warwick, Rhode Island

PREPARED BY





FEMA

NOV 21 2019

Marc Pappas, Director
Rhode Island Emergency Management Agency
645 New London Avenue
Cranston, Rhode Island 02920

Dear Director Pappas:


The U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA) Region I Mitigation Division has approved the 2019 City of Warwick Hazard Mitigation Plan Update effective **November 12, 2019** through **November 11, 2024** in accordance with the planning requirements of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended, the National Flood Insurance Act of 1968, as amended, and Title 44 Code of Federal Regulations (CFR) Part 201.

With this plan approval, the jurisdiction is eligible to apply to the Rhode Island Emergency Management Agency for mitigation grants administered by FEMA. Requests for funding will be evaluated according to the eligibility requirements identified for each of these programs. A specific mitigation activity or project identified in this community's plan may not meet the eligibility requirements for FEMA funding; even eligible mitigation activities or projects are not automatically approved.

The plan must be updated and resubmitted to the FEMA Region I Mitigation Division for approval every five years to remain eligible for FEMA mitigation grant funding.

Thank you for your continued commitment and dedication to risk reduction demonstrated by preparing and adopting a strategy for reducing future disaster losses. Should you have any questions, please contact Melissa Surette at (617) 956-7559 or Melissa.Surette@fema.dhs.gov.

Sincerely,


Captain W. Russ Webster, USCG (Ret.), CEM
Regional Administrator
FEMA Region I

WRW:ms

cc: Melinda Hopkins, RI State Hazard Mitigation Officer
Samantha Richer, Planning Branch Chief, RI Emergency Management Agency

THE CITY OF WARWICK
STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

RESOLUTION OF THE CITY COUNCIL

NO.....R-19-152..... DATE *November 5, 2019*

APPROVED.....*[Signature]*.....MAYOR

RESOLUTION TO ADOPT UPDATES TO CITY OF WARWICK
LOCAL MULTI-HAZARD MITIGATION PLAN

Resolved that,

WHEREAS, the health, safety and welfare of the citizens of the City of Warwick are matters of paramount importance to the City Council; and

WHEREAS, the Federal Emergency Management Agency ("FEMA") has established that municipalities review and revise their local multi-hazard mitigation plan every five years to reflect changes in development, progress in local hazard mitigation efforts, and changes in mitigation priorities and submit their revised multi-hazard mitigation plan for review and approval by FEMA to remain eligible for pre-disaster mitigation grant funding; and

WHEREAS, the update is a requirement of the FEMA for the City to be eligible to apply for and receive certain types of non-emergency disaster assistance, including grant funding for qualified hazard mitigation projects; and

WHEREAS, per City Council Resolution Number 19-100, as signed by the Mayor, the City of Warwick submitted the required revisions and updates to the Federal Emergency Management Agency for review and approval; and

WHEREAS, FEMA Region 1 found that the Plan updates meet the requirements of 44 CFR 201 and granted Conditional Approval of the Plan on October 4, 2019 with the single condition being that the City formally adopt the Plan.

NOW, THEREFORE, BE IT RESOLVED, that the City Council of the City of Warwick hereby adopts this Resolution to approve and adopt updates to the City of Warwick Multi-Hazard Mitigation Plan in accordance with FEMA requirements.

The City Clerk is hereby directed to forward a copy of this Resolution to the Rhode Island Emergency Management Agency and the Federal Emergency Management Agency.

This Resolution shall take effect upon passage.

SPONSORED BY: COUNCIL PRESIDENT MEROLLA
ON BEHALF OF MAYOR SOLOMON
COMMITTEE: INTERGOVERNMENTAL

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Conimicut Lighthouse



Executive Summary

This Hazard Mitigation Plan (HMP) is a product of the Warwick Hazard Mitigation Committee (HMC). It has been approved by the Warwick City Council, the Rhode Island Emergency Management Agency, and the Federal Emergency Management Agency in accordance with the Disaster Mitigation Act of 2000.

The HMC's overview of past natural hazard occurrences verifies that the City is vulnerable to diverse events including hurricanes, Nor'easters, snow storms, extreme temperatures, flooding, and high winds. The discussion puts the likelihood of these events into historical perspective and recognizes that although the probability of thunderstorms and lightning events may be higher, the intensity and potential impacts from less likely events such as hurricanes can be far greater.

The risk assessment portion of the plan confirms that the City has much to lose from these events. The identified vulnerabilities include flood prone drainage systems and infrastructure, bridges, water supply systems, dams, critical municipal hazard response facilities, populations, businesses, schools, recreation facilities, marinas, historic and natural resources.

To address these risks the 2019 HMP put forth a clear mission, a distinct set of goals and 19 specific mitigation actions. The City's hazard mitigation mission is to reduce losses, promote intergovernmental coordination, develop partnerships, enforce building standards, and continue public education and awareness.

To implement the plan, important goals must be met. The City should protect public health, reduce property damages, minimize social dislocation, reduce economic losses, protect ongoing operations of critical facilities, reduce the dependence and need for disaster assistance, expedite disaster recovery efforts.



1

Introduction

Plan Purpose

The purpose of the Warwick Hazard Mitigation Plan Update is to set forth guidelines of short-term and long-term actions, which will reduce the actual or potential loss of life or property from natural hazardous events such as hurricanes, Nor'easters, snow storms, and flooding, and high wind. This plan was constructed using input from a variety of municipal and private stakeholders and the general public was involved in the planning process. This plan serves as guidance to help the City reduce their losses and vulnerabilities relating to natural hazards.

Hazard Mitigation and its Benefits

Hazard mitigation planning consists of a series of actions taken to identify specific areas that are vulnerable to natural and human-caused hazards within a city or town and seek to permanently reduce or eliminate the long-term risk to human life and property. It coordinates available resources and identifies community policies, actions, and tools for implementation that will reduce risk and minimize future losses. The process of natural hazard mitigation planning sets clear goals, identifies appropriate actions, and produces an effective mitigation strategy that can be updated and revised to keep the plan current. In short, 'it's where we were, where we are and where we're going' in terms of hazard mitigation.

States and communities across the country are slowly, but increasingly, realizing that simply responding to natural disasters, without addressing ways to minimize their potential effect, is no longer an adequate role for government. Striving to prevent unnecessary damage from natural disasters through proactive planning that characterizes the hazard, assesses the community's vulnerability, and designs appropriate land-use policies and building code requirements is a more effective and fiscally sound approach to achieving public safety goals related to natural hazards.

A **Natural Hazard** is defined as an extreme natural event. **Natural Disasters** occur when these extreme natural events come into contact with people and property.

Natural hazard mitigation is any sustained action taken to permanently reduce or eliminate long-term risk to people and their property from the effects of natural hazards.

Natural Hazard mitigation planning is a process undertaken by a community to analyze the risk from natural disasters, coordinate available resources, and implement actions to minimize the damage to property, and injury or loss of life of its citizens before disaster occurs.

In the past, Federal legislation has provided funding for disaster relief, recovery, and some hazard mitigation planning. The Disaster Mitigation Act of 2000 (DMA 2000) is the latest federal legislation to improve this planning process. It reinforces the importance of natural hazard mitigation planning and establishes a pre-disaster hazard mitigation program and new requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP) or other annual funding opportunities. Section 322 of the Act specifically addresses mitigation planning at the state and municipal levels of government. It identifies new requirements that allow HMGP funds to be used for planning activities. As a result of this Act, states and communities must now have a FEMA-approved natural hazard mitigation plan in place prior to receiving post-disaster HMGP funds. In the event of a natural disaster, municipalities that do not have an approved natural hazard mitigation plan will not be eligible to receive post-disaster HMGP funding.

The purpose of this Plan is to recommend actions and policies for the City of Warwick to minimize the social and economic loss of hardships resulting from natural hazards. These hardships include the loss of life, destruction of property, damage to critical infrastructure and critical facilities, loss/interruption of jobs, loss/damage to businesses, and loss/damage to significant historical structures. To protect present and future structures, infrastructure and assets and to minimize the social and economic hardships, the City of Warwick implements some hazard mitigation elements through:


- › Revisions to the City's Comprehensive Plan
- › Local building code review
- › Public education/outreach

The City of Warwick also recognizes the important benefits associated with hazard mitigation, its interaction with municipal land use and infrastructure planning, and the need for a comprehensive planning approach, which accommodates these

interdependencies. The City's Comprehensive Community plan (2014) addresses natural and cultural resources, land use, housing, services and facilities, traffic circulation, open space and recreation, and economic development, among others. While the entire hazard mitigation plan will not be formally incorporated into the Comprehensive Plan, certain, applicable mitigation actions will be incorporated during the update process. The City recognizes coordination between the HMP and the Comprehensive Plan to be of benefit because it will ensure a unified planning approach into the future and ensure that risk reduction remains a critical element of municipal planning. This is also in alignment with current goals of Rhode Island Statewide Planning.

A second benefit of hazard mitigation allows for a careful selection of risk reduction actions through an enhanced collaborative network of stakeholders whose interests might be affected by hazard losses. Working side by side with this broad range of stakeholders can forge partnerships that pool skills, expertise, and experience to achieve a common goal. Proceeding in this manner will help the City ensure that the most appropriate and equitable mitigation projects are undertaken.

A third benefit of hazard mitigation would be endorsing a proactive planning approach focused on sustainability, whereby the City of Warwick could minimize the social and economic hardships that have resulted from the occurrence of previous natural disasters. These social and economic hardships include the loss of life/injuries, destruction of property, interruption of jobs, damage to businesses, and the loss of historically significant structures and facilities. This proactive planning approach would look for ways to combine policies, programs, and design solutions to bring about multiple objectives and seek to address and integrate social and environmental concerns. Linking sustainability and loss reduction to other goals can provide a framework within the state and local governments that will bring the comprehensive planning process full circle.



Every \$1 spent on mitigation saves society an average of \$6 in future disaster costs.

Lastly, the participation in a hazard mitigation planning process will establish funding priorities. The formal adoption and implementation of this plan will allow the City of Warwick and its residents to remain involved in several programs offered by the Federal Emergency Management Agency (FEMA) including: the Community Rating System Program (CRS); the Pre-Disaster Mitigation Assistance Program (PDM); the Flood Mitigation Assistance (FMA) Program; and the Hazard Mitigation Grant Program (HMGP). Money spent today on preventative measures can significantly reduce the cost of post-disaster cleanup tomorrow.

Mission Statement and Goals:

The purpose of the Warwick Multi-Hazard Mitigation Strategy is to:

1. Provide a coordinated consistent set of goals for reducing or minimizing: human and property losses; major economic disruption; degradation of ecosystems and environmental critical habitats; destruction of cultural and historical resources from natural disasters;
2. Provide a basis for intergovernmental coordination in natural hazard mitigation programs at the state and local level;
3. Develop partnerships between the City and private sector, local communities and non-profit organizations in order to coordinate and collaborate natural hazard mitigation programs;
4. Identify and establish close coordination with local government departments and agencies responsible for implementing the sound practices of hazard mitigation through building standards and local land use development decisions and practices; and to
5. Provide for a continuing public education and awareness about the risks and losses from natural disasters, in addition to natural hazard mitigation programs, policies and projects.

Goals

The goals of the Warwick Hazard Mitigation Strategy are to:

1. Protect public health, safety and welfare;
2. Reduce property damages caused by natural disasters;
3. Minimize social dislocation and distress;
4. Reduce economic losses and minimize disruption to local businesses;
5. Protect the ongoing operations of critical facilities;
6. Reduce the dependence and need for disaster assistance funding after natural disasters;
7. Expedite recovery disaster mitigation efforts during the recovery phase;
8. Promote non-structural flood and coastal erosion measures to reduce the risk of damage to the surrounding properties and environmental habitats;
9. Establish a local Hazard Mitigation Committee to support, implement and revise the Warwick multi-hazard mitigation strategy and to provide the support necessary for an ongoing forum for the education and awareness of multi-hazard mitigation issues, program, policies and projects; and to
10. Provide for adequate financial and staffing resources to implement the Warwick Hazard Mitigation Strategy.
11. Maintain an updated, FEMA-approved Hazard Mitigation Plan in accordance with 44 CFR 201 such that the City of Warwick is eligible to apply and receive assistance under federal hazard mitigation assistance programs.

Background

Warwick is located in east-central Rhode Island along the western coast of Narragansett Bay (Figure 1) and is comprised of approximately 35 square miles of land area, 39 miles of coastline, and hosts an estimate 2016 population of 81,881.

Warwick is the third largest city in Rhode Island. The city is situated at the center of the state's super-highway system. Theodore Francis (T.F.) Green State Airport is located in Warwick and is the state's largest commercial air terminal. Warwick offers many educational, recreational, and cultural opportunities. The Knight Campus of the Community College of Rhode Island, a State supported facility, is located in Warwick.

Figure 1: Locus Map



Warwick's central location in Rhode Island as well as the easy access for air travel, has made the city a prime area for further industrial, commercial and population growth.

Warwick is a coastal community with approximately 39 miles of coastline along Greenwich Bay and Narragansett Bay. The eastern border of the city includes a mix of developed and undeveloped coastal systems. The southern border of the city is shared with East Greenwich. The city is bordered on the west by West Warwick and Cranston to the north.

Warwick winters are cold and summers are warm. The city enjoys the moderating effect of the Atlantic Ocean and Narragansett Bay, so coastal temperature extremes are rare. Inland areas tend to have more extreme temperatures. The average daily minimum/maximum temperatures range from a low of 23 degrees Fahrenheit in winter to a high of 80 degrees Fahrenheit in summer. Precipitation amounts average 46 inches of rainfall and 33 inches of snowfall annually.¹ Warwick is exposed to severe weather coming up from the south during the summer months and experiences damaging Nor'easters in the winter months.

¹ www.intellicast.com

History

“Warwick was founded in 1642 as a town called Shawomet, after the local indigenous tribe from whom the land on the west shore of Narragansett Bay was purchased. Two years later, the beginning of a 34-year dispute with Massachusetts over title and jurisdiction sent the colony’s founder to England, seeking an official charter to maintain ownership and independence.

“His mission was successful, thanks to Robert Rich, the Earl of Warwick, then Governor-on-Chief of Foreign Plantations. When the charter was granted in 1647, the grateful townsmen promptly re-named the settlement after their benefactor and his family coat-of-arms became its seal.

“In 1772, Warwick was the scene for the first violent act against the Crown when local patriots boarded the British revenue cutter *HMS Gaspee*. It was here that the first English blood of the American Revolution was spilled when the commanding officer of the *Gaspee*, Lt. Duddingston, was shot with a musket ball while resisting the taking of his ship.”

Before the Great Depression and the Great New England Hurricane of 1938, more millionaires called Warwick their summer home than any other location in the country.

“In 1929, the State of Rhode Island began construction of Hillsgrove State Airport in the center of Warwick. When it was completed, it was called “The Most Modern Airport in the Nation”. Now known as Theodore Francis Green State Airport, the airport has recently undergone major renovations and now provides service to both domestic and international destinations.

“Warwick was incorporated as a City in 1931 and elected its first Mayor, Pierce Brereton, in 1932.

By the 1950's the textile industry had left New England and the post-war housing boom was underway. Warwick farms became subdivisions as people left cities for life in the suburbs.”²



Warwick City Hall Tower

² Warwick Rhode Island Digital History Project www.warwickhistory.com

“In the post-World War II era, most of the city’s remaining farms became suburban subdivisions; the resort communities became year-round neighborhoods; traditional village centers lost importance to strip shopping centers; a new, auto-dependent regional retail center emerged with the interstate system; and T.F. Green Airport expanded to serve the region”³

Demographics

The City of Warwick is a residential coastal community with a population of 81,881 (2016 Census). Despite the Community College of Rhode Island’s presence in Warwick the population is, on the average, older than the State average of 40. The median age in Warwick 45 years.

Table 1 Median Age (1980 to 2016)⁴

Year	Warwick	Kent County	Rhode Island
2016 (est.)	45	43.7	39.9
2010	43.3	42.7	39.5
2000	40	38.9	36.7
1990	36.9	35.8	34.0



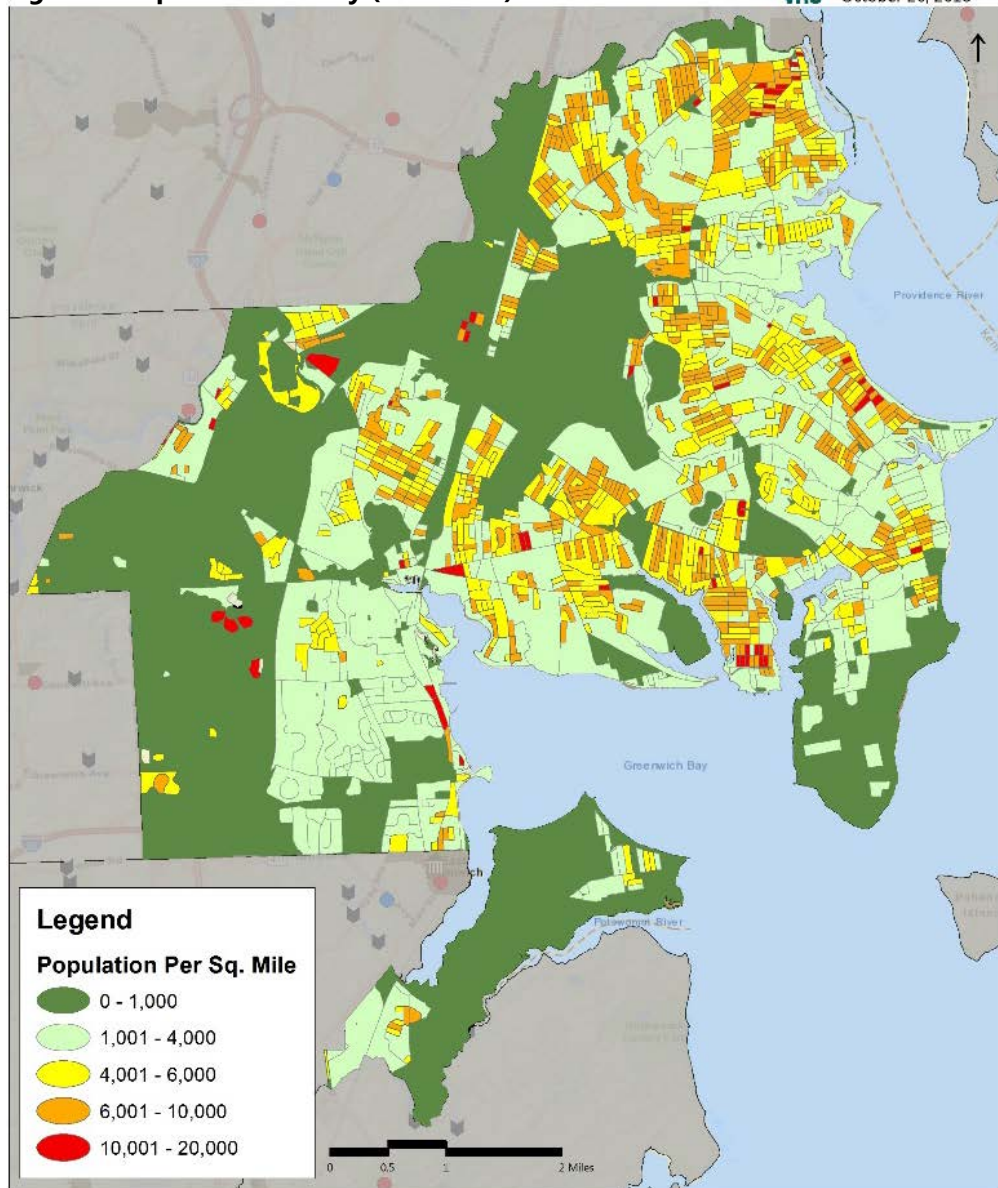
Historic Warwick Lighthouse

³ City of Warwick Comprehensive Plan 2013-2033

⁴ U.S. Census Bureau 1990, 2000, 2010, 2012-2016;

Figure 2: Population Density (2010 data)

vhb October 26, 2018



The population in Warwick is generally clustered in the northeast quadrant, east of Interstate 95. Other pockets of higher population densities are along Route 1 in the Cowesett neighborhood (condominiums and rentals), and south of Route 117/west of Route 95 (The Royal Crest Apartment Homes). The 2010 Population data was used in Figure 2 to estimate the most densely populated areas based on the best available data.

Annually, about 68% of the 37,730 housing units in Warwick are owner-occupied (compared to 60% for the state), and median family income (\$84,421) is a bit higher than the statewide median family income of \$75,655.

Table 2 Demographic Changes

	2010	2016	% Change
Housing Units	37,730	37,621	-0.3%
Population	82,672	81,881	-1%
Owner-occupied housing units	25,478	24,883	-2.3%

Economy

“Warwick’s most important primary industry sectors are health care and social assistance, retail trade, and accommodation and food services, the latter in part encompassing the tourism industry. Together these three industries comprise 44 percent of all wage and salary employment. Other important sectors are government, manufacturing, and finance and insurance. Some of the fastest growing industry segments have been in the health care and the professional and technical services sectors. In health care, growth has been particularly strong in ambulatory health care services, driven by growth in home health care services, and “offices of other health practitioners.” Growth has also occurred in nursing and residential care facilities, and hospitals. In professional and technical services, the most significant growth has occurred in computer systems design, accounting, and “other professional and technical services.” Bucking the overall decline in the retail sector, two retail segments, food and beverage stores, and building material and garden supply stores, have experienced employment growth.”⁵

“Among primary industry sectors, Warwick competes particularly well in transportation and warehousing, real estate and rental and leasing, retail trade, management of companies and enterprises (e.g., national or regional corporate headquarters), and finance and insurance. Warwick’s strength in the first two sectors primarily reflects the presence of T.F. Green Airport, and the high concentrations of employment in industries such as air transportation, couriers and messengers (e.g. Fedex, UPS), and automobile rental, which makes up the bulk of employment in rental and leasing services.”⁶

Government

The City of Warwick is governed by an elected Mayor and City Council with nine members, elected every two years. Day to day operation of the city is managed by the Mayor.

⁵ City of Warwick Comprehensive Plan 2013-2033, Page 8.5

⁶ City of Warwick Comprehensive Plan 2013-2033, Page 8.7

Land Use Patterns

Over half of the city's total land area is used for residential purposes; mainly single-family residences. Other residential areas include: waterfront properties in Oakland Beach, Warwick Neck, and Conimicut; the historic areas; and multi-family residents that are dispersed throughout the city. The amount of land used by commercial and industrial development has grown significantly in recent years. Commercial development that used to center around villages now has set up along major roadway arteries such as I-95 and I-295. One of the more prominent commercial areas, along Route 2, serves as a destination for shoppers throughout Rhode Island. Surprisingly, there is not a lot of commercial development along the waterfront. Some residents would like to see better connections to the waterfront, making it a more walkable and vibrant destination.

"The majority of city government facilities are centrally located within the Village of Apponaug including a cluster of civic buildings: City Hall, the Warwick Fire Department headquarters, and the Warwick Police Department. Remaining public safety facilities are spread out throughout the rest of the city, as are educational uses such as elementary, middle and high schools. Several school



Village of Apponaug

properties are currently being repurposed, the result of declining school enrollments, and additional properties could potentially follow. Other institutional uses include numerous churches thorough the city, Kent County Memorial Hospital and the Community College of Rhode Island Knight Campus."⁷

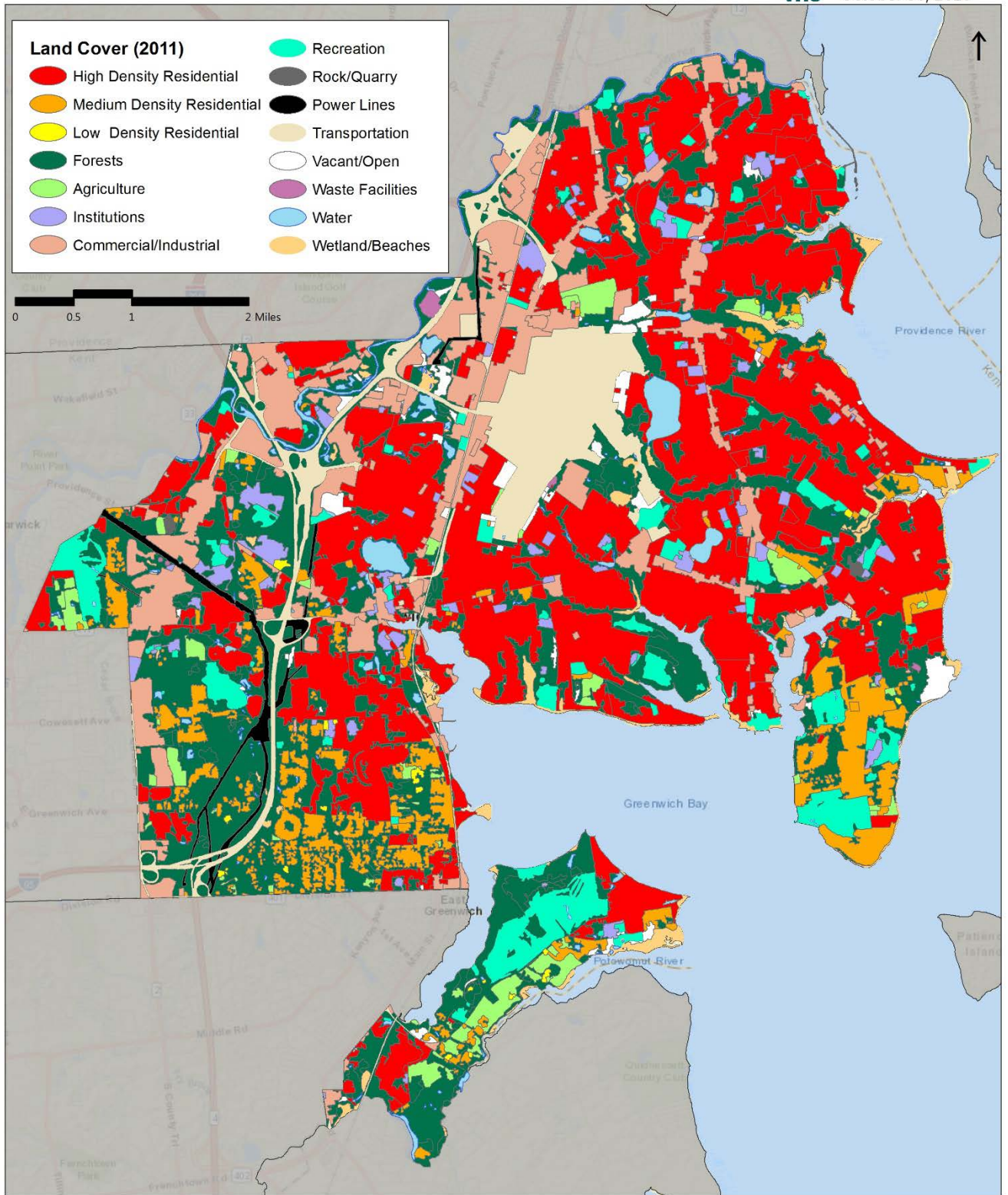
The latest (2011) depiction of land use throughout the city can be seen in Figure 3: Land Use 2011.⁸

⁷ City of Warwick Comprehensive Plan 2013-2033.

⁸ Land Use and Land Cover 2011 data obtained from RIGIS

<https://www.arcgis.com/sharing/rest/content/items/2ca25218976b4fe690427e5c0e17e54d/info/metadata/metadata.xml?format=default&output=html>

Figure 3: Land Use (2011 data)



Law Enforcement

The Warwick Police Department consists of about 172 sworn police personnel. The Department operates twenty-four hours a day and responds to all criminal complaints and city-wide emergencies. The Department is located at 99 Veterans Memorial Drive.

Warwick businesses and residents are protected from fires and other emergencies by ten fire stations. Station 1 and the Chief's Office is located at 111 Veterans Memorial Drive.

Emergency Management Agency

The Warwick Emergency Management Agency (WEMA) is managed by a Director who is a member of the Police Department, and supported by members of the Police, Fire, and Emergency Medical Services (EMS) departments.

The permanently established Emergency Operations Center (EOC) is located in the Fire Department Headquarters located at 111 Veterans Memorial Drive. The WEMA coordinates preparation and response activities to local emergencies with City departments, local fire and police departments, neighboring towns, the Community College of Rhode Island, and the State EMA.

Warwick is fortunate to have a regional Red Cross designated disaster/emergency shelters at Veterans Memorial High School. Pilgrim High School also serves as a primary shelter. Thayer Arena can be activated as a statewide pet shelter during emergencies.

Emergency Medical Services

The Warwick Emergency Services Department provides pre-hospital emergency medical services to the Warwick businesses, residents and visitors. The Department has a location at the Fire Department Headquarters on Veterans Memorial Drive.

Roads and Bridges

There are approximately 166 miles of City-owned roads, 60 miles of state roads, and 75 miles of private roads in Warwick. The major arteries include Interstate 95 which north-south, Route 1 (Post Road), and Route 2 which run north-south. Route 117 is a major east-west connector through Warwick.

There are no large suspension bridges in Warwick however there are numerous bridges that span streams and rivers.

Dams

In 2016 the Department of Environmental Management (DEM) identified 18 dams in the City of Warwick. Two of the 18 dams (Camp Warwick Pond and Grist Mill Apartments) are classified as high hazard dams and one dam is identified as a significant hazard dam. The remainder are considered low hazard.

High Hazard Dam- where failure or misoperation will result in probable loss of human life

Significant Hazard Dam- where failure or misoperation will result in no probable loss of human life but can cause major economic loss, disruption of lifeline facilities or impact other concerns detrimental to the public's health, safety or welfare.

Low Hazard Dam- where failure or misoperation will result in no probable loss of human life and low economic losses

Utilities

Nearly all Warwick residents get their drinking water from the Providence Water Supply Board (surface water) and Kent County Water Authority (groundwater and surface water) through 18 miles of transmission mains. The remaining few receive water from private wells.

Although the City has plans to expand sewer service to some neighborhoods, approximately 70% of the City is connected to sewer. The remainder have onsite septic systems.

The Warwick communication equipment is located throughout the city. Private cellular towers are also located throughout the city.

Forest and Open Space

"Since the early 1990's, the City of Warwick has worked closely with the Rhode Island Tree Council (RITC) to promote efforts on behalf of the city's urban forest. Warwick has an estimated 54,000 public trees, and 107,000 privately owned trees which make up 30% of the tree canopy cover."⁹ Warwick's recreation, conservation, and open space areas are used regionally by local residents as well as those in neighboring towns in Rhode Island.

The natural resources in Warwick are generally managed by one of the following organizations: Warwick Wildlife and Conservation Commission, the Pawtuxet River Authority and Watershed Council, the Warwick Land Trust, the Mill Cove Conservancy, and the Buckeye Brook Coalition and various other neighborhood-based, environmental groups.

Warwick's park features are a mix of six state-owned facilities, and 40 city-owned parks. "There are almost 2,000 acres of open space in Warwick, including large state

⁹ City of Warwick Comprehensive Plan 2013-2033.

and local parks like Goddard Park and City Park that include beaches, ball fields, picnic areas and other facilities; recreational fields, playgrounds and tot lots throughout the city; passive open spaces, city beaches and waterfront parks; and historic cemeteries and other permanently protected open spaces.”¹⁰

Water Resources

Warwick has abundant salt and freshwater resources including beaches, 10 freshwater ponds, portions of 5 rivers, nearly 24 brooks, and over 1,000 acres of inland wetlands. The surface waters in Warwick drain into either the Pawtuxet River Watershed or the Narragansett Bay Watershed; both of which terminate in to the waters of Narragansett Bay.

One of the most influential inland water features in Warwick is the Pawtuxet River. After centuries of pollutants entering the river, and more modern impervious growth along the river, water quality and overall river health are important for the Warwick community. Dam removal, and a restocking program for river herring and American shad have helped with restoration efforts and flood reduction in the lower part of the river.¹¹

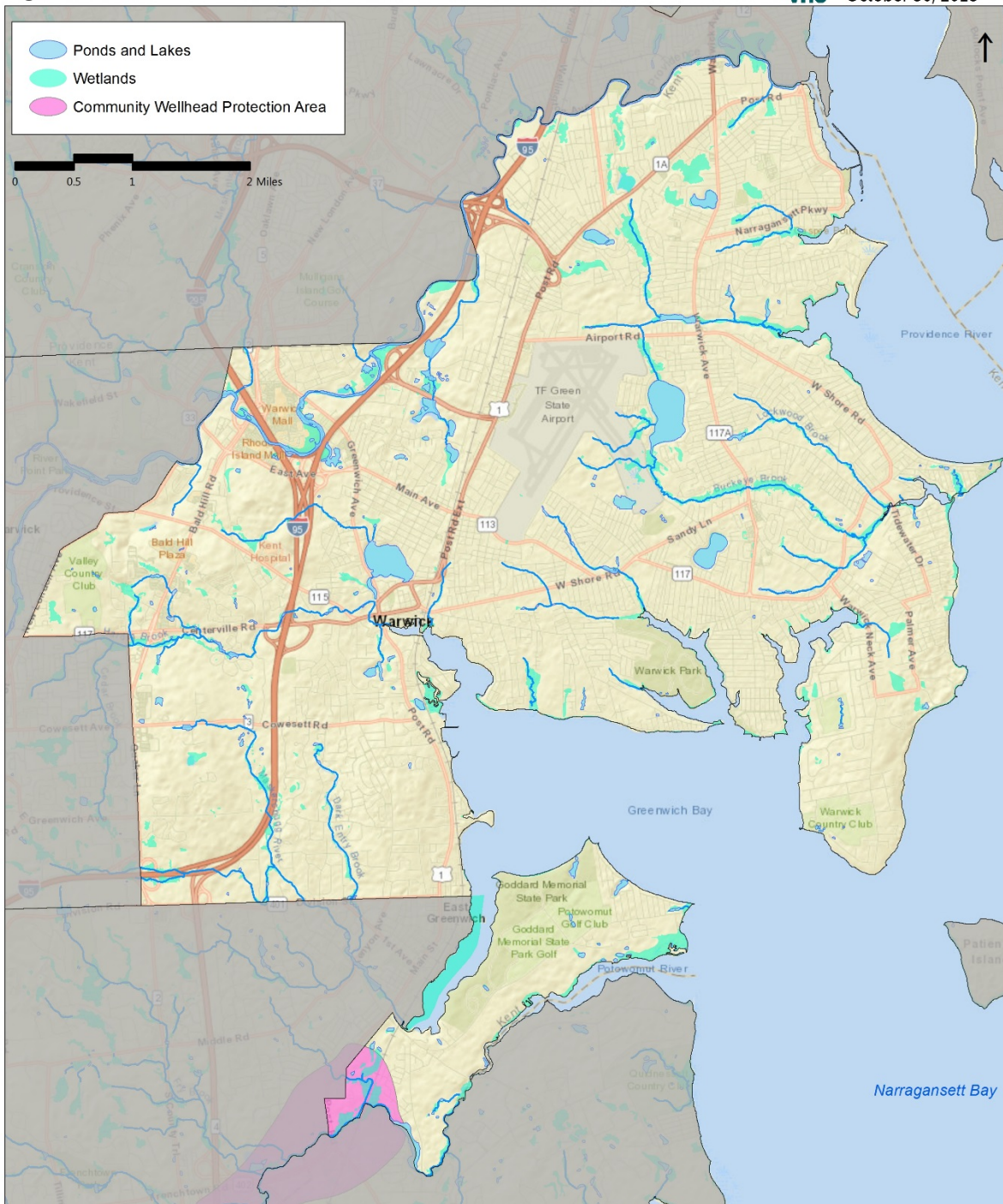


Reconstruction of Pontiac Mills (Nylo Hotel) along the Pawtuxet River after the 2010 Floods.

¹⁰ City of Warwick Comprehensive Plan 2013-2033.

¹¹ City of Warwick Comprehensive Plan 2013-2033.

Figure 4: Water Resources in Warwick



Cultural and Historic Resources

Historic resources and structures provide an irreplaceable link to the cultural history of the City. Historic properties may also be valuable economic assets that attract business and tourism. Historic structures may be more vulnerable to certain hazards since they have fewer safety measures installed.

Warwick is home to many historic homes, and archaeological sites which date back to pre-colonial farming and hunting communities. There are eight Historic Districts and 30 sites listed on the National Register of Historic Places. Of the eight, Warwick has three local historic districts where structures are protected from historically inappropriate exterior changes—Pawtuxet Village, Apponaug Village, and Pontiac Mills; however, many historic areas lack protection. Much of the historic context has been lost over the years, and those assets that remain are often surrounded by incompatible, post WWII sprawling residential and commercial strip development.¹²



Aldrich Mansion Outbuilding

Development Trends Since the 2011 Plan

Warwick is a mature City and most new development is characterized as in-fill residential development and commercial redevelopment. The City has seen an uptick in solar energy projects, including a 5-megawatt facility located along the Airport Connector and a smaller project located on West Shore Road near Apponaug. City Centre Warwick has experienced hospitality sector growth with the construction of a new 125 room hotel and a second 140 room hotel in permitting stages as of spring 2019. The Pontiac Mills building, located along the Pawtuxet River has been redeveloped into a mixed-use apartment building with limited commercial uses.

¹² City of Warwick Comprehensive Plan 2013-2033.

Major physical improvements include the T.F. Green Airport runway extension and safety improvement projects, and the construction of the Apponaug Circulator Project. T.F. Green Airport lengthened the primary runway 5-23 to a total of 8,700 feet, which represents an approximate 1,500 feet extension, a move that will allow the airport to offer nonstop flights to the west coast along with more international flights. Additionally, the runway extension required the relocation of Main Avenue further to the south.



T.F. Green Runway Expansion

The Apponaug Circulator is a five-roundabout project designed to drastically reduce the number of vehicles (25,000 daily) that pounded through the historical village center of Apponaug and relocate them to major roads thus creating a free traffic flow through Warwick, Rhode Island. With the removal of congestion, the area in front of and around Warwick City Hall in Apponaug Village was opened to economic development. The village center is more pedestrian friendly and amenable to restaurants and shops locating there. An 18th century mill site, the Sawtooth Building, isolated by the previous configuration, was sold and is being renovated to house the offices of the American Automobile Association. Additional project benefits included a river relocation which created an open system with improved fish migration.

2

Planning Process

Overview

The City of Warwick initiated the hazard mitigation planning effort in September 2018 under the direction of Executive Order 2018-06, signed by Mayor Solomon.

Warwick Hazard Mitigation Committee

This updated Hazard Mitigation Plan (HMP) is a product of the Warwick Hazard Mitigation Committee (HMC). Committee members include:

- Colonel Rick Rathbun (Chair) Police Chief /EMA Director
- Janine Burke Warwick Sewer Authority
- Al DeCorte Building Official
- Susan Folco* Department of Culture and Development
- Marcel Fontenault Fire Department (Retired 3/19)
- Daniel Geagan Planning Department
- Peter Goolgasian* Mayor's Office
- Debbie Hafferty* Building Department/CRS Official
- Eric Hindinger* Engineering Department
- Karen Jedson Department of Tourism, Culture, and Development
- Dan O'Rourke* Water Department

- Lauren Slocum* Central RI Chamber of Commerce
- Mat Solitro Public Works

* denotes Warwick resident.

Throughout the planning process a representative of the Rhode Island Airport Commission, and various residents participated in the regular meetings.

The Planning Process

This 2019 HMP update is the result of a seven-step process that was initiated in September 2018 with the establishment of the HMC. Membership of the HMC consisted of municipal staff and stakeholders by invitation from the Emergency Management Director. The City retained VHB to assist with the planning effort utilizing funding provided by the FEMA Pre-Disaster Mitigation Grant program.

Step two started the plan development process and included the first meeting of the HMC on September 26, 2018. The HMC met monthly in Warwick.

The City's previous plan was dated 2011, so the first meeting focused on re-ranking hazards and discussing the process for updating the plan. At this initial meeting, the group reviewed a set of questions to be included in an online public survey. The purpose of the survey was to capture the local residents' perception of natural hazards.

The link to the survey was widely distributed on social media and on the City's website. Over 280 people responded to the survey. See Appendix A for survey results.

Step three began with the HMC meeting on October 22, 2018. After reviewing the hazards of concerns and survey results, the HMC identified critical infrastructure and community assets within the city. Fifteen areas of vulnerability were identified: flood prone drainage systems/streets/infrastructure, bridges, wastewater, water supply, services/utilities, communication towers, dams, marinas/docks, critical municipal hazard response facilities, populations, businesses, schools, natural resources, recreational facilities, and historic resources.

During this early phase, the City's consultant reviewed the existing Comprehensive Plan, local ordinances, and gathered information on current infrastructure projects going on within the city.

Current city capabilities were discussed at the meeting on November 29, 2018. Many different departments, committees, and programs already engage in activities that help Warwick be more resilient to a variety of hazards. It is important to highlight these capabilities and show how they support the City's hazard mitigation efforts.

Step four was creating an updated list of mitigation actions to reduce the impact to the identified vulnerable areas. At the November 29, 2018 and the January 3, 2019 meetings the HMC reviewed goals and mitigation items that were proposed in the 2011 plan. Status updates were given for all the previous actions. The incomplete actions that were still important were rolled into the list of actions for this 2019 plan update.

Step five began at the January 3rd meeting where the group reviewed maps and vulnerabilities before brainstorming additional mitigation actions. Included in this step was proposing new actions, establishing action timelines, costs, and identifying responsible parties.

On January 31, 2019, the Committee met as a group and continued to develop new mitigation actions, prioritized their proposed actions (step six). After this meeting the consultant finished the draft of the plan for committee review.

Step seven furthered the public input and review process with general public for review and comment. The plan was posted on the City’s website. Facebook, and made available at City Hall and Library for public review. The Hazard Mitigation Plan was also emailed to the Rhode Island Airport Corporation (RIAC), National Grid, and Planners in the neighboring municipalities of Cranston, West Warwick, and East Greenwich for their review and comments. No comments were received from the general public nor the local municipalities. On August 19, 2019, the draft plan was presented to the Town Council for approval to forward the HMP to the state and FEMA for review.

Table 3 below provides a summary of the Committee’s meeting dates and the activities that they conducted:

Table 3 Committee Meetings

Date	Meeting Summary
09/26/2018	Kick off meeting with new planning contractor, VHB. HMC discussed the plan purpose and hazards of concern. Reviewed survey questions.
10/17/2018	Hazards survey posted online.
10/22/2018	The HMC reviewed the hazards of concern and listed critical infrastructure and community assets.
11/29/2018	Review of community assets and discussion of current capabilities. Review status of 2011 actions.
01/03/2019	Discussed mitigation goals. Brainstormed new mitigation actions.
01/31/2019	Finalized mitigation actions and discussed prioritization.
04/24/2019	Draft plan sent to HMC for review.
07/03/2019	Draft plan sent to City Council members for review. No comments received.
07/24/2019	Draft of 2019 HMP posted for public comment and promoted through social media and on the City’s website. One commenter’s concern about Buckeye Brook was already addressed in the draft plan.
07/24/2019	Draft was emailed to neighboring municipal Planners for review. No comments received.
08/15/2019	End of public comment period. Meeting of the HMP Committee to address comments.
08/19/2019	2019 HMP was presented to City Council to get approval for state and FEMA review.
08/23/2019	Sent to RIEMA for review.

Date	Meeting Summary
	Comments received from RIEMA. Edits made to draft plan by City's consultant under the guidance of the EMA Director.
	Sent to FEMA for review.
	Edits made to draft plan by City's consultant under the guidance of the EMA Director.
	Plan approved and adopted by City Council

Public Input

This hazard mitigation plan benefits from various distinct types of public input strategies that were utilized by the HMC during the drafting process and prior to its adoption by the City Council. Public input for the updated Warwick Hazard Mitigation Plan was primarily collected through a public survey, public meetings and an invitation to comment.

Early in the planning process, the HMC promoted and distributed a "Hazard Perceptions" survey online. The purpose of the anonymous survey was to solicit input from residents and business owners as to which hazards and neighborhoods they are most concerned about. Over 280 individuals participated in the survey. Not surprisingly, about the top concerns included hurricanes/tropical storms, Nor'easters, snow events, ice storms, and high winds. The survey also provided the HMC with a list of problematic areas that are susceptible to flooding. The HMC used the input from the survey to focus their mitigation planning efforts.

The 2019 HMC included a mix of staff, residents and individuals that represented the local businesses community and other stakeholders. The HMC's roles focused on reviewing the content of the risk assessment matrix to ensure proper classification of problems and estimates of potential impacts; formulation of mitigation actions and sequencing of primary tasks; and identification of feasible implementation methods and schedules. Their comments were incorporated into the final 2019 hazard mitigation plan.

Prior to public release of the 2019 HMP, the HMC drafted the plan through a series of committee meetings. While these meetings did not rise to the level of public hearings, they were posted on the Secretary of State's website and were open to the public. Local interest groups, such as the Friends of Warwick Pond and others did occasionally participate.

Another public input strategy was geared toward the general public as opposed to specific stakeholders. During the draft review portion of the plan development, an electronic copy of the draft 2019 HMP was posted to the City's website. The public was informed of both the webpage posting and the public hearing (see Appendix B). They were encouraged to review the document, comment on the HMP and attend the meeting. Notice of the public hearing was also posted as an agenda item on the City's website in accordance with state law. During the public review period, a few comments were received suggesting ways to make the city and residents better prepared to

withstand storms. See the end of Appendix A. On August 15, 2019, the Hazard Mitigation Committee hosted a public meeting in which to receive additional public comments. None were received. At the City Council meeting on August 19, 2019, the Council passed a resolution to submit the draft plan to the Rhode Island Emergency Management Agency for review.

Review and comments from the Federal Emergency Management Agency and the Rhode Island Emergency Management Agency were also incorporated prior to adoption by the City Council.

Warwick updated their Comprehensive Plan in 2014. The current plan includes discussions on floodplains, resource protection districts, and development trends. Members of the HMC were involved in the Comprehensive Plan update and will be incorporating elements of this document into the other plan when it is next updated.

3

Natural Hazards

Hazards of Concern

The Rhode Island 2016 Hazard Identification and Risk Assessment and the 2011 Warwick Hazard Mitigation Plan were used as a starting point for identifying hazards that pose the largest threats to the City. The following table summarizes the hazards identified by the Warwick Hazard Mitigation Committee.

Table 4 Hazards Identified by the Warwick Hazard Mitigation Committee and the State

Natural Hazards Identified by the State	Identified by the WHM Committee	Notes
Severe Winter Weather		
<i>Ice Storm</i>	✓	
<i>Snow</i>	✓	
Flood		
<i>Riverine</i>	✓	
<i>Coastal</i>	✓	
<i>Flash</i>	-	Conditions generally not present
<i>Urban/Street</i>	✓	
High Wind	✓	

Natural Hazards Identified by the State	Identified by the WHM Committee	Notes
Extreme Heat	✓	
Hurricane and Tropical Storms		
<i>Nor'easter</i>	✓	
<i>Storm Surge</i>	✓	Included with coastal flooding
Extreme Cold	✓	
Thunderstorm		
<i>Hail</i>	✓	
<i>Lightning</i>	✓	
Dam Failure	✓	
Fire		
<i>Urban</i>	-	Focus on natural hazards
<i>Wildfire/Brushfire</i>	✓	
Sea Level Rise	✓	
Epidemic	-	Focus on natural hazards
Drought	✓	
Earthquake	✓	
Tornado	✓	
Human-Caused Hazards		Notes
Cyber Security	-	Not covered by this natural hazard plan
Chemical Incident	-	Not covered by this natural hazard plan
Terrorism	-	Not covered by this natural hazard plan
Biological Incident	-	Not covered by this natural hazard plan
Radiological Incident	-	Not covered by this natural hazard plan
Civil Unrest	-	Not covered by this natural hazard plan
Technological Hazards		Notes
Infrastructure Failure	-	Not covered by this natural hazard plan

During the beginning phases of the planning process, the Hazard Mitigation Committee participated in an exercise that captured the frequency of various hazards, their potential damage extent, and their impacts (e.g. to populations, infrastructure, natural environment, etc.). The following scales were used during the analysis:

Probability of Future Occurrence

Highly likely: near 100% probability within the next year;

Likely: between 10% and 100% probability within the next year or at least one chance in next 10 years;

Possible: between 1% and 10% probability within the next year or at least one chance in next 100 years;

Unlikely: less than 1% probability in next 100 years

Damage Extent

Low: some local property damage not city-wide, minor injuries/ no loss of life

Medium: 50% of property could be damaged and possible injuries/ possible loss of life

High: major city-wide property damage, injuries and loss of life

Anticipated Probability of Risk

Developed by the HMC to rank the various hazards based on frequency and damage potential.

Low - not expected to occur with any frequency, damages will be limited

Medium - will occur within the next 10 years but the City has resources to reduce risks

High - expected to occur within the next 5 years and is a major concern for the City, city-wide impacts.

Based on a combination of probability of future occurrence, damage extent and impacts, the team assigned each hazard a Level of Concern. The table below summarizes the hazards of concern for the City of Warwick, ranked from a high concern to low concern.

Table 5 Hazards Ranked

Hazard	Anticipated Probability of Risk
Hurricane	High
Nor'easter	High
Snow Storm	High
Extreme Heat and Cold	Medium
Flooding (Urban/Street)	Medium
High Winds	Medium
Ice Storm	Medium
Brushfire	Low
Coastal Erosion	Low
Dam Failure	Low
Drought	Low
Earthquake	Low
Flooding (Riverine)	Low
Flooding (Coastal)	Low
Hail	Low

Hazard	Anticipated Probability of Risk
Lightning	Low
Sea Level Rise	Low
Tornado	Low

Climate Change

In this hazard mitigation plan, climate change is treated as an ongoing amplifier to the identified natural hazards. According to the State of Rhode Island 2016 Hazard Identification and Risk Assessment, “climate change is both a present threat and an ongoing hazard that is expected to have a significant impact on municipalities, including those in Rhode Island. It acts as an amplifier for existing natural hazards.¹³ Extreme weather events have become more frequent during the past half-century, and this trend is projected to continue.¹⁴ For instance, more frequent intense precipitation events may translate into more frequent flooding episodes. The National Climate Assessment and Development Committee has documented that the average temperature across the United States has increased 1.5°F since 1895, with the majority of the increase since 1980. Weather events have and will continue to become more intense and frequent and will result in health and livelihood related impacts; such as water supply, agriculture, transportation, and energy. The impact of dynamic storm events includes, but is not limited to, more frequent and intense heat waves, increases in ocean and freshwater temperatures, frost-free-days, heavy downpours, floods, sea level rising, droughts, and wildfires.^{15” 16}

Potential climate change impacts will be mentioned for each hazard.

The following sub-sections are organized by the level of risk as identified in the table above.

13 The Copenhagen Diagnosis, 2009: Updating the World on the Latest Climate Science. I. Allison, N.L. Bindoff, R.A. Bindshadler, P.M. Cox, N. de Noblet, M.H. England, J.E. Francis, N. Gruber, A.M. Haywood, D.J. Karoly, G. Kaser, C. Le Quéré, T.M. Lenton, M.E. Mann, B.I. McNeil, A.J. Pitman, S. Rahmstorf, E. Rignot, H.J. SchellInhuber, S.H. Schneider, S.C. Sherwood, R.C.J. Somerville, K. Steffen, E.J. Steig, M. Visbeck, A.J. Weaver. The University of New South Wales Climate Change Research Centre (CCRC), Sydney, Australia, 60pp.<http://www.copenhagendiagnosis.com/>

14 IPCC, 2012 - Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (Eds.) Available from Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 8RU ENGLAND, 582 pp.

15 National Climate Assessment and Development Advisory Committee (NCADAC) January 2013 Draft Climate Assessment Report. <http://ncadac.globalchange.gov/>

16 RI Emergency Management Agency, State of Rhode Island Hazard Identification and Risk Assessment. November 2016

Hurricanes (Tropical Cyclones)

Description

Tropical cyclones, a general term for tropical storms and hurricanes, are low pressure systems that usually form over the tropics. These storms are referred to as “cyclones” due to their rotation. Tropical cyclones are among the most powerful and destructive meteorological systems on earth. Their destructive phenomena include very high winds, heavy rain, lightning, tornadoes, and storm surge. As tropical storms move inland, they can cause severe flooding, downed trees and power lines, and structural damage (Rhode Island State Hazard Mitigation Plan 2014).

There are three categories of tropical cyclones:

1. Tropical Depression: maximum sustained surface wind speed is less than 39 mph
2. Tropical Storm: maximum sustained surface wind speed from 39-73 mph
3. Hurricane: maximum sustained surface wind speed exceeds 73 mph

Once a tropical cyclone no longer has tropical characteristics it is classified as an extratropical system (Rhode Island State Hazard Mitigation Plan 2014).

Most Atlantic tropical cyclones begin as atmospheric “easterly waves” that propagate off the coast of Africa and cross the tropical North Atlantic and Caribbean Sea. When a storm starts to move toward the north, it begins to leave the area where the easterly trade winds prevail and enters the temperate latitudes where the westerly winds dominate. This situation produces the eastward curving pattern of most tropical storms that pass through the Mid-Atlantic region. When the westerly steering winds are strong, it is easier to predict where a hurricane will go. When the steering winds become weak, the storm follows an erratic path that makes forecasting very difficult (Rhode Island State Hazard Mitigation Plan 2014).

Hurricanes are categorized according to the Saffir/Simpson scale (Table 6) with ratings determined by wind speed and central barometric pressure. Hurricane categories range from one (1) through five (5), with Category 5 being the strongest (winds greater than 155 mph). A hurricane watch is issued when hurricane conditions could occur within the next 36 hours. A hurricane warning indicates that sustained winds of at least 74 mph are expected within 24 hours or sooner (Rhode Island State Hazard Mitigation Plan 2014).

The Saffir-Simpson scale below is based primarily on wind speeds and includes estimates of barometric pressure and storm surge associated with each of the five categories. It is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall.

Table 6 Saffir/Simpson Hurricane Wind Scale¹⁷

Wind Speed	Typical Effects
<p>Category 1 – Weak</p> <p>74-95 MPH (64-82kt)</p>	<p>Minimal Damage: Damage is primarily to shrubbery, trees, foliage, and unanchored mobile homes. No real damage occurs in building structures. Some damage is done to poorly constructed signs.</p> <p>Examples:</p> <ul style="list-style-type: none"> • Hurricane of 1938 in RI • Hurricane Carol 1954 in RI (decreasing wind speeds as it moved inland) • Hurricane Gloria 1985 in RI (decreasing wind speeds as it moved inland)
<p>Category 2 – Moderate</p> <p>96-110 MPH (83-95kt)</p>	<p>Moderate Damage: Considerable damage is done to shrubbery and tree foliage; some trees are blown down. Major structural damage occurs to exposed mobile homes. Extensive damage occurs to poorly constructed signs. Some damage is done to roofing materials, windows, and doors; no major damage occurs to the building integrity of structures.</p> <p>Examples:</p> <ul style="list-style-type: none"> • Hurricane Bob 1991 in Rhode Island
<p>Category 3– Strong</p> <p>111-130 MPH (96-113kt)</p>	<p>Extensive damage: Foliage torn from trees and shrubbery; large trees blown down. Practically all poorly constructed signs are blown down. Some damage to roofing materials of buildings occurs, with some window and door damage. Some structural damage occurs to small buildings, residences and utility buildings. Mobile homes are destroyed. There is a minor amount of failure of curtain walls (in framed buildings).</p>
<p>Category 4 – Very Strong</p> <p>131-155 MPH (114-135kt)</p>	<p>Extreme Damage: Shrubs and trees are blown down; all signs are down. Extensive roofing material and window and door damage occurs. Complete failure of roofs on many small residences occurs, and there is complete destruction of mobile homes. Some curtain walls experience failure.</p> <p>Examples:</p> <ul style="list-style-type: none"> • Hurricane Charlie 2004 (FL)
<p>Category 5 – Devastating</p> <p>Greater than 155 MPH (135kt)</p>	<p>Catastrophic Damage: Shrubs and trees are blown down; all signs are down. Considerable damage to roofs of buildings. Very severe and extensive window and door damage occurs. Complete failure of roof structures occurs on many residences and industrial buildings, and extensive shattering of glass in windows and doors occurs. Some complete buildings fail. Small buildings are overturned or blown away. Complete destruction of mobile homes occurs.</p> <p>Examples:</p> <ul style="list-style-type: none"> • Hurricane Andrew 1992 (FL/LA) • Hurricane Katrina 2005 (LA) • Hurricane Wilma 2005 (FL) • Hurricane Maria 2017 (Puerto Rico)

17 National Weather Service, National Hurricane Center

Storm surge is the abnormal rise in water level caused by the wind and pressure forces of a hurricane or nor'easter (Rhode Island State Hazard Mitigation Plan 2014). According to the National Hurricane Center, storm surge flooding has accounted for about half of the hurricane-related deaths since 1970. Given today's ever-increasing population densities in coastal communities, the need for information about the potential for flooding from storm surge has become even more important.

Location

The City's close proximity to the Atlantic Ocean renders it particularly susceptible to hurricanes and the resulting loss of human life and property.

Probability of Future Occurrence

Likely.

Extent (Event Magnitude)

Hurricanes that likely make it up to Rhode Island are usually weak (Category 1) or downgraded tropical systems. The wind speeds may be lower but the storms can still bring a lot of rain which can cause widespread flooding.

Impact and Damage Extent

Warwick is a coastal community. Hurricane strength storms can cause coastal flooding, dangerous storm surge, and widespread inland flooding. The rain and storm surge alone could damage homes, roads, businesses, and infrastructure, and cripple the city. The high winds could down power lines and trees, and damage mobile homes or older structures. During extremely dangerous conditions, the City may elect to open shelters which can easily become stressed during the tourism season. Damages to roofs and basement flooding could also put a halt to the real estate market. Damage extent is dependent upon the size and timing of the storm. A slow-moving storm may sit offshore and bring more rain to the area than a fast-moving storm.

Climate Change Impacts

Warming global air and water temperatures may increase the intensity of hurricanes that travel along the Atlantic Coast.

History

The unforeseen Great New England Hurricane of 1938 is the most catastrophic weather event in Rhode Island and history. The event occurred slightly before high tide and brought with it winds upward of 120 mph.

"The Great New England Hurricane of 1938, originating in the far-eastern Atlantic, was one of the most powerful and devastating storms in New England history. The wind speed of this hurricane reached record highs of over 120 mph and resulted in flood tides of more than 12 feet above the normal high water line in Greenwich Bay (Journal-Bulletin, 1979). The phase of the moon and the autumnal equinox

combined to produce one of the highest tides of the year and the storm surge coincided almost exactly with it from ebb to flood (Brown, 1979), exacerbating the impact of the storm (Boothroyd's hurricane figure showing quadrant hits).

"Property losses in and around Greenwich Bay from the Great New England Hurricane of 1938 were substantial. Among these were the loss of more than 700 permanent residences and hundreds of summer homes in Warwick, the devastation of Rocky Point (the oldest resort in Rhode Island), and the destruction of Scalloptown in neighboring East Greenwich (Journal-Bulletin, 1979). The Warwick Point lighthouse, which sits on a 20-foot cliff, was undermined by a 38-foot recession due to heavy erosion (Brown, 1979). After the hurricane of 1938, the Warwick Light was moved landward 75 feet. The erosion and changing coastline not only impacted the local infrastructure but has also had an impact on various habitats within the Bay.

"Hurricane Carol (1954) was the most destructive storm to hit New England since the Great New England Hurricane of 1938. Sustained winds of 80 to 110 mph resulted in \$3 million worth of property damage in Warwick; flash flooding in Apponaug; and an estimated \$250,000 worth of damages to Rocky Point. Storm surges were just below the 1938 Hurricane levels. Oakland Beach was the most heavily battered section along the upper Narragansett Bay due to its exposure to southeast winds. Many observers noted that the destruction to Oakland Beach was identical to what occurred in the 1938 storm. Apponaug, Chepiwanoxet, and Potowomut shores were littered with "houses, industrial structures, docks and stately trees" (Providence Journal Company, 1954). Greenwich Cove escaped the full force of the hurricane due to its location, and fishing and pleasure boats survived the storm with minor battering. The entire State lost electrical power during this storm (Journal-Bulletin, 1979).



Conimicut Point after Hurricane Carol, 1954



Flooded Suburban Parkway after Hurricane Carol, 1954 (John Greene Collection)



Rocky Point after Hurricane Carol, 1954 (John Greene Collection)



Shore Dinner Pavilion at Rocky Point

Rocky Point after Hurricane Carol, 1954

“Hurricane Bob reached Rhode Island on August 19, 1991 after developing in the Central Bahamas three days earlier. This hurricane caused a storm surge of 5 to 8 feet along the Rhode Island shore. Bob’s damage in Rhode Island was primarily from the sustained winds of 75 to 100 mph. The winds caused over 60% of the residents across Rhode Island and Southeast Massachusetts to lose electricity due to tree and power line damage. Agricultural losses in peach and apple orchards were substantial. Boat damage from this hurricane was significant, as many were torn from their moorings (Vallee and Dion, 1998). The storm path of Bob was quite similar to Hurricane Carol (1954). Though the storm hit at high tide as a Category 2 hurricane, its center passed over Massachusetts. Rhode Island suffered over \$115 million dollars in damage, with spillage of 100 million gallons of untreated sewage into Narragansett Bay and a resulting nine-day shellfish bed closing (RIEMA 1995). Each of these major storms had significant northward acceleration. The average forward speed at time of landfall was 51 km/hr. The Great New England Hurricane of 1938 registered 82 km/hr.”¹⁸

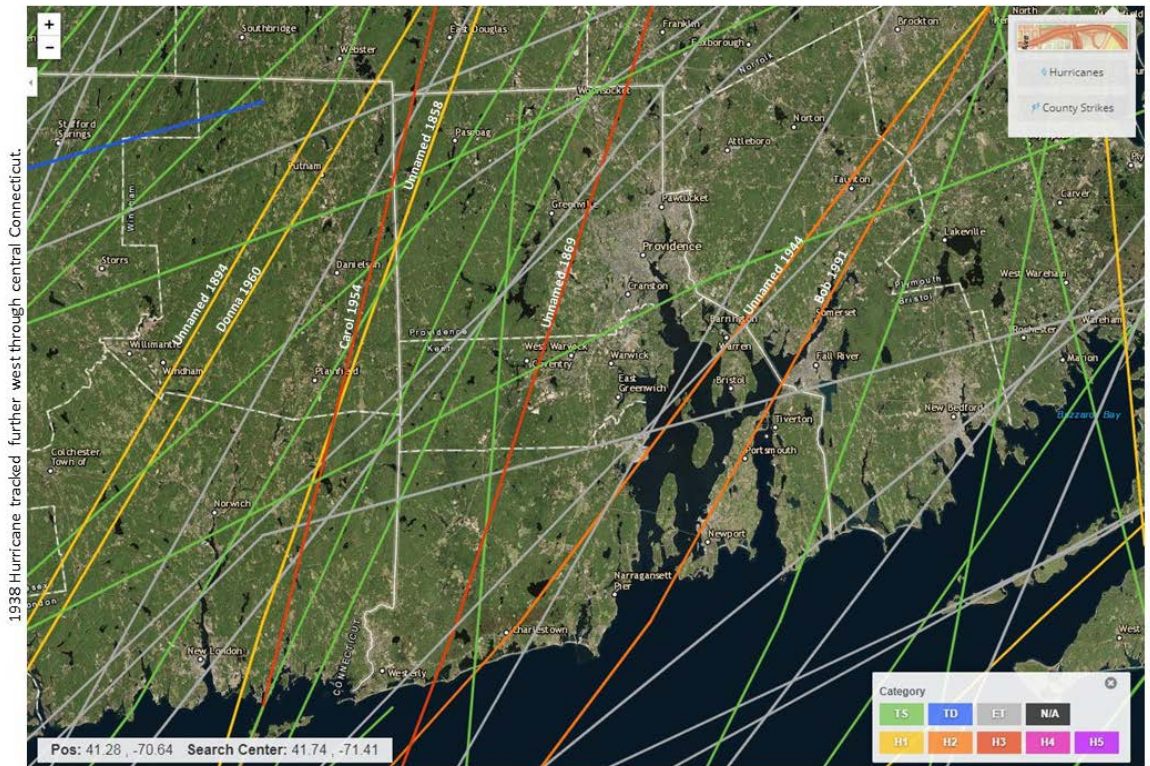
In 2011, Hurricane Irene hit Warwick as a tropical storm. Despite the relatively low wind speeds, sustained winds over a 6 to 12-hour long duration resulted in widespread tree damage and resulted in power outages to roughly half a million customers throughout the state. Numerous trees, poles, and wires were downed throughout Warwick. Local roads were also flooded. Collective effects throughout Massachusetts and Rhode Island resulted in one fatality, no injuries, and \$127.3 million in property damage.¹⁹

¹⁸ City of Warwick, Local Multi-Hazard Mitigation Plan, 2012

¹⁹ NOAA Storm Event Database (accessed September 2018).

In October 2012, Hurricane Sandy severely impacted coastal Rhode Island as it came ashore with Tropical Storm strength winds. Warwick was mainly impacted by flooding, minor erosions, and minor tree damage. Whipple Avenue was the only street that required minor repairs after the storm. Since many of the weaker trees had fallen in 2011 during Irene, the tree damage from Sandy was not as great as it could have been.

Figure 5 **Historic Hurricane Tracks near Rhode Island**



Source: NOAA Historical Hurricane Tracks 1842 to 2017 <https://coast.noaa.gov/hurricanes/>

Nor'easters

Description

A strong low-pressure system along the Mid-Atlantic and New England, can form over land or over coastal waters. The storm radius is often as large as 1,000 miles, and the horizontal storm speed is about 25 miles per hour, traveling up the eastern United States coast. Sustained wind speeds of 10-40 MPH are common during a nor'easter, with short term wind speeds gusting up to 70 MPH. Typically a winter weather event, Nor'easters are known to produce heavy snow, rain and heavy waves along the coast. Unlike hurricanes and tropical storms, nor'easters can sit off shore, wreaking damage for days.

Also called East Coast Winter Storms, Nor'easters are characterized by:

- › A closed circulation.
- › Located within the quadrilateral bounded at 45N by 65W and 70W, and at 30N by 85W and 75W.
- › Show a general movement from the south-southwest to the north-northeast.
- › Contain sustained winds greater than 23 mph.
- › The above conditions must persist for at least a 12-hour period²⁰.

The magnitude or severity of a severe winter storm or Nor'easter depends on several factors including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, and time of occurrence during the day (e.g., weekday versus weekend), and season.

The extent of a severe winter storm (including Nor'easters that produce snow) can be classified by meteorological measurements and by evaluating its combined impacts. For measuring wind effects, the Beaufort Wind Scale is a system that relates wind speed to observed conditions at sea or on land (See Figure 6). The snow impact of a Nor'easter can be measured using NOAA's Regional Snowfall Index (See the section *Snow Storm*).

Location

Warwick's close proximity to the Atlantic Ocean renders it particularly susceptible to Nor'easters and the resulting loss of human life and property.

Probability of Future Occurrence

Highly Likely.

20 Hersher, et al. An East Coast Winter Storm Climatology. Northeast Regional Climate Center, Cornell University, Ithaca, NY, 2001.

Extent (Event Magnitude)

On average, Warwick experiences or is threatened by a Nor'easter every couple of years.

Impact and Damage Extent

Warwick is a coastal community; most damage would be to utilities, roads, stormwater infrastructure, marine infrastructure, personal property, trees, and snow loads on roofs. Expected damages are similar to those from a hurricane. The Blizzard of 1978 was the largest Nor'easter on record. Many people in Rhode Island were without heat and electricity for over a week.

Climate Change Impacts

Similar to hurricanes, changes in air and water temperatures may lead to stronger Nor'easters along the Atlantic Ocean. Warwick should plan for stronger and more frequent severe storms.

History

Table 7 Nor'easter History²¹

Date	Comments
02/10/1969	Up to 20 inches of snow in parts of Rhode Island
02/06/1978	Catastrophic snow storm in Southern New England. 3' of snow reported in nearby Providence.
02/11/1994	Major Nor'easter. School closed by noon, business and highway travel disrupted.
02/18/1998	Heavy rainfall, isolated flash floods, and thunderstorms to mainly central and southern Rhode Island. 2.16 inches of rain at T.F. Green Airport in Warwick during a 12-hour period.
02/23/1998	Second Nor'easter to affect region in less than one week brought heavy rainfall and strong winds. 2" of rain fell in Coventry.
03/21/1998	Spring Nor'easter brought a mixture of snow, sleet, and rain to Rhode Island. Over the northern half of the state, snow accumulation was from 2 to 4.5 inches.
05/25/2005	Late season Nor'easter brought strong winds and heavy rains, some gusts as high as 60 Mph.
02/12/2006	Heavy snow (9.4 inches at T.F. Green) and windy conditions.
01/12/2011	A developing nor'easter coastal storm dumped nearly two feet of snow across portions of Rhode Island in a 24 hour period.

²¹ NOAA Storm Event Database for flood events in Kent County. <https://www.ncdc.noaa.gov/stormevents/>

Date	Comments
10/29/2011	A rare and historic October Nor'easter brought very heavy snow to portions of southern New England on Saturday October 29. Low pressure tracked northeast from the North Carolina coast Saturday morning, rapidly strengthening as it passed well south of Nantucket Saturday evening. As the storm intensified, colder air from aloft was drawn into New England resulting in heavy snow in the interior. 2-3 inches of snow fell across eastern Kent County.
01/26/2015	An Alberta clipper that turned into a strong Nor'easter brought heavy snow and strong winds to the region. About a foot and a half of snow fell across western Kent County.
02/08/2015	Long duration snow storm that dumped 7-10 inches of snow in eastern Kent County.
03/14/2017	Heavy wet snow followed by plunging temps hampered roads. Strong/damaging winds gusted to 45 to 60 mph across much of Rhode Island. There was no significant damage in Warwick; just snow removal and minor tree damage.

Snow Storm

Description

The majority of Rhode Island lies outside the heavy snow and ice regions of the northeast. Due to its maritime climate, Rhode Island generally experiences cooler summers and warmer winters than inland areas. However, snow and ice do occur and can be more than an inconvenience and cause extensive damage. The two major threats from these hazards are loss of power due to ice on electrical lines and snow loading on rooftops. Additionally, loss of power could mean loss of heat for many residents.

Winter storms vary in size and strength and can be accompanied by strong winds that create blizzard conditions and dangerous wind chill. There are three categories of winter storms. A blizzard is the most dangerous of the winter storms. It consists of low temperatures, heavy snowfall, and winds of at least 35 miles per hour. A heavy snow storm is one which drops four or more inches of snow in a twelve-hour period. An ice storm occurs when moisture falls and freezes immediately upon impact.

Location

A severe winter storm could have a serious impact in private, and public structures, as well as the general population throughout Warwick.

Probability of Future Occurrence

Highly Likely.

Extent (Event Magnitude)

On average, Warwick receives 33 inches of snow throughout the year. The average winter temperature (December-February) in Warwick is 39.3 Fahrenheit.²²

Impact and Damage Extent

The combination of wind, ice, and snow can have a crippling effect on the city. Wind and ice impacts are described in their respective sections of this plan. Heavy and/or excessive snowfall amounts can stress roofs and hinder slow plowing efforts, as well as cause power outages.

Climate Change Impacts

Warwick may likely see less snowfall over the winter season but may see more intense blizzards when they do occur.

History

Warwick has been subjected to annual snowstorms and Nor'easters. The Great Blizzard of 1978 blanketed Warwick with 28.6 inches of snow and closed businesses for several days. In February 2013, Winter Storm Nemo temporarily crippled the city. Power lines were downed, and road crews had a challenging time keeping the roads passable.

Table 8 History of Blizzard and Winter Storm Events in and Near Warwick

Date	Inches	Comments
01/20/2001	7	7" in Warwick. Minor accidents reported throughout state, few power outages.
03/05/2001	7	6.5" reported at T.F. Green Airport in Warwick. Schools and businesses were shut down for three days in some communities throughout the state.
11/27/2002	5-7	7" in Warwick though storm occurred the day before Thanksgiving, travel was not notably interrupted.
12/05/2002	6	Warwick received 6" of heavy snow.
02/07/2003	6-12	Storm total at T.F. Green Airport in Warwick was 7.2". The main impact was to travel, as police and fire departments responded to numerous fender-benders. No injuries were reported.
02/17/2003	15	Major winter storm. Storm total at T.F. Green Airport was 15 inches.
03/06/2003	5-10	5" reported in Warwick.
12/05/2003	10-20	17" reported at T.F. Green in Warwick. Transportation was greatly disrupted during this storm.
12/26/2004	17	17" reported at T.F. Green in Warwick. There were dozens of car accidents state wide due to slick roads and poor visibility. High gusts of wind reported.
01/22/2005	15-25	23.4" reported at T.F. Green in Warwick which was the second greatest snowstorm for the Providence area since records began in 1905. Winds gusting wind as high as 60mph creating blizzard condition making travel impossible during the height of the storm.

22 Intellicast <http://www.intellicast.com/Local/History.aspx?location=USRI0063>

Date	Inches	Comments
02/24/2005	5-8	5.8" reported at T.F. Green in Warwick.
03/01/2005	4-8	Officially, the snowfall total at T.F. Green State Airport in Warwick was 6.9 inches.
02/12/2006	9-16	Storm created blizzard conditions with high winds and heavy snowfall. 9.4 inches of snow accumulated at T.F. Green airport, which breaks the previous record snowfall maximum for the date.
12/13/2007	12	Snow fell at rates up to 2 inches an hour for 8 to 10-hour period. Many motorists were affected as early dismissals from work and school just before snow began created rush hour like conditions which limited the snowplows ability to plow.
12/19/2008	9-11	Snow started early afternoon and intensified quickly.
12/31/2008	5-7	In addition to the snow this storm brought with it very cold temperatures and strong winds.
01/18/2009	6-7	No major disruptions caused by snow.
03/01/2009	10-12	Storm caused many car accidents and flight cancellations.
12/26/2010	10	A strengthening winter storm passed southeast of Nantucket and brought heavy snow and strong winds to much of Rhode Island, resulting in near blizzard conditions at times. Officially, the snowfall total at T.F. Green State Airport in Warwick was 9.6 inches. Sustained winds of 40 mph with gusts as high as 54 mph were also reported, leading to near blizzard conditions at times.
01/12/2011	12-15	With only a brief thaw in between the December storm and the January storm, snow piled up across southern New England resulting in numerous roof collapses, towns seeking permission to dump excess snow in area rivers and bays, and numerous disruptions to transportation.
02/1/2011	6	A total of 6 inches of snow fell across Eastern Kent County over the two-day period, with upwards of a tenth of an inch of ice accumulation for isolated locations falling during the morning period on the 2nd.
01/21/2012	7-8	Amateur Radio operators reported 7 to 8 inches of snow on the ground.
12/29/2012	8-11	Snowfall totals between eight and eleven inches were reported in eastern Kent County.
02/08/2013	18-22	An historic winter storm deposited tremendous amounts of snow over all of southern New England. Eighteen to twenty-two inches of snow fell across eastern Kent County.
01/02/2014	7-9	Seven to nine inches of snow fell across eastern Kent County.
01/22/2014	5-8	Five to eight inches of snow fell across eastern Kent County.
01/26/2015	11-20	The Blizzard of January 2015 produced very strong winds late Monday into Tuesday near the Massachusetts and Rhode Island coasts where gusts of 50 to 65 mph were common. The Governor of Rhode Island declared a state-wide travel ban beginning at midnight on January 27th and continuing through 8 pm. Blizzard conditions occurred at nearby T.F. Green Airport from approximately 6 am to 9 am. Outside this time frame, near blizzard conditions occurred with gusty winds and limited visibilities. Eleven to twenty inches of snow fell across eastern Kent County.
02/02/2015	7-10	Seven to ten inches of snow fell across eastern Kent County.
02/08/2015	7-10	Seven to ten inches of snow fell across eastern Kent County.
02/14/2015	8-12	Eight to twelve inches of snow fell across eastern Kent County.

Date	Inches	Comments
01/23/2016	5-9	With bare trees, there was remarkably little damage associated with winds that gusted near hurricane force at times.
02/5/2016	5-8	Five to eight inches of snow fell across eastern Kent County. In addition, heavy snow downed a tree on Stony Creek Drive in nearby West Warwick.
02/8/2016	5-7	Five to seven inches of snow fell across eastern Kent County.
04/4/2016	5-7	Early April snowstorm. Five to seven inches of snow fell across eastern Kent County.
01/7/2017	10-12	Snow and wind event. Ten to twelve inches of snow fell on Eastern Kent County during the day and evening.
02/09/2017	11to 14	Strong winds and heavy snow event. Eleven to fourteen inches of snow fell on Eastern Kent County.
03/14/2017	7	A major winter storm brought snow and strong damaging winds. The Dept. of Transportation reported 6.5 inches of snow in Warwick and a trained spotter reported 6.3 inches in West Warwick.
01/14/2017	11-16	Eleven to sixteen inches of snow fell on Eastern Kent County. Wind gusts of 55 mph were recorded at T. F. Green State Airport.
01/29/2018	4-8	From four to eight inches of snow fell on Eastern Kent County.
03/13/2018	10-17	The storm brought snow accumulations of up to two feet in Northern Rhode Island and up to one foot in Southern Rhode Island. Ten to seventeen inches of snow fell on Eastern Kent County.

Apponaug area of Warwick, the night of the 1978 blizzard. (Warwick Beacon)



Warwick Neck Avenue on March 13, 2018. (Photo Credit: Beth Hurd)

Extreme Temperatures

Description

Extreme cold may accompany winter storms, be left in their wake, or can occur without storm activity. Extreme cold can lead to hypothermia and frostbite, which are both serious medical conditions. The definition of an excessively cold temperature varies according to the normal climate of a region. In areas unaccustomed to winter

weather, near freezing temperatures are considered “extreme cold.” In Rhode Island, extreme cold usually involves temperatures below zero degrees Fahrenheit (Rhode Island State Hazard Mitigation Plan 2014).

The wind chill index attempts to quantify the cooling effect of wind with the actual outside air temperature to determine a wind chill temperature that represents how cold people and animals feel, based on the rate of heat loss from exposed skin. A wind chill index of -5 indicates that the effects of wind and temperature on exposed flesh are the same as if the air temperature alone were five (5) degrees below zero (0), even though the actual temperature could be much higher. The NWS issues a wind chill advisory when wind chill temperatures are potentially hazardous and a wind chill warning when the situation can be life-threatening (Rhode Island State Hazard Mitigation Plan 2014).

The National Weather Service issues **extreme (or excessive) heat** warnings when the maximum expected heat index is expected to be 105° F or higher for at least 2 consecutive days and night time air temperatures are not expected to fall below 75°. In the northeast, these criteria are generally modified to a heat index of 92° or higher for 2 consecutive days.

Location

An extreme heat or cold event would be a regional issue affecting Warwick and significant portions of Southern New England. Extreme temperatures could have a serious impact on private and public structures, as well as the general population throughout Warwick. Those most at risk to extreme temperatures are the elderly and those who work outside.

Probability of Future Occurrence

Highly Likely.

Extent (Event Magnitude)

In 2011, T.F. Green Airport reported heat indexes of 105 to 106 over an 8-hour period.

Wind chills of 32 below zero were reported at T.F. Green Airport in 2016.

Impact and Damage Extent

Personal exposure to dangerous heat conditions may lead to heat cramps, heat exhaustion, and heat stroke. These are especially important to monitor in children, elderly, and vulnerable populations that are not able to move to cooler conditions.

Extreme cold conditions may occur during, after, or without any connection to a winter storm. Exposure to extreme cold can lead to hypothermia and frostbite.

Climate Change Impacts

Over the coming century, the number of extremely hot days (over 90 degrees F) is projected to increase in New England.²³

“Extreme cold in Rhode Island is projected to continue as extreme weather events experience an upswing due to climate change. The specific likelihood of extreme cold is unpredictable, as days of frigid, arctic air and below freezing temperatures may be followed by days of mild temperatures in the 40s or 50s.”²⁴

History²⁵

NOAA’s Storm Events Database does not have any records specifically for Warwick but reports at T.F. Green are usually available.

Table 9: Extreme Temperatures (Excessive Heat, and Extreme Cold/Wind Chill) at T.F. Green Airport²⁶

Date	Temperature	Comments
05/09/2000	91	The high temperature at T.F. Green State Airport in Warwick reached 91 degrees, which broke the previous record high for the date set in 1963. It was also the third day in a row of high temperatures exceeding 90 degrees, making May 7th through the 9th the earliest heat wave on record in greater Providence. The previous record was in 1992, from May 21st through the 23rd. Records date back to 1904.
05/03/2001	91	Record high for the day.
05/04/2001	92	Record high for the day. The previous record for the earliest heat wave was set just last year, from May 7th to 9th of 2000.
05/12/2001	90	The high temperature of 90 degrees at T.F. Green State Airport in Warwick broke the record high for the date, which was 87 degrees set in 1959.
07/06/2010	105-106	Heat index values at the T.F. Green Providence Airport (KPVD) Automated Surface Observing System were 105 to 106 degrees.
07/22/2011	105-106	The Automated Surface Observing System at T.F. Green State Airport (KPVD) recorded heat indexes of 105 to 106 over an eight-hour period.
02/16/2015	-26	Wind chills as low as 26 below zero were reported at T.F. Green Airport
02/14/2016	-32	Wind chills as low as 32 below zero were reported at T.F. Green Airport

23 Confronting Climate Change in the Northeast, by the Northeast Climate Impacts Assessment Group, July 2007

24 RI Emergency Management Agency, State of Rhode Island Hazard Identification and Risk Assessment. November 2016

25 Intellicast <http://www.intellicast.com/Local/History.aspx?month=2>

26 National Climate Data Center (2018)

The following Warwick temperature records provided by Intellicast which is owned by the same company as the Weather Channel.

- › February 9, 1934: record low of -17 degrees
- › August 2, 1975: record high of 104 degrees

Flooding (Street/Urban)

Description

A flood, which can be slow or fast rising but generally develops over a period of days, is defined by the National Flood Insurance Program (NFIP) as:

- › A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from: overflow of inland or tidal waters; unusual and rapid accumulation or runoff of surface waters from any source; or a mudflow; or
- › The collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above.”

More specifically, urban flooding occurs where there has been development within stream floodplains and water runs over the land's surface impervious surfaces (paved areas, building subdivisions, and highways). Two major environmental modifications are primarily responsible for drastically altering the rain fall-runoff relationship.

1. Making the land surface impervious by covering it with pavement and construction work.
2. Installing storm sewer systems that collect urban runoff rapidly discharging large volumes of water into stream networks and/or freshwater wetland system.

Note: During a major event such as the flooding experienced in March 2010, both urban and riverine flooding were present. For the purpose of this plan, the Warwick HMC makes the distinction that urban flooding caused by rapid accumulation of runoff will occur more frequently than flooding caused only by overtopped riverbanks.

Location

During the March 2010 flood events several roads were unpassable in Warwick, including Interstate 95. In combination with riverine flooding, the low-lying coastal roads, as well as the neighborhoods along the Pawtuxet River are the most vulnerable.



Neighborhood of Jambray Court

Probability of Future Occurrence

Likely.

Extent (Event Magnitude)

Localized flooding can be expected to occur on an annual basis. The flood event which occurred in March 2010 was a 250 year +/- event.

Impact and Damage Extent

Heavy rains, quick thaws with precipitation, and hurricanes accompanied by heavy winds and rain make the City vulnerable to personal, property and environmental damage occasioned by flooding.

Flood prone areas and/or areas of concern include coastal and riverine neighborhoods.

Vulnerable structures include stormwater infrastructure, dams, residential homes, marinas, water supply lines, and roads.

Climate Change Impacts

Changing weather patterns may lead to more severe rain events.

History

Warwick regularly experiences street/urban flooding on the nuisance level. The larger events are outlined in the following table.

Table 7 History of Flooding in Warwick Since 2000²⁷

Date	Damage (reported)	Comments
10/15/2005	\$200,000	Between 2.5 and 4.5" of rain. The Pawtuxet River flooded portions of Warwick, causing Fletcher Road, Route 37, and Pontiac Avenue to be closed by police. Evacuations and rescues were also performed in Warwick.
10/28/2006	\$4,000	2-4 inches of rain. In Warwick, moderate coastal flooding affected Pawtuxet Cove, where a boat house was surrounded by water and Peck Lane had minor flooding.
04/15/2007	\$25,000	3-5 inches of rain from a slow-moving coastal storm. Minor to moderate flooding affected the Blackstone and Pawtuxet Rivers.
08/08/2008	\$0	In nearby West Warwick, a couple of businesses and an apartment complex was evacuated due to flooding.
03/15 - 16/2010	\$1.3 M	Pawtuxet River reached record high level when it crested at 15.2'. The main branch of the Pawtuxet River flooded portions of Warwick and West Warwick. Multiple streets across West Warwick, Coventry, and Warwick were closed due to flooding, including Aster, Begonia, Canna, Daisy, and River Streets in West Warwick. These streets were flooded with up to four feet of water and resulted in residents in the area being evacuated. At least 100 people were evacuated from their homes in West Warwick.
03/29- 03/31/2010	\$25.65 M	The Pawtuxet River flows into Kent County and resultant flooding occurred in Warwick, West Warwick, and Coventry. The river crested at 21 feet, roughly 6 feet higher than the previous record set earlier in the month. A pond at the Royal Crest Estates apartment complex in Warwick flooded, submerging at least one car. Numerous buildings flooded in Warwick. Approximately 2500 homes and businesses were evacuated in Warwick. The river flooded the Warwick Mall, submerging cars in the parking lot and sending up to four feet of water in spots and at least two feet of water into the stores on the lower level. The Warwick plant was inundated with 78 million gallons of polluted water that had to be removed before wastewater treatment could resume. The mayor of Warwick issued an executive order shutting down the city's coin-operated laundries and asking health clubs to stop offering free showers to residents.

²⁷ NOAA National Centers for Environmental Information, Storm Event Database. <https://www.ncdc.noaa.gov/stormevents/>

Date	Damage (reported)	Comments
08/10/2012	\$15,000	Post Road in Warwick was flooded with cars stuck in the floodwaters.
06/07/2013	\$0	Remnants of Tropical Storm Andrea. Three to five inches of rain fell across Kent County. The intersection of Groveland Avenue and Route 117 in Warwick was flooded with six inches of water.
05/31/2015	\$0	Flooding and pockets of flash flooding. Lansdowne Road near Miantonomo Drive in Warwick was closed due to flooding.
02/09/2016	\$0	Arnold's Neck Drive in Warwick was closed due to coastal flooding.
06/21/2016	\$0	Walker Lane was flooded and impassable.
07/22/2016	\$0	Main Street closed due to flooding.
07/07/2017	\$0	Heavy rain caused street flooding on Kilvert Street in Warwick. The street was closed.

High Winds

Description

Wind is the movement of air caused by a difference in pressure from one place to another. Local wind systems are created by the immediate geographic features in a given area such as mountains, valleys, or large bodies of water. National climatic events such as high gale winds, tropical storms, thunderstorms, nor'easters, hurricanes, and low-pressure systems produce wind events in Rhode Island. Wind effects can include blowing debris, interruptions in elevated power and communications utilities, and intensification of the effects of other hazards related to winter weather and severe storms.

Figure 6 Beaufort Scale
Beaufort Wind Chart – Estimating Winds Speeds

Beaufort Number	MPH		Terminology	Description
	Range	Average		
0	0	0	Calm	Calm. Smoke rises vertically.
1	1-3	2	Light air	Wind motion visible in smoke.
2	4-7	6	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	11	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-18	15	Moderate breeze	Dust and loose paper is raised. Small branches begin to move.
5	19-24	22	Fresh breeze	Smaller trees sway.
6	25-31	27	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult.
7	32-38	35	Near gale	Whole trees in motion. Some difficulty when walking into the wind.
8	39-46	42	Gale	Twigs broken from trees. Cars veer on road.
9	47-54	50	Severe gale	Light structure damage.
10	55-63	60	Storm	Trees uprooted. Considerable structural damage.
11	64-73	70	Violent storm	Widespread structural damage.
12	74-95	90	Hurricane	Considerable and widespread damage to structures.

The Beaufort Wind Scale is a 12-level scale used to describe wind speed and observed wind conditions at sea and on land. A wind classification of 0 has wind speeds of less

than 1 mile per hour are considered calm. On the other end, a classification of 10 with wind speeds reaching 63 miles an hour will blow down trees and cause considerable damage.

Location

Wind events are expected throughout the year in Warwick.

Probability of Future Occurrence

Possible.

Extent (Event Magnitude)

The windier part of the year lasts for 6.2 months, from October 18 to April 26, with average wind speeds of more than 6.8 miles per hour. The average windiest day of the year is February 23, with an average hourly wind speed of 8.6 miles per hour.²⁸

Impact and Damage Extent

Strong wind gusts of 40 miles an hour (Beaufort Scale of 8) can blow twigs and small branches from trees. Occasional gusts and sustained winds at this speed (and above) are of concern to the City. Damages from wind events range from power outages, property damage to vehicles and buildings and fallen trees/limbs. Wind events in Warwick have resulted primarily in power outages and downed tree limbs with minimal property damage. It is important that the City of Warwick maintain their public tree trimming program that will reduce the likelihood of fallen trees/limbs from disrupting transportation routes and/or taking down power lines.

Climate Change Impacts

Changes in atmospheric circulation are predicted to occur. See "Hurricanes" and "Nor'easters".

History²⁹

Table 10 History of High Winds in Kent County

Date	Magnitude (kts)	Comments
12/17/2000	50	Countless reports of downed trees, limbs and power lines.
11/13/2003	50	In Rhode Island, peak wind gusts of 50 to 60 mph brought down trees and power lines.
03/08/2005	61	A trained spotter in Warwick reported a 70 mph gust.

²⁸ WeatherSpark <https://weatherspark.com/y/26172/Average-Weather-in-Warwick-Rhode-Island-United-States-Year-Round> accessed 9/19/2018

²⁹ National Climate Data Center (2017)

Date	Magnitude (kts)	Comments
05/25/2005	50	Late season Nor'easter brought strong winds and heavy rains, some gust as high as 60 mph. In neighboring East Greenwich, a large tree fell onto a roadway, and in neighboring West Warwick was reported down across a roadway.
09/29/2005	58	Wind gusts between 40 and 60 mph downed trees and wires.
01/18/2006	58	In Warwick, winds knocked a utility pole and a transformer down.
10/28/2006	50	Trees fell onto a house in Warwick, causing significant damage. In Warwick, moderate coastal flooding affected Pawtuxet Cove, where a boat house was surrounded by water and Peck Lane had minor flooding.
04/16/2007	53	61 mph gusts reported at T.F. Green Airport in Warwick. There were widespread reports of downed trees, large branches, and power lines.
11/03/2007	50	A tree fell on power lines at the intersection of Fairlane Lane and Warwick Avenue in Warwick. A large sailboat was smashed against Conimicut Seawall in Warwick.
03/08/2008	66	A tree was downed and landed on a house on Mullen Road in Warwick. Another tree was reported down on Payton Avenue in Warwick. In West Warwick, a large tree was downed blocking West Natick Road.
10/25/2008	51	The weather observing station at Conimicut Lighthouse in Warwick recorded a wind gust of 59 mph.
01/25/2010	50	The Automated Surface Observing System at T.F. Green State Airport recorded a wind gust of 58 mph. No damage was reported.
10/29/2012	51	Superstorm Sandy. The Automated Surface Observing System at T.F. Green State Airport in Warwick, RI (KPVD) recorded sustained winds of 41 mph and gusts to 59 mph. A tree was downed onto a house in Warwick.
12/27/2012	53	A wind gust to 61 mph was reported at Conimicut Lighthouse in Warwick.
01/31/2013	52	There was some tree damage and downed power lines with winds gusting to 60 to 70 mph. The Automated Surface Observing System at T.F. Green State Airport in Warwick (KPVD) recorded a wind gust to 60 mph. No damage was reported.
02/08/2013	55	Blizzard of 2013. The Automated Surface Observing System at TF Green State Airport in Warwick, RI (KPVD) recorded a wind gust of 63 mph. No damage was reported.

Date	Magnitude (kts)	Comments
10/22/2014	50	A tree was downed onto Division Road in East Greenwich. In Warwick, a tree was down blocking Natick Avenue. In West Warwick, a tree was downed onto Natick Road.
08/04/2015	60-74	Wet Macroburst caused tree and home damage in Warwick. Affected an area larger than 2.5 miles and lasted longer than 5 minutes.
12/15/2016	55	Winds at Conimicut Point in Warwick gusted to 63 mph.
10/29/2017	56	Wind gusts of 65 mph reported at Conimicut Point in Warwick. A tree was reported down on a house on Helen Avenue and a tree and wires were down on Ryan Avenue, both in Warwick.
03/02/2018	56	At 3:58 PM EST the Automated Surface Observation System platform at T. F. Green Airport measured a wind gust to 64 mph.

Ice Storm

Description

An ice storm occurs when moisture falls and freezes immediately upon impact. The term ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Freezing rain most commonly occurs in a narrow band within a winter storm that is also producing heavy amounts of snow and sleet in other locations. If extreme cold conditions are combined with low or no snow cover, the cold can better penetrate



Ice Storm. (Source: NOAA)

downward through the ground and potentially create problems for underground infrastructure, as well. When utilities are impacted and heating systems are compromised or do not work, water and sewer pipes can freeze and even rupture.

Location

All of Warwick is susceptible to ice storms.

Probability of Future Occurrence

Possible.

Extent (Event Magnitude)

Ice storms can be the most devastating winter weather phenomena and are often the cause of automobile accidents, power and communication system outages, personal injury, and death. Moreover, they can hinder the delivery of emergency services needed in response to these catastrophes and endanger the responders. Ice storms accompanied by wind gusts cause the most damage.

The Sperry–Piltz Ice Accumulation (SPIA) Index is a scale for rating ice storm intensity, based on the expected storm size, ice accumulation, and damages on structures, especially exposed overhead utility systems. The SPIA Index uses forecast information to rate an upcoming ice storm's impact from 0 (little impact) to 5 (catastrophic damage to exposed utility systems).

Warwick expects at least a level 1- isolated or localized utility interruptions every year due to ice.

Figure 7 SPIA Index

The Sperry-Piltz Ice Accumulation Index, or "SPIA Index" – Copyright, February, 2009

ICE DAMAGE INDEX	* AVERAGE NWS ICE AMOUNT (in inches) <small>*Revised-October, 2011</small>	WIND (mph)	DAMAGE AND IMPACT DESCRIPTIONS
0	< 0.25	< 15	Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages.
1	0.10 – 0.25	15 - 25	Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous.
	0.25 – 0.50	> 15	
2	0.10 – 0.25	25 - 35	Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulation.
	0.25 – 0.50	15 - 25	
	0.50 – 0.75	< 15	
3	0.10 – 0.25	> = 35	Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1 – 5 days.
	0.25 – 0.50	25 - 35	
	0.50 – 0.75	15 - 25	
	0.75 – 1.00	< 15	
4	0.25 – 0.50	> = 35	Prolonged & widespread utility interruptions with extensive damage to main distribution feeder lines & some high voltage transmission lines/structures. Outages lasting 5 – 10 days.
	0.50 – 0.75	25 - 35	
	0.75 – 1.00	15 - 25	
	1.00 – 1.50	< 15	
5	0.50 – 0.75	> = 35	Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeks in some areas. Shelters needed.
	0.75 – 1.00	> = 25	
	1.00 – 1.50	> = 15	
	> 1.50	Any	

(Categories of damage are based upon combinations of precipitation totals, temperatures and wind speeds/directions.)

Impact and Damage Extent

The Warwick Hazard Mitigation Committee is most concerned about ice taking down trees and knocking out power, blocked roads, structure damage, and airport groundings. Falling trees have taken out power lines, damaged buildings, and essentially shut down the city. Flash freezes and icy roads can also cause dangerous driving conditions.

Climate Change Impacts

Warming temperatures may mean less snowfall but if there is enough moisture in the atmosphere, it may fall as freezing rain, coating everything in ice. Warwick should expect more ice events.

History

Due to the unique weather in New England, ice storms are usually part of larger snow events. The winter storm event that crippled the state in February 1978 did include a FEMA disaster declaration for snow and ice. Subsequent storms have included ice warnings when there are rapidly warming and cooling temperatures. Rhode Island was spared the brunt of the 2008 ice storm which affected more than a million people across New Hampshire, Vermont, Massachusetts, Maine, Connecticut, and New York.

Brushfire

Description

Brushfires are fueled by natural cover, including native and non-native species of trees, brush and grasses, and crops along with weather conditions and topography. While available fuel, topography, and weather provide the conditions that allow wildfires to spread, most wildfires are caused by people through criminal or accidental misuse of fire.

Brushfires pose serious threats to human safety and property in rural and suburban areas. They can destroy crops, timber resources, recreation areas, and habitat for wildlife. Wildfires are commonly perceived as hazards in the western part of the country; however, smaller brushfires are a growing problem in the wildland/urban interface of the eastern United States, including Rhode Island.

Brushfires are dependent upon the quantity and quality of available fuels. Fuel quantity is the mass per unit area. Fuel quality is determined by a number of factors, including fuel density, chemistry, and arrangement. Arrangement influences the availability of oxygen. Another important aspect of fuel quality is the total surface exposed to heat and air. Fuels with large area-to-volume ratios, such as grasses, leaves, bark and twigs, are easily ignited when dry.

Climatic and meteorological conditions that influence wildfires include solar insolation, atmospheric humidity, and precipitation, all of which determine the moisture content of wood and leaf litter. Dry spells, heat, low humidity, and wind increase the susceptibility of vegetation to fire. In Rhode Island, common factors leading to large fires include short-term drought, humidity below 20%, and fuel type.

Various natural and human agents can be responsible for igniting brushfires. Natural agents include lightning, sparks generated by rocks rolling down a slope, friction produced by branches rubbing together in the wind, and spontaneous combustion.

Human-caused brushfires are typically worse than those caused by natural agents. Arson and accidental fires usually start along roads, trails, streams, or at dwellings that

are generally on lower slopes or bottoms of hills and valleys. Nurtured by updrafts, these fires can spread quickly uphill. Arson fires are often set deliberately at times when factors such as wind, temperature, and dryness contribute to the fires' spread.

The humid coastal climate in Warwick is not set up to endure long periods of drought that lead to widespread vegetation loss. Destructive lightning fires in remote locations are rare but there is always a risk of fires from arson or careless fire use.

Location

The open fields, forested areas, and grassy areas throughout the city are most at risk. The forested areas of Goddard Park are susceptible to brushfires.

Probability of Future Occurrence

Highly Likely.

Extent (Event Magnitude)

Minor brushfires frequency averages about twice per year with a burn area of generally two to three acres. The extent has decreased over the years due to better response equipment, faster response time, and the widespread use of cell phones to report fires. However, the built/wildland interface is growing, potentially putting more infrastructure and lives at risk.

Impact and Damage Extent

Individual buildings may be more or less vulnerable to damage from brushfires based on factors such as the clear distance around the structure and the structure's construction materials. Brushfires primarily impacts timber and forest ecosystems, although the threat to nearby buildings is always present.

The likelihood of brushfires occurring and having widespread impact has decreased over the years as fields and wooded areas are taken over by development.

Climate Change Impacts

Longer dry periods and droughts may increase the probability of brushfires but their extent has diminished over the years due to advances in detecting and firefighting technologies.

History

There have been no significant brushfires in the past 25 years in Warwick.

Coastal Erosion

Description

Coastal erosion is the gradual wearing away of land. Although this can happen along rivers and streams, for the purpose of this hazard mitigation plan, erosion will focus on coastal erosion as a hazard.



Rocky Point Avenue.

Strong storms, rising sea level, flooding, and ocean waves can wear away beaches swiftly or over time. Erosion reduces the amount of protective buffer between the ocean and the built environment. Homes, businesses, and City infrastructure become closer to the ocean, thereby putting them at greater risk of being unusable or uninhabitable.³⁰

Location

The 39 miles of the Warwick coastline are susceptible to erosion. Some areas are more fortified than others and can withstand some wave impacts. These areas are not immune to long-term sea level rise and larger storm waves. City Park and Oakland Beach experience regular movement of sand that requires maintenance.

Probability of Future Occurrence

Highly Likely. Ongoing and episodic.

Extent (Event Magnitude)

Over the next 50 years, coastal erosion may contribute to the loss of 1 in 4 of the houses within 500 feet of the shore. The average rate of erosion along the Atlantic Ocean is 2-3 feet.³¹

³⁰ The H. John Heinz III Center for Science, Economics and the Environment. *Evaluation of Erosion Hazards*. April 2000. https://www.fema.gov/media-library-data/20130726-1553-20490-1159/hz_erosn.pdf

³¹ The H. John Heinz III Center for Science, Economics and the Environment. *Evaluation of Erosion Hazards*. April 2000. https://www.fema.gov/media-library-data/20130726-1553-20490-1159/hz_erosn.pdf

However, the more protected Warwick coast experiences an average erosion rate of less than 6 inches.³² The rate can be higher or lower, depending on the shoreline orientation and composition.

Impact and Damage Extent

Locally, erosion has already shown to remove beaches, expose on-site wastewater treatment systems, compromise road beds, and undermine coastal homes. Bringing the saltwater barrier further inland also promotes saltwater intrusion into the freshwater drinking systems.

In addition to narrowing the beaches, important coastal habitats can be destroyed through erosion.

Unfortunately, local FEMA maps do not reflect the risk of erosion in their Flood Insurance Rate Maps. People are often caught unaware of the real risk of living along the coast.

Climate Change Impacts

Warwick expects erosion to be a growing concern in exposed areas as storms become more intense and sea levels rise.

History

There has been no significant erosion in Warwick but there have been specific areas where sand moves along the shoreline on a regular basis.

Dam Failure

Description

Dams are classified as high hazard, significant hazard or low hazard. The classification is not based on whether a dam is deemed safe or unsafe. As of 2018, there are 96 high hazard dams, 82 significant hazard dams and 491 low hazard dams in the state. Each dam's hazard classification determines the frequency of inspection. The higher the classification, the more frequently the inspection is conducted.

A High Hazard dam is one whose failure or misoperation will result in a probable loss of human life.

A Significant Hazard dam is one whose failure or misoperation results in no probable loss of human life but may cause major economic loss, disruption of lifeline facilities or impact other concerns detrimental to the public's health, safety or welfare.

A Low Hazard dam is one whose failure or misoperation results in no probable loss of human life and low economic losses.

³² Coastal Resource Management Council Shoreline Change Maps http://www.crmc.ri.gov/maps/maps_shorechange.html

As part of each Rhode Island Department of Emergency Management (RIDEM) inspection, the major components of the dam are subjectively rated as good, fair or poor. The major components are the embankment, the spillway and the low-level outlet. Good means the dam meets the minimum Army Corps of Engineers (ACOE) guidelines. Fair means the dam has one or more components that require maintenance. Poor means a component of a dam has deteriorated beyond maintenance and is in need of repair.

Flood events call into question the structural integrity of dams that would affect Warwick. In 2016, RIDEM identified 18 dams in the City of Warwick. Two of the 18 dams are classified as high hazard dams and 1 dam is identified as a significant hazard dam. The remainder are considered low hazard.

The following summaries set forth the conditions of the seven dams that are classified as significant or high hazard dams.

Location

See Appendix C for the locations of various dams in Warwick.

Table 11: High and Significant Hazard Dams of Warwick

Dam #	Name	Hazard Class	Ownership
462	Camp Warwick Pond	High	Unknown
764	Grist Mill Apartments	High	Unknown
669	Dave’s Marketplace	Significant	Unknown

Probability of Future Occurrence

Possible.

Extent (Event Magnitude)

All three dam hazard classifications are represented in Warwick. The extent of a failure would vary. The Warwick Hazard Mitigation Committee has identified failure as a break in the dam, sending water downstream. The City is also concerned about large dam breaches in other parts of the state that would impact Warwick.

Impact and Damage Extent

The Warwick Hazard Mitigation Committee recognizes that a dam failure is not a natural hazard in itself but several of the hazards listed in the hazard list could contribute to a dam failure in the City of Warwick. Severe winter storms, flooding, and a hurricane could all bring enough rain and or snowfall to cause a dam failure. The age and design materials of these dams also poses a risk to the structural integrity of these dams. A failure of the earth or masonry construction materials could cause loss of lives, property, the natural environment, and economy.

Climate Change Impacts

Related to flooding, more intense rain events may stress the structural integrity of existing dams which could weaken or lead to structural failure.

History

Warwick has not experienced any significant dam failures.

Drought

Description

Drought is characterized as a continuous period of time in which rainfall is significantly below the norm for a particular area over a multi-year period. The American Meteorology Society defines drought as a period of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance. Drought differs from other natural hazards in that they do not occur suddenly. Rather, a drought evolves over months or even years and, while causing very little structural damage, can have profound economic, environmental, and social impacts.



Drought in nearby Connecticut.

(Source: Bob Luckey Jr./ Hearst Connecticut Media)

There are four different ways that a drought can be defined:

1. Meteorological – A measure of departure of precipitation from normal. Due to climatic differences, what is considered a drought in one location may not be a drought in another location.
2. Agricultural – refers to a situation when the amount of moisture in the soil no longer meets the needs of a particular crop.
3. Hydrological- occurs when surface and subsurface water supplies are below normal.
4. Socioeconomic- refers to the situation that occurs when physical water shortage begins to effect people.

Characteristics and impacts of drought differ in many ways, so it is difficult to quantify drought. An existing index called the Palmer Drought Severity Index (PDSI) that uses temperature and precipitation levels to determine dryness, measuring a departure from the normal rainfall in a given area. The advantage of the PDSI is that it is standardized to local climate, so it can be applied to any part of the country to demonstrate relative drought or rainfall conditions. A monthly PDSI value below -2.0 indicates moderate drought, and a value below -3.0 indicates severe drought.

The U.S. Drought Monitor tracks drought conditions in Rhode Island and in the rest of the nation. They create maps based on climate data, hydrologic and soil conditions, as well as reported impacts and observations from over 350 contributors nationwide.

Table 12: Drought Severity ³³

Severity	PDSI Index Value	Drought Level	Possible Impacts
Exceptional Drought	-5 or less	Emergency	Widespread crop/pasture losses, shortages of water creating water emergencies.
Extreme Drought	-4 to -4.9	Warning	Major crop/pasture losses, widespread water shortages or restrictions.
Severe Drought	-3 to -3.9	Watch	Crop or pasture losses likely, water shortages common, water restrictions imposed.
Moderate Drought	-2 to -2.9	Advisory	Some damage to crops/pastures, developing water shortages, voluntary water-use restrictions requested.
Mild Drought/Abnormally Dry	-1 to -1.9	Normal	Short term dryness slowing planting or crop growth.
Incipient Dry Spell	-0.9 or less	-	-

Rhode Island, as with most states within the United States, uses both the Palmer Drought Severity Index (PDSI) and the Crop Moisture Index (CMI) as indices for a drought occurrence. The CMI (a derivative of the PDSI) provides information on the short-term or current status of purely agricultural drought or moisture surplus. The PDSI is most effective for determining long-term drought conditions, while the CMI is effective at helping determine short-term drought.

The RI Drought Steering Committee assigns drought levels for the seven designated drought regions in the state, based on hydrological indices such as precipitation, groundwater, stream flow, and the PDSI, as well as on local supply indices such as static groundwater levels and reservoir levels. The Normal, Advisory, and Watch levels are issued statewide. The Warning and Emergency levels are issued on a regional basis and consider local conditions, source of water supply, and water storage capacity issues.

Location

According to the Rhode Island Water Resource Board the potential for a drought exists every eleven years in Rhode Island. Although temporary drought conditions

33 <http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx>

may occasionally exist in Rhode Island, affecting Warwick, devastating long term drought conditions are not indicative of this temperate region.

Probability of Future Occurrence

Possible.

Extent (Event Magnitude)

According to The National Weather Service Rhode Island receives on average 39" to 54" of rain annually. Notwithstanding the same, the State experiences extended periods of dry weather. Some type of drought in Rhode Island occurs approximately once every 11 years.

Impact and Damage Extent

The main impacts of meteorological drought are periods of very high fire danger and low drinking water supplies. Warwick's drinking water is supplied by a combination of surface and groundwater resources. Changes in water levels can impact not only the quantity of available water but also the quality.

Drought conditions have been known to trigger the rapid increase of the gypsy moth populations in the region. The extended period of dry weather (specifically in May and June) slows the fungus that usually keeps the gypsy moth caterpillars at bay. Denuded trees can have cascading effects on the local ecosystem.

Climate Change Impacts

Even though rain events may intensify due to climate change, the periods between them may be longer. Rhode Island expects longer periods of drought. According to the 2016 Rhode Island Hazard Identification and Risk Assessment, "Recent climate change studies³⁴ have indicated that although precipitation is projected to increase throughout this century, it will be in the form of short duration, intense, and less frequent events. In addition, it is projected by the Northeast Climate Impacts Assessment Group (NECIA) and the New York City Panel on Climate Change (NPCC) that most of this increased precipitation may occur during colder times of the year in the form of snow or ice. Furthermore, it is projected that the frequency and intensity of both long-term and short-term droughts throughout the Northeast will increase throughout the century with the impacts beginning to occur with a greater degree of frequency beginning in the mid-century (2050s)."

History

Extended droughts are rare in Rhode Island with a record of six major droughts (those lasting for more than one year) since 1929 (Table 13; USGS: Rhode Island Floods and Droughts). The longest and most severe drought occurred in 1963-67 and affected

³⁴ Information derived from two recent studies: *Confronting Climate Change in the Northeast*, by the Northeast Climate Impacts Assessment Group, July 2007, and *Climate Risk Information*, by the New York City Panel on Climate Change, 2/17/09.

most of the northeast (USGS: Rhode Island Floods and Droughts). Water shortages affected most communities in Rhode Island and several municipal-supply wells were drilled to augment declining public supplies (USGS: Rhode Island Floods and Droughts).

Table 13: History of Droughts

Date	Area Affected	Remarks
1930-31	Statewide	Stream flow of 70% normal.
1941-45	Statewide	Stream flow of 70% normal in Blackstone and Pawtuxet Rivers.
1949-50	Statewide	Stream flow of 70% normal.
1963-67	Statewide	Water restrictions/well replacements common.
1980-81	Statewide	Groundwater deficient in eastern part of state. Considerable crop damage.
1987-88	Southern part of the state	\$25 million crop damage.
1998-99	Statewide	Spring through summer the State experienced 75% of normal flow.
2012	Statewide	January –April 2012. Meteorological drought due to precipitation levels one half of normal.
2016	Statewide	Drought Advisory.

Earthquake

An earthquake (also known as a quake, tremor or temblor) is the result of a sudden release of energy in the Earth's crust that creates seismic waves. The seismicity or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time. Earthquakes are measured with a seismometer. The size or magnitude is recorded on a device known as a seismograph. Earthquakes with a magnitude 3 or lower are mostly imperceptible (too low to recognize) and magnitude 7 earthquakes cause serious damage over large areas.

Although earthquakes are not considered to be a major problem in the northeast United States, they are more prevalent than one might expect. Table 14 presents historical seismic activity for Rhode Island. It highlights the earthquake epicenter, the Richter magnitude at the epicenter, and the Mercalli Intensity Level. Richter magnitudes are technical quantitatively based calculations that measure the amplitude of the largest seismic wave recorded. Richter magnitudes are based on a logarithmic scale and are commonly scaled from 1 to 8 (see the graphic below). The higher the magnitude on the Richter Scale, the more severe the earthquake. Mercalli intensity levels are based on qualitative criteria that use the observations of the people who have experienced the earthquake to estimate the intensity level. The Mercalli scale ranges from I to XII. The higher the intensity level on the scale, the closer the person is to the epicenter.

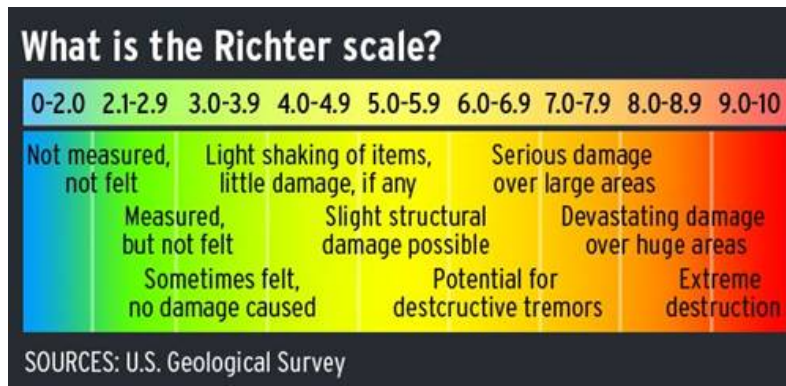


Table 14: Mercalli Scale

Modified Mercalli Intensity	Description of Intensity Level
I	Not felt except by a very few under especially favorable circumstances.
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in building of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars.
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level distorted. Objects thrown into the air.

Despite the low probability of a high impact earthquake, physical characteristics in Rhode Island may increase earthquake vulnerability:

- › Hard Rock: Due to the geological makeup of New England’s base rock, seismic energy is conducted on a greater scale four to ten times that of an equivalent Richter magnitude earthquake in California).
- › Soft Soil: Many coastal regions of New England are made up of soft soils. These soils can magnify an earthquake as much as two times.
- › Structures: The New England region, being one of the first settled areas of the United States, has an abundance of older, unreinforced masonry structures that are inherently brittle and very vulnerable to seismic forces.
- › Low Public Awareness of Vulnerability: Little public recognition of earthquake threat, and no established system of educating or informing the public of the threat or how to prepare for or respond during an earthquake. Therefore, higher losses will occur here than in other regions of the country.

Location

Rhode Island is located in the North Atlantic tectonic plate and is in a region of historically low seismicity. Only three or four earthquakes of Modified Mercalli Intensity Scale (MMI) V or greater have been centered in Rhode Island, including the 1951 South Kingstown earthquake of magnitude 4.6 on the Richter scale.

Probability of Future Occurrence

Possible. Scientific data suggests that New England should expect to experience a 4-5 magnitude earthquake every decade.

Extent (Event Magnitude)

Damaging earthquakes do not normally occur in this region. Rhode Island is located in an area of “moderate” seismicity and “high” risk. Seismic risk applies to the seismic hazard, location demographics, and regional economics to the vulnerabilities of the structure or lifeline on the site. Seismologists have estimated that there is about a 50% probability of a very damaging magnitude 5.0 earthquake occurring anywhere in New England, in a 50-year period.³⁵

Impact and Damage Extent

The committee recognizes that the potential for an earthquake to strike the City of Warwick is relatively low but the hazard could cause city-wide damage, causing power outages, building collapses, water main breaks, dam failures, gas leaks, fires and injuries or deaths. Buildings that are most at risk from earthquakes typically are historic structures.

35 RI Emergency Management Agency, State of Rhode Island Hazard Identification and Risk Assessment. November 2016

Climate Change Impacts

It is uncertain how climate change will affect earthquake magnitude in and around Warwick.

History

No major earthquakes have happened in Warwick.

Table 15: Historic Seismic Activity in/near Rhode Island³⁶

Date	Epicenter	Epicenter Magnitude	Mercalli Intensity Level
10/16/1963	Coastal MA	4.5	Caused some cracked plaster (MMI V) at Chepachet, Rhode Island.
6/14/1973	Western Maine	unknown	The intensities in Rhode Island were IV at Charlestown and I-III at Bristol, East Providence, Harmony, and Providence.
03/11/1976	Near Newport, RI	3.5	Intensity level VI shock effects felt throughout Southern New England. This earthquake has the distinction of being the largest earthquake to originate in Rhode Island.
04/20/2002	Plattsburgh, NY	5.2	Intensity level II to III shock effects felt throughout Rhode Island.
03/11/2008	Central Connecticut	2.9	No data reported for Rhode Island.
06/23/2010	Ontario-Quebec	5.0	Felt throughout Rhode Island.
2011	Rhode Island	0.9	Felt locally.
2012	Rhode Island	1	Felt locally.
2013	Kingston, RI	Unknown	Felt locally.
04/04/2013	Hope Valley, RI	1.8	Felt locally.

³⁶ United States Geologic Survey http://neic.usgs.gov/neis/states/rhode_island/rhode_island_history.html and Earthquake Hazards Program "Did You Feel It" Archives.

Flooding (Riverine)

Description

Riverine flooding occurs when heavy rainfall or snow melt causes the water in rivers and streams to flow over their banks. The severity of the flood depends on the saturation of the surrounding ground, the amount of precipitation, and duration of the event. In Warwick, coastal waters can also be so high that the rivers are unable to drain, thereby causing inland flooding. Riverine flooding is most likely to occur in the late summer and early spring due to snow melt and spring rainfalls.

Location

During the March 2010 flood events several roads including Interstate 95 were unpassable. Low-lying areas around the Pawtuxet River are the most vulnerable.



Route 2

Probability of Future Occurrence

Riverine flooding is likely.

Extent (Event Magnitude)

Localized flooding can be expected to occur on an annual basis. The 2010 flood event which occurred in March/April 2010 was a 250 year +/- event with about 5 1/2 inches of rain in a short period of time. Several factors contributed to these destructive floods. Beginning with a Feb. 23-24 storm, the National Weather Service registered 4 inches of rainfall on its Warwick rain gauge. Another quarter of an inch fell between March 1-4 and from March 13-15 and March 22-23 the gauge logged another 3.7 and 3.4 inches, respectively. Add to that amount the 8.8 inches of rain that fell between March 29 and April 1, and Rhode Island was soaked by a total of 20.15 inches of rain in just 38 days.

Impact and Damage Extent

Damages are localized but can be serious. In addition to inconveniencing populations, severe flooding can impact the wastewater infrastructure and local businesses.

Bridges along the flooded rivers can be compromised as waters rise and scour away at the foundations.

Climate Change Impacts

Changing climate conditions are likely to bring more rainfall events to Warwick and fewer snow storms. More intense storms will stress the natural floodplains and stormwater infrastructure. In coastal areas where storm drains empty into the ocean, rising tides and storm surge may further exacerbate flooding during heavy rain events.

History

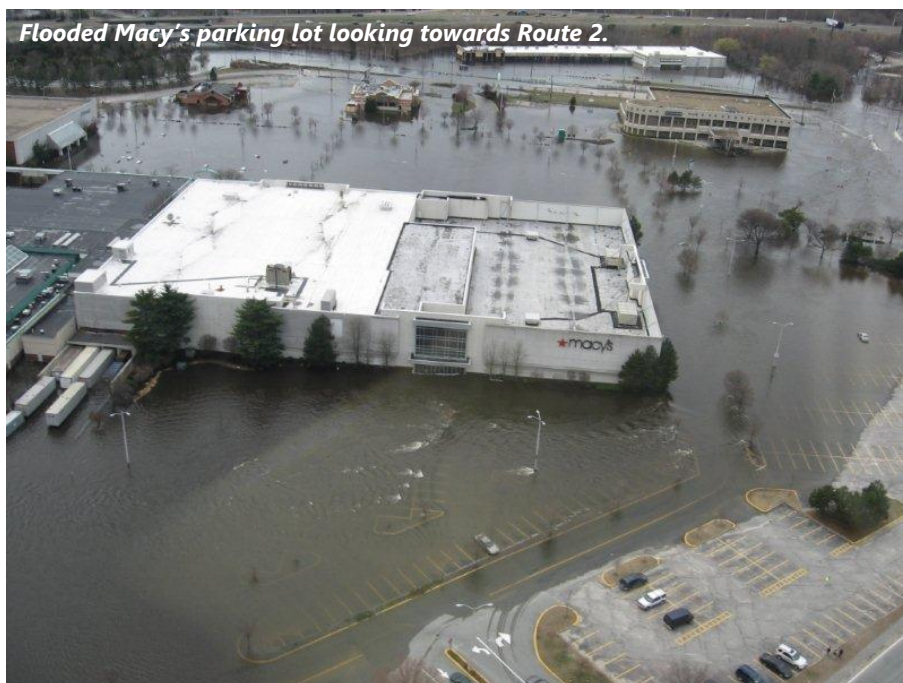
Table 16 History of Riverine Flooding in Warwick Since 2000.³⁷

Date	Damage (reported)	Comments
10/15/2005	\$200,000	Between 2.5 and 4.5" of rain. The Pawtuxet River flooded portions of Warwick, causing Fletcher Road, Route 37, and Pontiac Avenue to be closed by police. Evacuations and rescues were also performed in Warwick.
10/28/2006	\$4,000	Minor flooding of the Pawtuxet River which crested at 6 inches over its flood stage. Coastal flooding affected Pawtuxet Cove where a boathouse was surrounded by water and Peck Lane had minor flooding.
04/15/2007	\$25,000	3-5 inches of rain from a slow-moving coastal storm. Minor to moderate flooding affected the Blackstone and Pawtuxet Rivers.
08/08/2008	\$0	In nearby West Warwick, a couple of businesses and an apartment complex was evacuated due to flooding.
03/15 - 16/2010	\$1.3 M	Pawtuxet River reached record high level when it crested at 15.2'. The main branch of the Pawtuxet River flooded portions of Warwick and West Warwick. Multiple streets across West Warwick, Coventry, and Warwick were closed due to flooding, including Aster, Begonia, Canna, Daisy, and River Streets in West Warwick. These streets were flooded with up to four feet of water and resulted in residents in the area being evacuated. At least 100 people were evacuated from their homes in West Warwick.
03/29-03/31/2010	\$25.65 M	The Pawtuxet River flows into Kent County and resultant flooding occurred in Warwick, West Warwick, and Coventry. The river crested at 21 feet, roughly 6 feet higher than the previous record set earlier in the month. A pond at the Royal Crest Estates apartment complex in Warwick flooded, submerging at least one car. Numerous buildings flooded in Warwick. Approximately 2500 homes and businesses were evacuated in Warwick. The river flooded the Warwick Mall, submerging cars in the parking lot and sending up to four feet of water in spots and at least two feet of water into the stores on the lower level. The Warwick plant was inundated with 78 million gallons of polluted water that had to be removed before wastewater treatment could resume. The mayor of Warwick issued an executive order shutting down the city's coin-operated laundries and asking health clubs to stop offering free showers to residents.
08/10/2012	\$15,000	Post Road in Warwick was flooded with cars stuck in the floodwaters.
06/07/2013	\$0	Remnants of Tropical Storm Andrea. Three to five inches of rain fell across Kent County. The intersection of Groveland Avenue and Route 117 in Warwick was flooded with six inches of water.

³⁷ NOAA Storm Event Database for flood events in Kent County, specifically the City of Warwick.
<https://www.ncdc.noaa.gov/stormevents/>

Date	Damage (reported)	Comments
05/31/2015	\$0	Flooding and pockets of flash flooding. Lansdowne Road near Miantonomo Drive in Warwick was closed due to flooding.
06/21/2016	\$0	Walker Lane was flooded and impassable.
07/22/2016	\$0	Main Street closed due to flooding.
07/07/2017	\$0	Heavy rain caused street flooding on Kilvert Street in Warwick. The street was closed.

Select Photos from Riverine Floods of 2010



Flooded Macy's parking lot looking towards Route 2.



Flooded administration building of sewer treatment plant.

Flooding (Coastal)

Description

Simply put, coastal flooding occurs when seawater inundates the land. Because of development pressures and population increases on the coast, a greater number of structures are at risk to flooding. According to the Rhode Island 2014 Hazard Mitigation Plan Update, "Flooding is a localized hazard that is generally the result of excessive precipitation. Flooding is the most commonly occurring natural hazard, due to the widespread geographical distribution of river valleys and coastal areas, and the attraction of human settlements to these areas. Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss."

"A flood, which can be slow or fast rising but generally develops over a period of days, is defined by the National Flood Insurance Program (NFIP) as:

- › A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from: overflow of inland or tidal waters; unusual and rapid accumulation or runoff of surface waters from any source; or a mudflow; or
- › The collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above."

FEMA maintains regulatory flood maps called Flood Insurance Rate Maps (FIRM). Insurance companies refer to these when providing coverage to homeowners. These maps are available for viewing at City Hall and online at The FEMA Map Service Center <https://msc.fema.gov>. Please note that there is a process for the public to request a change in the flood zone designation for their property.

Location

Low-lying coastal areas are the most vulnerable.

Probability of Future Occurrence

Coastal flooding is highly likely.

Extent (Event Magnitude)

Localized flooding can be expected to occur on an annual basis.

Impact and Damage Extent

Along the Warwick coast, hurricanes accompanied by heavy winds and rain make the City vulnerable to personal, property and environmental damage occasioned by coastal flooding. Storm surge coupled with large fast moving waves can scour beaches and building foundations. Coastal storms that occur during the summer have the likelihood of catching visitors off guard without a plan to evacuate.

Salt water intrusion into freshwater systems is another concern. Large storms will push the seawater up into the rivers and estuaries causing flooding. This can also impact the freshwater resources. The timing of these storms around high tide could impact the extent of the damages.

Vulnerable structures include stormwater infrastructure, dams, residential homes, marinas, water and waterlines, and roads.

Climate Change Impacts

Changing climate conditions are likely to bring stronger coastal events to Warwick. More intense storms will stress the natural floodplains and stormwater infrastructure. In coastal areas where storm drains empty into the ocean, rising tides and storm surge may further exacerbate flooding during heavy rain events.

History

Table 17 History of Coastal Flooding in Warwick Since 2000.³⁸

Date	Comments
10/28/2006	2-4 inches of rain. In Warwick, moderate coastal flooding affected Pawtuxet Cove, where a boat house was surrounded by water and Peck Lane had minor flooding.
04/15/2007	Minor to moderate coastal flooding.
02/09/2016	Arnold's Neck Drive in Warwick was closed due to coastal flooding.

Hail

Description

Hail is formed in towering cumulonimbus clouds (thunderheads) when strong updrafts carry water droplets to a height at which they freeze. Eventually, these ice particles become too heavy for the updraft to hold up, and they fall to the ground at speeds of up to 120 mph. Hail falls along paths called swaths, which can vary from a few square acres to up to 10 miles wide and 100 miles long. Hail larger than 0.75 inch in diameter can do great damage to both property and crops, and some storms produce hail over two inches in diameter. Hail causes about \$1 billion in damages annually in the U.S. (Rhode Island State Hazard Mitigation Plan 2014).

Table 18: Hail Size

Hail Diameter	Size Description
1/4"	Pea Size
1/2"	Mothball Size

³⁸ NOAA Storm Event Database for flood events in Kent County, specifically the City of Warwick. <https://www.ncdc.noaa.gov/stormevents/>

Hail Diameter	Size Description
3/4"	Penny Size
7/8"	Nickel Size
1" (Severe Criteria)	Quarter Size
1 1/4"	Half Dollar Size
1 1/2"	Walnut or Ping Pong Ball Size
1 3/4"	Golf Ball Size
2"	Hen Egg Size
2 1/2"	Tennis Ball Size
2 3/4"	Baseball Size
3"	Teacup Size
4"	Grapefruit Size
4 1/2"	Softball Size

Location

All of Warwick is susceptible to hail.

Probability of Future Occurrence

Possible.

Extent (Event Magnitude)

The hail in Warwick is usually 1 inch or smaller.



Impact and Damage Extent

Structure vulnerability to hail is determined mainly by construction and exposure. Metal siding and roofing is better able to stand up to the damages of a hailstorm than many other materials, although it may also be damaged by denting. Exposed windows and vehicles are also susceptible to damage. Crops are extremely susceptible to hailstorm damage, as even the smallest hail stones can rip apart unsheltered vegetation.

Human vulnerability is largely determined by the availability and reception of early warnings for the approach of severe storms, and by the availability of nearby shelter. Early warnings of severe storms are also vital for aircraft flying through the area.

Climate Change Impacts

There is uncertainty about the effects of climate change on hail storms in Warwick. It is likely that the changes in weather patterns may bring more severe hail events.

History

Table 19: Recent History of Hail in Warwick³⁹

Date	Size	Comments
08/04/1995	0.75"	Quarter-sized hail.
07/25/1999	1"	Hail as large as quarters fell in West Greenwich and Warwick
06/11/2000	0.75"	Isolated severe thunderstorms downed trees in Scituate and produced dime size hail in Warwick.
07/04/2004	0.75"	Dime sized hail was reported in Warwick
06/24/2008	0.88"	Penny to nickel size hail fell in Warwick, specifically in the Cowesett neighborhood and near Greenwich Bay.
07/23/2008	0.75"	Quarter-sized hail.
07/03/2009	0.75"	Quarter-sized hail.
07/23/2009	0.75"	Strong storms produced hail and wind damage.

Lightning/Thunderstorms

Description

Thunderstorms are formed when the right atmospheric conditions combine to provide moisture, lift, and warm unstable air that can rise rapidly. Thunderstorms occur any time of the day and in all months of the year but are most common during summer afternoons and evenings and in conjunction with frontal boundaries. The National Weather Service (NWS) classifies a thunderstorm as severe if it produces hail at least one inch in diameter, winds of 58 MPH or greater, or a tornado. About 10 percent of the estimated 100,000 annual thunderstorms that occur nationwide are considered severe. Thunderstorms affect a smaller area compared with winter storms or hurricanes, but they can be dangerous and destructive for a number of reasons. Storms can form in less than 30 minutes, giving very little warning; they have the potential to produce lightning, hail, tornadoes, powerful straight-line winds, and heavy rains that produce localized flooding.

All thunderstorms contain lightning. Thunderstorms can occur singly, in clusters, or in lines. Therefore, it is possible for several thunderstorms to affect one location over the course of a few hours. Lightning is caused by the attraction between positive and negative charges in the atmosphere, resulting in the buildup and discharge of electrical energy. Lightning is one of the most underrated severe weather hazards yet ranks as the second-leading weather killer in the United States. "Hundreds of people across the nation are injured annually by lightning, most commonly when they are moving to a safe place but have waited too long to seek shelter. Lightning strike victims often suffer long-term effects such as memory loss, sleep disorders, weakness

39 National Climate Data Center, 2018

and fatigue, chronic pain, depression and muscle spasms. Lightning has the potential to start both house fires and wildfires. Lightning causes an average of 55-60 fatalities, 400 injuries, and over \$1 billion in insured losses annually nationwide.” Lightning often strikes as far as 10 miles away from any rainfall.

Location

All of Warwick is susceptible to lightning/thunderstorms.

Probability of Future Occurrence

Highly likely.

Extent (Event Magnitude)

There is no universally accepted standard for measuring the strength or magnitude of a lightning storm. Similar to modern tornado characterizations, lightning events are often measured by the damage they produce. Building construction, location, and nearby trees or other tall structures will have a large impact on how vulnerable an individual facility is to a lightning strike. A rough estimate of a structure’s likelihood of being struck by lightning can be calculated using the structure’s ground surface area, height, and striking distance between the downward-moving tip of the stepped leader (negatively charged channel jumping from cloud to earth) and the object. In general, buildings are more likely to be struck by lightning if they are located on high ground or if they have tall protrusions such as steeples or poles which the stepped leader can jump to.

Impact and Damage Extent

Lightning can strike buildings and accessory structures, often causing structure fires. Electrical and communications utilities are also vulnerable to direct lightning strikes. Damage to these lines has the potential to cause power and communication outages for businesses, residencies, and critical facilities.

Human vulnerability is largely determined by the availability and reception of early warnings for the approach of severe storms, and by the availability of nearby shelter. Swimming, boating, and fishing are particularly dangerous during periods of frequent lightning strikes, which can also cause power outages, topple trees, and spark fires. Individuals who immediately seek shelter in a sturdy building or metal-roofed vehicle are much safer than those who remain outdoors. Like hail, early warnings of severe storms are also vital for aircraft flying through the area.

Climate Change Impacts

Changing weather patterns may lead to more severe thunder and lightning storms.

History

There has been no reported loss of human life in Warwick in the past 50 years due to lightning.

Table 20 History of Lightning Strikes in Warwick

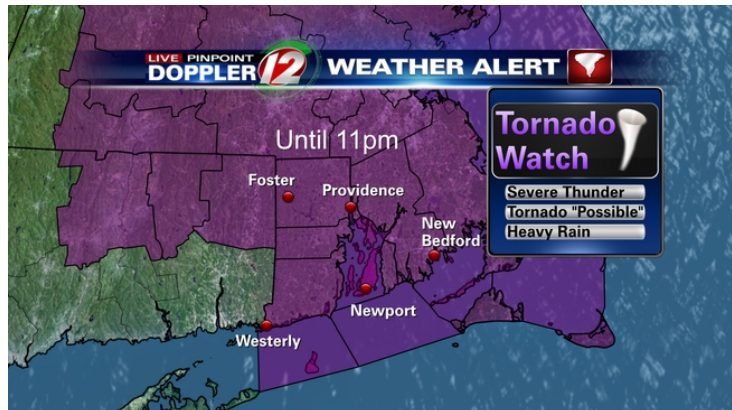
Date	Type	Comments
06/22/1997	Lightning Strike	In Warwick, lightning started a fire in an historic clock tower on a school and damage was estimated at \$250,000.
11/09/1997	Lightning Strike	A bolt of lightning knocked a 10-foot tall concrete cross from a church and sent it crashing onto the roof 25 feet below. The roof and some of the beams were damaged. A garage was struck by lightning in the Warwick Neck neighborhood. There was no report of fire.

Tornadoes

Description

A tornado is a violent windstorm with a twisting, funnel-shaped cloud often spawned by thunderstorms or hurricanes.

Tornadoes are produced when cool air overrides a layer of warm air, forcing



the warm air to rise rapidly. The damage from a tornado is a result of the high wind velocity and wind-blown debris. Tornado season is generally March through August, although tornadoes can occur at any time of year. Over 80 percent of all tornadoes strike between noon and midnight. During an average year, about 1,000 tornadoes are reported across the United States, resulting in 80 deaths and over 1,500 injuries. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of one-mile-wide and 50 miles long.

Tornadoes are categorized according to the damage they produce using the Fujita Scale (F-scale). Below is the Enhanced Fujita (EF) Scale and the Old Fujita (F) Scale. An F0 tornado causes the least amount of damage, while an F5 tornado causes the most amount of damage. Relatively speaking, the size of a tornado is not necessarily an indication of its intensity. On August 7th, 1986, a rare outbreak of seven tornadoes occurred in New England. One such tornado, rated F2 on the Fujita Scale, carved its way through Cranston, RI, and Providence, RI, causing twenty injuries and \$2,500,000 in damages. Table 22 highlights more tornado events that have affected, Rhode Island.

Table 21: Fujita Scale

Fujita Scale			Enhanced Fujita Scale		Damage Scale
F Number	Fastest ¼ mile (MPH)	3 Second Gust (MPH)	EF Number	3 Second Gust (MPH)	
0	40-72	45-78	0	65-85	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
1	73-112	79-117	1	86-110	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
2	113-157	118-161	2	111-135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
3	158-207	162-209	3	136-165	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
4	208-260	210-261	4	166-200	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
5	261-318	262-317	5	Over 200	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yds); trees debarked; incredible phenomena will occur.

Probability of Future Occurrence

Possible.

Location

The Hazard Mitigation Committee recognizes that the risk of tornadoes is low for the State of Rhode Island and the City of Warwick but with the recent changing weather patterns and touchdowns of tornadoes, it would be unwise not to consider them a possible hazard.

Extent (Event Magnitude)

Historically, Warwick isn't known to be a hotbed of tornado activity. It is expected that future tornadoes will be 0 or 1 on the F-Scale of magnitude.

Impact and Damage Extent

Tornadoes can cause significant damage to buildings, trees and above ground utility lines. Flying debris can cause injuries to residents. Mobile homes are generally more vulnerable to damage than steel framed structures. Warwick has one year-round mobile or manufactured homes within its borders- Tollgate Village. Due to the lower housing quality, these types of structures are more susceptible to tornado damages than a traditional house.

Climate Change Impacts

It is uncertain how climate change will affect tornado outbreaks in Warwick.

History

Table 22: Recent Tornado Events in Rhode Island⁴⁰

Date	EF-Scale	Injuries	Damage	Location
8/16/2000	0	0	\$0	Providence County
8/7/2004	0	0	\$0	Kent County
7/23/2008	1	0	\$47,987	Bristol County
8/10/2012	0	0	\$50,000	Washington County
10/24/2018	0/1			North Providence and Lincoln

Sea Level Rise

Description

As Warwick expects to see changes in the climate within the next 100 years, the City is concerned about the gradual effects of sea level rise. "Sea level rise is the level of the sea's surface related to the level of the continental crust. Relative sea level changes can be caused by absolute changes of the sea level and/or by absolute movements of the continental crust. Sea level rise (SLR) presents a hazard that should be considered in long-term land use, development, and critical infrastructure planning. Rhode Island has large exposure to the potential impacts of SLR, with approximately 400 miles of shoreline, 21 coastal communities, and significant areas of low elevation. Climate change, including the continued increase in global temperature, is projected to result

40 Rhode Island Emergency Management Agency (RIEMA), Rhode Island 2014 Hazard Mitigation Plan Update. There have been no reported tornadoes in Warwick.

in an acceleration of observed rates of SLR. Projections of global increases in sea level rise by 2100 range from one to two feet up to 6.6 feet.”

“Although SLR is a gradual process, impacts may be experienced in the short term. Some examples include increased frequency of low-level inundation, exacerbated flood elevations during storm events, increased rates of coastal erosion, and increased saltwater intrusion into groundwater.”⁴¹

Location

Coastal areas.

Probability of Future Occurrence

Possible.

Extent (Event Magnitude)

Sea levels are rising, caused by rising sea temperatures, which causes thermal expansion, and rising air temperatures, which causes melting glaciers and ice sheets. Sea levels have risen, both in Rhode Island and around the world. In Rhode Island, sea levels have risen over 10 inches (0.25 meters) since 1930, as measured at the Newport tide gauge.⁴²

As of the drafting of this plan, Warwick is expecting about 9 feet of sea level rise by 2100. This won't be uniform throughout the coast, but it can give the City an estimate to plan towards. In the shorter term, the City is uncertain about when to expect to experience measurable impacts.

⁴¹ RI Emergency Management Agency, State of Rhode Island Hazard Identification and Risk Assessment. November 2016

⁴² Coastal Resources Management Council, *Shoreline Change SAMP Volume 1*, June 2018.

Impact and Damage Extent

Sea level rise will affect the terrestrial and marine environments. "Future increases in relative sea level will displace coastal populations, threaten infrastructure, intensify coastal flooding and ultimately lead to the loss of recreation areas, public space, and coastal wetlands. Coastal infrastructure will become increasingly susceptible to complications from rising sea levels, as the upward trend continues. Residential and commercial structures, roads, and bridges will be more prone to flooding."⁴³

Climate Change Impacts

Over the coming century as oceans warm, Warwick expects sea levels to rise at an increasing rate.

History

Tide gauges in Newport have already documented an average of one inch per decade since 1930. Over the past half century, sea levels in the northeast region has been increasing three to four times faster than the global average rate, resulting in a six-inch rise since 1970.⁴⁴

Climate Change

Changing climate patterns globally and in Rhode Island will worsen the effects of natural hazards and affect future planning and mitigation efforts. Changes are already being observed and documented. Long-term climate change is likely to cause the following impacts in Warwick:

- › More flooding from higher tides and storm surge.
- › Heavier, more frequent precipitation events, which may cause more riverine flooding and flash flooding events.
- › Longer periods of drought which may affect water availability and increase the threat for wildfires.
- › Increasing air and water temperatures.
- › More frequent high heat days and heat waves.

How rapidly these changes will be felt is debatable but there is certainty within the state that municipalities need to be prepared. The City aims to become more adaptable/resilient to the changing conditions.

Through the exercise of creating this plan, the City of Warwick is exploring ways to reduce their long and short-term risks to a variety of hazards. Any storm that comes

⁴³ RI Emergency Management Agency, State of Rhode Island Hazard Identification and Risk Assessment. November 2016

⁴⁴ RI Emergency Management Agency, State of Rhode Island Hazard Identification and Risk Assessment. November 2016

up the eastern seaboard will likely impact this coastal city. As climate conditions intensify, the HMC is prepared to update this plan accordingly.

4

Risk Assessment

Facilities/Resources Inventory

The first step in the assessment process was to create the inventory of facilities and resources of special concern to the City. The HMC identified the following as community assets:

- › Flood prone drainage systems, streets, and infrastructure
- › Bridges
- › Wastewater facilities
- › Water supply systems
- › Services/utilities
- › Communication towers
- › Dams
- › Marinas/docks
- › Critical municipal hazard response facilities
- › Populations
- › Businesses
- › Schools
- › Recreational facilities
- › Natural resources
- › Historic resources

During the review of these assets, the HMC came to the conclusion that not all of these are so vulnerable they require a new mitigation action within the next 5 years. For some, assets, the City will continue with ongoing actions. As infrastructure ages, and climate conditions change, the HMC will update this plan accordingly.

These most vulnerable assets are identified in the Community Assets Matrix located at the end of this section.

Hazard Mitigation Mapping

The City's GIS database, including parcel data, latest NOAA sea level rise predictions, orthophotography and FEMA flood zone information, were utilized to complete the assessment. The use of this system allowed the HMC to estimate potential fiscal and population impacts for individual parcels.

The final output of this resource mapping exercise is the Warwick Resources map in Appendix C. The focus of the map is not to duplicate all of the spatial information generated through the inventorying process but rather to present the location of the identified risks as they relate to the City's response facilities.

Fiscal Impact Analysis

Major planned capital improvement projects include stormwater infrastructure improvements, school district roof assessment, replacement generator at Warwick Veterans Junior High School, and a new generator for City Hall.⁴⁵ Boating-related business real estate in Greenwich Bay also generates millions in tax revenue. A substantial portion of the revenue generated by Warwick is also from tourism.

Flooding is one of the hazards that affects both inland and coastal populations. The City of Warwick's parcel data and FEMA's 1% annual chance floodplain data were utilized to generate estimates of potential fiscal impacts from flooding. The information utilized from the tax assessor's database and GIS included the building value and structure type (commercial, residential, etc.). The analysis showed that Warwick is comprised of 22,720 acres of land, with about 2,760 acres (12%) in the regulatory floodplain. These 2,760 acres are mainly located along the coastline, and the Pawtuxet River.

HAZUS-MH was used to further understand the potential risk from a large hurricane. HAZUS-MH is a software tool that contains models for estimating potential losses from earthquakes, floods, and hurricanes. For the purpose of this plan, a scenario



FEMA's nationally applicable standardized methodology which uses Geographic Information Systems to determine loss estimates.

⁴⁵ City of Warwick, Rhode Island, 2018-2019 Capital Improvement Program and Budget.

was run that capture the city's risk from hurricane damage. The table below summarizes some of the potential damages. The hurricane scenario model uses the same path as the Hurricane Carol which tracked west of Warwick in 1954.⁴⁶

In 1954 Hurricane Carol (Category 1, peak gusts at 100 mph when it reached Warwick) tore through Southern New England, causing extensive damage throughout Rhode Island. If this same storm were to strike again today, it would cause nearly \$143.9 million dollars in total economic losses (property damage and business interruption loss) in Warwick.⁴⁷ About 536 buildings are expected to be at least moderately damaged, 11 of which would be total destroyed.

HAZUS Qualitative Damage Description

No Damage or Very Minor Damage

Little or no visible damage from the outside. No broken windows, or failed roof deck. Minimal loss of roof over, with no or very limited water penetration.

Minor Damage

Maximum of one broken window, door or garage door. Moderate roof cover loss that can be covered to prevent additional water entering the building. Marks or dents on walls requiring painting or patching for repair.

Moderate Damage

Major roof cover damage, moderate window breakage. Minor roof sheathing failure. Some resulting damage to interior of building from water

Severe Damage

Major window damage or roof sheathing loss. Major roof cover loss. Extensive damage to interior from water.

Destruction

Complete roof failure and/or, failure of wall frame. Loss of more than 50% of roof sheathing.

⁴⁶ Hazus-MH Hurricane Event Report. Hurricane Scenario: Carol. Region: Warwick. Based on 2010 Census data. Run 12/28/2018. The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

⁴⁷ 2010 dollars

Table 23 HAZUS-MH Scenarios for Warwick, RI

1954 Hurricane Carol Scenario- If It Happened Today	
Estimated Damage	Amount
Debris generated	28,486 tons
Buildings destroyed	11
Buildings at least moderately damaged	536
Displaced households	23 households may be displaced. 3 people out of a population of 82,672 will seek temporary shelter in public shelters.
Essential Facility Damage (fire, police, schools)	48 (100%) would expect to be non-operational for less than a day.
Residential Property (capital stock)	\$120,548,000
Commercial and Industrial Property	\$11,944,400
Business interruptions	\$10,162,000

Figure 8 Hurricane Carol Path



During non-cyclone events, flooding can still impact the City. Table 24 displays potential damage estimates of property values of buildings within the City’s Special Flood Hazard Area (SFHA), or regulatory floodplain. The parcel information, using the best available data, provides the number of parcels in the SFHA, and values of the buildings on each property. Land value was not considered for this exercise. This percentage was calculated in order to assist with identifying which areas are at greater

risk. According to Table 24, the city-wide total potential building damages within these floodplain areas are nearly \$200,000,000.

Approximately 74% of Warwick’s revenue is generated from property taxes.⁴⁸ Should any of the properties forming the tax base be destroyed by a hazardous event, a causal effect would be those property owners whose parcels remain intact would carry and increased financial burden with regards to property taxes. It is an important course of action for the City to protect both lives and property from natural disasters. However, as Warwick’s population grows, the burden of protecting lives and property grows. It is important that the potential economic impacts of a natural disaster continue to be assessed in future hazard mitigation plans so that the resulting policy accounts for these potential impacts.

Using data from the RI Geographic Information System (RIGIS) and information from the Warwick Tax Assessor, the following table summarizes the value of the insurable buildings that are located within the Special Flood Hazard Areas. Accessory buildings such as sheds located in the SFHA were not included in the summaries.

Table 24 Property Values in Special Flood Hazard Areas⁴⁹

Zone	# of Parcels	Residential	Commercial/ Industrial	Public	Total
A	17	\$3,445,800	\$134,700	\$263,800	\$3,844,300
AE	971	\$113,735,800	\$45,219,460	\$4,850,000	\$163,805,260
VE	213	\$28,357,800	\$1,974,200	-	\$30,332,000
TOTAL	1,201	\$145,539,400	\$47,328,360	\$5,113,800	\$197,981,560

Most of the NFIP insured properties are located along the Pawtuxet River and the 39 miles of coastline. The area between West Shore Road that the end of Conimicut Point has a large density of structures in the VE and AE flood zones. Other clusters occur in the Oakland Beach/Warwick Cove area, the Potowomut neighborhood, Apponaug, and along the Pawtuxet River.

The Committee recognized that the local fishing/shellfishing industry is a valued and historic waterfront industry that could be adversely and inordinately impacted by coastal hazards and flooding. Particularly damage to marine infrastructure that the industry utilizes to launch and store their vessels. It is also recognized that closure of fishing and shellfishing areas due to coastal storm events would create potential short and long-term economic hardship. To that end the Committee recognizes the need to maintain waterfront infrastructure and recognizes the Policy found within the

⁴⁸ The City of Warwick Fiscal Year 2019 Budget

⁴⁹ Based on RIFIS e911 Sites, FEMA 2014 Flood Insurance Rate Maps, and 2017 parcel information from the City. This data is to be used for planning purposes only to prove estimate values.

Comprehensive Plan to preserve the shellfishing industry by maintaining needed infrastructure that serves commercial fishermen.⁵⁰

Built Environment

According to HAZUS-MH, Warwick has over an estimated 33,000 buildings with a total replacement value (excluding contents) of \$11,533 million (2010 dollars). Approximately 90% of the buildings and 71% of the value are associated with residential housing.

Using the Rhode Island GIS e911 structure file, and the City’s GIS, it was determined that there are total of 1,323 non-accessory structures within the City’s Special Flood Hazard Areas (112 are commercial buildings, 2 are industrial, 13 are public structures, 1,385 are residential structures, and 7 are associated with utilities).

There are 1,399 flood insurance policies in place for a City that has 1,323 non-accessory buildings in the regulatory floodplain (A and V-zones). That includes the 494 policies in the lower risk X-zones. These policies are more affordable than those in the A and V-zones.

Table 25 Flood Insurance Information⁵¹

Total Number of Policies	1,043
Total Premiums	\$1,730,424
Insurance in Force	\$301,070,100
Total Number of Closed Paid Losses	588
\$ of Closed Paid Losses	\$10,878,700
Repetitive Loss Properties	47 structures, 108 losses (42 residential, 5 commercial)
Severe Repetitive Loss Properties	4 (residential)
Number of Policies in Each Zone	
Zone	Policies
A-Zone	538
V-Zone	59
X-Zone (Standard)	0
X-Zone (Preferred)*	446

* Preferred Risk Policies (PRP) are more affordable policies cover structures that were built in an X zone but due to new mapping, are now located in a Special Flood Hazard Area.

Warwick is essentially built out. The City has been encouraging development in less risky areas but some of the at-risk development predates recent regulations requiring

⁵⁰ City of Warwick Comprehensive Plan, 2013-2033, Page 8.18, Strategy D: Preserve the shellfish industry by maintaining needed infrastructure and appropriate land use policies, and advocating for supportive federal and state policies.

⁵¹ As per the State Floodplain Manager January 15, 2019

flood proofing, leaving many vulnerable areas unprepared to face a storm of any significance.

The HMC has identified critical infrastructure listed in the Community Asset Matrix (Table 25). The list includes: flood prone drainage systems, streets or infrastructure; bridges; wastewater; water supply; services/utility facilities; communication towers; dams; marinas/docks; critical municipal hazard response facilities; populations; businesses; schools; recreational facilities; and historic resources. All of these important community resources have the potential to be affected by natural disasters. The magnitude of the losses would be dependent upon the type, location, and extent of each unique hazard.

Warwick's marinas and boating facilities are some of the densest in the state.⁵² With approximately 30 marinas/yacht clubs and almost 4,000 boat slips, personal safety concerns and property damage could be substantial.

The City's zoning laws help dictate future development while maintaining Warwick's unique character. Continued enforcement of Rhode Island State building codes and new regulations as required will lessen potential damage caused by a natural hazard event. The codes adopted by the City of Warwick range from building codes and design standards, to zoning regulations.

Population Impact Analysis

Of primary concern during a hazard event is protecting the health and safety of Warwick residents. In addition to knowing the total population, it's also important to estimate how many people would be impacted by loss of service or need to evacuate. According to the 2016 U.S. Census, there are 37,730 housing units in Warwick supporting a population estimate of 81,881. The population is not spread evenly throughout the city. The more densely populated areas are along the eastern coast.

A powerful storm can significantly cripple Warwick. In addition to direct damage to personal property, impacts can include the disruption of vital services, the loss of utilities, and the emotional strain from financial and physical losses. This is especially jarring when residents are forced to evacuate their homes.

According to the American Community Survey 2013-2017, there are approximately 15,673 Warwick residents who are over the age of 65. Senior residents have access to three senior centers (two municipally owned and one privately operated). These facilities offer services such as meal programs, transportation, health and wellness programs, recreational opportunities, and community programs.

Residents in group homes, nursing homes, assisted living, or subsidized housing may not have the resources to shelter in place or evacuate. Improving emergency response and making accommodation for these populations is important to the City.

⁵² City of Warwick Comprehensive Plan, 2013-2033. Page 11.12

Seasonal residents, visitors, and employees from out of town represent another segment of the vulnerable population. These non-residents may be unfamiliar with evacuation routes, or flood risks. The HMC was careful to consider this more transient population when developing hazard mitigation actions.

Social vulnerability includes the long-standing 'sense of place' or cultural traditions that have been long held in Warwick. The shops, theaters, historic sites, beaches, and restaurants provide both active and passive recreational opportunities and serve as regional destinations.

Natural Environment

The Warwick 2013-2033 Comprehensive Plan identifies the following important natural and cultural resources:

- › 39 miles of coastline
- › The Pawtuxet River
- › 10 ponds and numerous streams
- › Shellfish habitat
- › Rare and endangered species and habitats
- › 9 saltwater coves and 2 bays
- › Over 1,000 acres of freshwater wetlands and over 2,000 acres of coastal wetlands.
- › 54,000 public trees, and 107,000 privately-owned trees
- › Farmland
- › Hunt River Aquifer System



Warwick Beach



Looking out on Warwick Cove

The biggest threats to the natural environment are non-point source pollution, point source pollution, and development pressures.

When the natural environment is impacted there are both direct and indirect costs. Some of the direct costs may include: erosion of recreational beaches; loss of upland property; loss of urban landscaping and community forest resources due to high winds. Indirect costs include: the widespread distribution of debris; accidental fuel

spills; release of sewage, industrial waste and household chemicals onto the land or into the marine environment.⁵³

Impacts of severe weather events to the natural environment include loss of habitat, salinization of land/ groundwater, threats to ecosystems/ species, and contamination of potable water supply.

The Greenwich Bay Special Area Management Plan, first adopted by the Coastal Resource Management Council in 2010, "provides recommendations on addressing and balancing environmental and economic issues including poor water quality, loss of natural habitats, displacement of traditional commercial fisheries (including shellfishing), and privatization of the shoreline".⁵⁴ Although this plan covers a larger region of the state, specific water quality recommendations for Warwick include best management practices for stormwater management in Brush Neck Cove, Apponaug Cove, and areas with large impervious drainage areas.

Vulnerability of Future Structures

There is potential for additional development. However, growth should only occur when there is an available capacity for municipal services to absorb the growth, and there is a fiscal ability and community agreement to the expanded infrastructure required for growth. This hazard mitigation plan as well as the current Comprehensive Plan have outlined ways to address these issues.

Warwick's vulnerability to natural hazards is not expected to change dramatically over the next five years due to increased development. The City is already built out. Enforcement of current building codes will ensure that development will be stronger and more resilient than some of the older structures in Warwick.

Future Vulnerability

As climate conditions change, sea level rise, storm surge, and increased rainfall intensity will continue to be a serious threat for the sustainability of the property and infrastructure in Warwick. Roads will flood more often and may eventually become unusable. Drainage infrastructure may be overwhelmed more often. Fire hydrants, pump stations, and sewer and water lines will be stressed or inaccessible by the rising tides. Areas that are not used to flooding may see flood waters inch closer to their property.

The City of Warwick has been the subject of a couple of studies aimed at better predicting future damage from sea level rise. In 2016 the mapping tool CERI (Coastal Environmental Risk Index) was used to analyze which housing structures could be damaged if a storm like Hurricane Carol in 1954 were to strike again. The tool shows

⁵³ H. John Heinz III Center for Science, Economics and the Environment, (1999). *The Hidden Cost of Coastal Hazards*, p. 105

⁵⁴ City of Warwick Comprehensive Plan 2013-2033.

the extent of damage during a 100-year storm as well as with additional levels of sea level rise. CERI projections show as storm surge makes its way up the bay, it is amplified, increasing the potential impact to Warwick. Under the present-day scenario, that would push coastal flood waters inland. Future scenarios that include additional sea level rise would exacerbate the effects of the storm. "Of the 34,479 structures in Warwick, 2,504 would receive some damage from a 100-year storm, according to the projections. With seven feet of sea level rise, that figure doubles to 5,304 — 15 percent of the city's buildings."⁵⁵

In 2017 a group of Rhode Island researchers used Warwick to test their models establishing the risk to structures and infrastructure from storm surge and associated waves.⁵⁶ The result of this effort was a new, revised set of flooding maps that incorporate wave inundation risk.

Future vulnerability is also part of the City of Warwick's 2013-2033 Comprehensive Plan. "The vulnerability of the built environment in Warwick and the value of insured property suggests that sea level rise is a serious threat to life and property. Storm surge floods could erode coastal areas and result in loss of life, property and infrastructure. Road transportation may be interrupted by ponding water, potentially isolating communities and damaging low elevation buildings. Future land use decisions should consider the impact of climate change."⁵⁷ One strategy calls for planning to accommodate a base rate of expected 3 to 5-foot rise in sea level by 2100 in the siting, design, and implementation of public and private coastal activities. The City proposes the following related actions in the 2013-2033 Comprehensive Plan:

1. Work with CRMC on the Rhode Island Shoreline Change Special Area Management Plan (Beach SAMP) as well as appoint a Climate Change Task Force to work with the Rhode Island Climate Change Commission, City departments, and the public.
2. Study impacts and create adaptation and mitigation measures and require City departments to consider climate change impacts in all long-range planning and critical public infrastructure projects.
3. Ensure consistency between the Hazard Mitigation Plan, the Comprehensive Plan, SAMP plans, and the city's land use regulations.
4. Enhance education and community engagement through increased understanding of climate change and its potential impacts on the community.

⁵⁵ The Providence Journal, *Rhode Island Researchers Predict, Map Future Flooding*. December 1, 2016 <http://www.govtech.com/data/Rhode-Island-Researchers-Predict-Map-Future-Flooding.html>

⁵⁶ Spaulding et al., 2017. *Application of State of the Art Modeling Techniques to Predict Flooding and Waves for a Coastal Area within a Protected Bay*. Journal of Marine Science and Engineering. March 20, 2017. [file:///C:/Users/cmills/Downloads/jmse-05-00014-v2%20\(1\).pdf](file:///C:/Users/cmills/Downloads/jmse-05-00014-v2%20(1).pdf)

⁵⁷ City of Warwick Comprehensive Plan 2013-2033.

5. Enforce building and zoning codes along the coast to protect residents from potential hurricane and tropical storm impacts, and to protect coastal wetlands.
6. Develop examples of attractive design solutions for elevating existing buildings and for development of new elevated buildings.

Community Assets Matrix

The matrix (Table 26): Critical Infrastructure/Community Assets represents the culmination of the risk assessment process and is the final product. Its purpose is to gather all the pertinent results in one place for ease of presentation and to serve as a starting point for discussion of specific mitigation actions. It not only lists the specific areas of concern, but provides detailed location information, summarizes the applicable hazard, problem, and mitigation benefits.

Table 26 Warwick Critical Infrastructure/Community Assets

At Risk	Location	Hazard/Problem	Ongoing Actions	New Mitigation Actions
<p>Flood Prone Drainage Systems, Streets, or Infrastructure</p>	<p>Arnold’s Neck Drive- signage Conimicut Point- signage/notification Bellows Street Shawmet Point Avenue Lakeshore Drive on Warwick Pond Pontiac Neighborhood (East Ave/West Natick Rd) Hardig Road culvert Centerville Road West Shore Road Warwick Ave Veterans Memorial Drive Extension Warwick Neck Ave. Mohawk and Seminole near Fairwinds Marina</p>	<p>Flooding due to ground saturation, and coastal flooding. Storm surge and SLR</p>	<p>Lakeshore- removing Buckeye Brook sediment. CodeRED used for closed road messages. Partnership with Save the Bay to improve coastal pervious areas in the Conimicut neighborhood. Pull back pavement at the end of: - Mill Cove, Pender Ave., Grove Ave., Rock Ave. Hewett St. (Oakland Beach area) In partnership with Save the Bay, closed parts of Midgely Avenue and Edgewater Road to allow migration of vegetation and water infiltration. Comprehensive Plan Strategy: Improve the City’s stormwater management system to enhance infiltration and expand stormwater retention areas.</p>	<p>1. Improve flood safety messaging for motorists. a) Place permanent alternate route signage on Arnold’s Neck b) Place evacuation route signage on Conimicut. 2. Reduce riverine flood damage in the Bellow Street industrial park area. a) Educate building tenants about floodproofing options.</p>

At Risk	Location	Hazard/Problem	Ongoing Actions	New Mitigation Actions
			<p>Comprehensive Plan Strategy: Begin planning to accommodate a base rate of expected 3 to 5 foot rise in sea level by 2100 in the siting, design, and implementation of public and private coastal activities.</p>	
<p>Bridges</p>	<p>Old Forge Bridge- erosion undermining the SW section of the bridge abutment. (as per the RIDOA Municipal Vulnerability to SLR report) Woodmansee Apponaug (Evacuation Route) Apponaug Mill (Evacuation Route) Tidewater (Evacuation Route) Carpenter’s Corner (Evacuation Route) Cottage Home (Evacuation Route) Warner Brook Hardig Brook East Avenue- taken out in 2010 flood (State) Buckeye Brook Forge Road Wellington Avenue RR1 (Amtrak) Arnold’s Neck Drive (Amtrak) Masthead Drive RR (Amtrak)</p>	<p>Evacuation Routes Storm surge and SLR</p>		<p>3. Maintain the usefulness of Warwick’s bridges.</p> <ul style="list-style-type: none"> a) Establish a local bridge inspection program for municipally owned bridges. b) Prioritize repairs to failing bridges. c) Consider bridge elevation when undergoing structure maintenance/improvements.
<p>Wastewater</p>	<p>Warwick Sewer Authority, 125 Arthur W. Devine Blvd</p>	<p>Severe storms that would cut power</p>	<p>Levee on the river side of the Wastewater Treatment Facility was built in 2017 to withstand flood waters from a 500-year flood.</p>	<p>4. Improve sewer pump station resiliency.</p> <ul style="list-style-type: none"> a) Identify and secure funding for the Oakland

At Risk	Location	Hazard/Problem	Ongoing Actions	New Mitigation Actions
				Beach sewer pump station. b) Prioritize remaining pump stations for elevation. c) Obtain 8 backup generators d) Elevate prioritized pump stations.
Water Supply Systems	Infrastructure at Point Avenue Infrastructure at Potowomut	Drought Extreme Temps Flooding	Relocate and isolate 42-inch water main valve under Pawtuxet River (Design phase only). Comprehensive Plan Strategy: Promote and encourage water conservation efforts to meet the requirements of the state's Water Use and Efficiency Act of 2009.	5. Fund build phase of relocating 42-inch water main valve subject to inundation.
Services/Utilities	48 pump stations, 29 in flood zones. Warwick Neck National Grid stations- Cowesett, Kilvert, 95 @ Hardig Road	Flooding High winds Hurricane	National Grid has tree trimming program.	(See Action 4)
Communication Towers	CCRI Aldrich Jr. and Sr. High Behind the Police Station Warwick Neck MetLife Various private towers	Wind	Cell on Wheels (COW) provided by Verizon in a storm. Radio back up for WWTF	None identified at this time.

At Risk	Location	Hazard/Problem	Ongoing Actions	New Mitigation Actions
	City owned towers		Communication redundancy in place.	
Dams	<p>High Hazard</p> <ul style="list-style-type: none"> • Camp Warwick Pond • Grist Mill Apartments <p>Significant Hazard</p> <ul style="list-style-type: none"> • Dave’s Marketplace <p>Low Hazard</p> <ul style="list-style-type: none"> • Fruit of the Loom • Silver Hook • Valley Country Club Pond • Keith Farm Pond • Feiring Farm Pond • Cranberry Bog • Gorton Pond • Three Ponds • Manor Drive Ext. Pond • Squantum Drive • Gorton Pond/Route 5 • Unnamed (Hardig Brook) • Royal Crest Apartments Upper • Royal Crest Apartments Lower • Valley Country Club #2 	Severe storms	Several dams were already removed in the Pawtuxet River.	6. Communicate to the State/Federal government the issue of flood control at existing upstream dams- outside of Warwick.
Marinas/Docks	<p>Greenwich Bay Marina</p> <p>Cowesett Marina</p> <p>Fairwinds Marina</p> <p>Harbor Light Marina</p> <p>Winstead’s Marina</p> <p>Ponaug Marina</p> <p>Apponaug Harbor Marina</p> <p>Pleasure Marina</p> <p>Pawtuxet Cove Marina</p>	Storm surge Coastal flooding	Comprehensive Plan Strategy: Work with the Rhode Island Coastal Resources Management Council (CRMC) to complete an update to the city’s Harbor Management Plan.	7. Provide more dependable locations to take out boats prior to a storm. a) Review the list of ramps from the Harbormaster

At Risk	Location	Hazard/Problem	Ongoing Actions	New Mitigation Actions
				<ul style="list-style-type: none"> b) Prioritize conditions of all ramps, not just City owned facilities. c) Improve/fix prioritized ramps. <p>8. Coordinate education and outreach efforts with the RI Marine Trade Association to distribute messaging about the dangers of watercraft turning into destructive debris during a storm.</p>
<p>Critical Municipal Hazard Response Facilities</p>	<p>City Hall T.F. Green Airport Kent Hospital Public Works Sewer Department Pilgrim H.S. (Primary Shelter) Warming and Cooling Centers Thayer Arena used as a Pet Shelter during emergencies</p> <p>Fire Stations (none in SFHA)</p> <ul style="list-style-type: none"> • Fire Alarm, 915 Sandy Lane • Station 1 HQ, 111 Veterans Memorial Drive • Station 2, 771 Post Road • Station 3, 2373 West Shore Road • Station 4, 1501 West Shore Road • Station 5, 450 Cowesett Road • Station 6, 456 West Shore Road • Station 8, 1651 Post Road 	<p>Wind, Snow, Flooding</p>	<p>Various departments have debris management plans.</p>	<p>9. Maintain continuity of services at City Hall and Management Information Services (MIS) during a power outage.</p> <ul style="list-style-type: none"> a) Conduct a generator needs assessment b) Secure necessary funding c) Purchase and install generator <p>10. Maintain supplemental power at Pilgrim High School which serves as a warming/cooling center.</p> <ul style="list-style-type: none"> a) Secure necessary funding to replace the generator.

At Risk	Location	Hazard/Problem	Ongoing Actions	New Mitigation Actions
	<ul style="list-style-type: none"> • Station 9, 314 Commonwealth Ave. • Station 10, 225 Potowomut Road <p>Police Stations (none in SFHA)</p> <ul style="list-style-type: none"> • Headquarters, 99 Veterans Memorial Drive • Outdoor Firearms Range, 190 Range Road • Conimicut Police Center, 759 West Shore Road • Oakland Beach Police Venter, 732 Oakland Beach Ave. <p>Conimicut Point Lighthouse- owned by the City, hosts NOAA weather equipment, and is an active navigational aid.</p>			<ul style="list-style-type: none"> b) Purchase and install new generator. <p>11. Maintain supplemental power at Fire Station 4.</p> <ul style="list-style-type: none"> a) Identify funding to either repair or replace existing generator. b) Install new generator. <p>12. Improve the resiliency of the Public Works garage on Sandy Lane.</p> <ul style="list-style-type: none"> a) Install a new roof b) Purchase and install a new generator. <p>13. Retire and replace aging vehicles.</p> <ul style="list-style-type: none"> a) Purchase a new bucket truck to aid the existing truck that has been in service for 15 years. b) Replace the 6-wheel dump truck and 4-wheel drive pick-up truck that are showing signs of excessive wear. <p>14. Purchase a wood chipper and a rear loading yard waste truck.</p>

At Risk	Location	Hazard/Problem	Ongoing Actions	New Mitigation Actions
				15. Purchase a new Harbor Master Boat.
Populations	<p>All residents Elderly, Infants, Mobility Impaired</p> <p>Senior Centers</p> <ul style="list-style-type: none"> • Pilgrim Senior Center <p>House of Hope Shelter (Homeless Shelter)</p> <p>Senior Housing</p> <ul style="list-style-type: none"> • Warwick Terrace • Warwick Terrace Annex • West Shore Terrace • Meadowbrook Terrace • Father Olsen Terrace • Charles Ford Terrace • Saint Elizabeth Terrace (independent living) <p>Section 8 Senior Housing</p> <ul style="list-style-type: none"> • Cranberry Pond • Greenwood Terrace • Greenwich Village • Hardig Brook Village • Matthew XXV • Shalom Apartments • Shawomet Terrace • Sparrows Point I • Sparrows Point II • Sparrows Point III <p>Nursing Homes</p> <ul style="list-style-type: none"> • Warwick Rest Home • Brookdale West Bay Manor • Ethan Place • Gaspee Mansion 	All Hazards	<p>Nursing homes in good shape, less so with Section 8</p> <p>Low Impact Development Standards</p> <p>Comprehensive Plan Strategy: Provide for conservation subdivisions by right, and consider making them mandatory, with appropriate design standards, in remaining open areas that may be developed some time in the future.</p> <p>Comprehensive Plan Strategy: Create Sustainable Neighborhood Livability Plans and Projects.</p> <p>Comprehensive Plan Strategy: Educate the public to better understand the concept of community resilience and the meaning of probabilities and risk,</p>	<p>16. Reduce the number of flood claims in Warwick.</p> <ol style="list-style-type: none"> a) Create an inventory of private structures in the floodplain. b) Determine appropriate structural activities (including participation in a voluntary acquisition program) for high risk residential properties. <p>17. Confirm emergency plans for senior housing and nursing homes.</p> <ol style="list-style-type: none"> a) Suggest generator hook ups if necessary. b) Suggest infrastructure changes if current emergency sheltering facilities are inadequate.

At Risk	Location	Hazard/Problem	Ongoing Actions	New Mitigation Actions
	<ul style="list-style-type: none"> • Greenwood Oaks Retirement Center • Roosevelt Manor • Avalon Nursing Home • Brentwood Nursing Home • Burdick Convalescent Home • Buttonwoods Crest Home • Greenwood House Nursing Home • Greenwood Oaks Rest Home • Kent Nursing Home • Sunny View Nursing Home • Warwick Health Center • Warwick Rest Home Mobile Home Parks <ul style="list-style-type: none"> • Senior City • Tollgate Village 		especially for stream and coastal flooding.	
Businesses	Warwick Mall Warwick Commons (West Marine) Businesses along Bellows Street and Venturi Avenue Businesses in and near Shaw's Plaza (Route 117 and Vine Ave) Businesses near Pontiac Street Businesses near Hardig Brook (i.e. Lay-z Boy at Bald Hill Road) Shellfishing and fishing industry	Flooding Hurricane- shuts down industry, loss of boats, dock space, habitat impacts	Comprehensive Plan Strategy: Preserve the shellfish industry by maintaining needed infrastructure and appropriate land use policies and advocating for supportive federal and state policies.	(See Action 2.)
Schools	New England Institute of Technology- Access Road and Post Road Campuses Community College of Rhode Island (Knight Campus)	Severe Storms Blizzards Wind Extreme Heat	All Hazards safety plan for public schools	None at this time.

At Risk	Location	Hazard/Problem	Ongoing Actions	New Mitigation Actions
	Salve Regina- Flood zone Public <ul style="list-style-type: none"> • Warwick Area Career & Technical Center • Pilgrim High School • Toll Gate High School • Veterans Middle School • Winman Middle School • 14 Elementary Schools Private <ul style="list-style-type: none"> • Apponaug Christian Academy • Rocky Hill School • Bishop Hendricken HS • Eleanor Briggs School • First Baptist Christian School • 19 Elementary Schools 			
Recreation Facilities	Warwick City Park Belmont Park Winslow Park Conimicut Point Park Oakland Beach Park Pawtucket Park Apponaug Park Clegg Field George Slater Memorial Grove Rocky Point Thayer/Warburton Ice Arenas McDermott Pool	Flooding Public Safety	Belmont Park was designed/allowed to flood.	18. Encourage visiting sport referees and coaches to sign up for Warwick's Code Red to be alerted to local emergencies.
Natural Resources	Beaches Wetlands Goddard Memorial State Park Warwick Pond	Beach erosion	Comprehensive Plan Strategy: Protect, preserve and enhance natural resource areas adjacent to	19. Remove debris (silt, and vegetation) from Buckeye Brook to reduce flooding and

At Risk	Location	Hazard/Problem	Ongoing Actions	New Mitigation Actions
	Sand Pond Gorton Pond Buckeye Brook Pawtuxet River	Accumulated vegetation choking Buckeye Brook	<p>developed or potentially developed areas.</p> <p>Comprehensive Plan Strategy: Support the programs of the Pawtuxet River Authority and Watershed Council that mitigate flood damage to low lying areas of the City.</p> <p>Comprehensive Plan Strategy: Continue policies and programs that protect, enhance, and increase the city's tree canopy.</p>	allow for Warwick Pond to retain more flood waters.
Historic Resources	Historic Districts (7) Historic Places (28)	All Hazards Flooding, high winds	<p>3 main districts (Apponaug, Pontiac, Pawtuxet)</p> <p>Comprehensive Plan Strategy: Provide resources for information and guidance to property owners on historic preservation issues.</p>	<p>20. Develop and implement a plan to protect historic structures, collections, and public records.</p> <ul style="list-style-type: none"> a) Make records electronic b) Create additional electronic storage

5

Programmatic Capabilities

Purpose

This capability assessment examines the existing studies, plans, programs, and policies that have incorporated hazard mitigation and other pro-active tools into the City system. The purpose of the capability assessment is to highlight successes, identify shortcomings, and to lay the groundwork for possible improvement. The City of Warwick recognizes that the inclusion of mitigation initiatives not only benefits the community by reducing human suffering, damages and the costs of recovery, but also helps build and maintain the sustainability and economic health of the City. This section details the City's existing relevant plans, programs, and policies that were reviewed during the drafting of this plan.

Primary Plans, Regulations, and Departments

PLANS AND PROGRAMS

Capital Improvement Program

The City Capital Improvement Program lists the priorities of necessary items of the community within the context of the community's fiscal ability to meet them during a five-year program period. The CIP is not intended to be an all-inclusive inventory of the City's capital needs for the upcoming five years. It is a document that summarizes planned or needed capital improvements. The plan is reviewed and updated regularly.

Examples of past elements in the Capital Improvement Program include constructing a fire station at Potowomut, replacing original library windows with more energy efficient windows, roof replacement, implementing a Geographical Information System, and sewer expansion. The plan is reviewed and updated regularly.

Dam Emergency Action Plans

The three high and significant hazard dams are privately owned. The City may reach out to dam owners and provide them with State-approved guidance for creating an Emergency Action Plan for their dams.

Debris Management Plan

The City of Warwick has developed a basic debris management plan which provides general information and procedures that support debris management operations.

Emergency Evacuation Plan/Routes

The City maintains an emergency evacuation plan as well as a marked hurricane evacuation routes. The map available [online](#) has routes to shelters as well as routes that direct people out of the area and away from the coast.

Harbor Management Plan

The Warwick Harbor Management Plan provides guidance for the City to manage water quality, moorings, commercial and residential development, commercial and recreational fishing, public access, boating safety, natural hazard mitigation/storm preparedness, and enforcement issues. The goal is to protect coastal areas through proactive planning.

Land Development and Subdivision Regulations

These regulations, last revised in 2001, establish procedural and substantive provisions for the development and subdivision of land. The regulations were designed to protect public health, safety, and welfare of the City, and protect existing natural and built environments and mitigate the significant negative impacts of proposed development on those environments, among other things. The regulations promote design of land developments and subdivisions which are well-integrated with the surrounding neighborhoods and concentrate development in areas which can best support intensive use by reason of natural characteristics and existing infrastructure.

MEDS-POD (Medical Emergency Distribution System- Point of Dispensing)

The MEDS-POD Plan (currently being updated) outlines the processes to enact a mass antibiotic or vaccine dispensing campaign within the jurisdiction. The general objective of the plan is to provide necessary framework to administer medical countermeasures to the entire targeted Warwick populations within 48 hours of

notification from the RI Department of Health or the RI Emergency Management Agency.

National Flood Insurance Program (NFIP)

The City of Warwick is an active and compliant member of the National Flood Insurance Program since 1991. As such, Warwick residents are able to purchase flood insurance to protect their property against flood losses. The City of Warwick has adopted the most recent (October 02, 2015) Flood Insurance Rate Maps (FIRM) and Flood Insurance Study (FIS). Insurance companies refer to these when providing coverage to homeowners. These maps are available for viewing at City Hall and online at The FEMA Map Service Center <https://msc.fema.gov>. The City has designated the Planning Director as the NFIP Coordinator to manage the program. Chapter 8, Section 8-5 of the Code of Ordinances is dedicated to the floodplain management program. The Special flood hazard areas make up the floodplain overlay district.

Soil Erosion, Runoff and Sediment Control (SERSC) Ordinance

This Warwick ordinance is maintained by the City to ensure proper storm water management of runoff from new development and re-development projects. Potential contaminants in storm water runoff may include suspended solids, nitrogen, phosphorus, hydrocarbons, heavy metals, pathogenic organisms (bacteria and viruses), and road salts.

StormReady Community

Warwick is a StormReady Community having demonstrated necessary communication and safety procedures needed to save lives and property before and during a storm event. There is an existing notification network, and weather radios and lightning detection devices are distributed throughout town. The City has adopted Standard Operating Procedures to provide guidance in preparing for and dealing with the effects of hazardous weather conditions. If the Warwick EMA Director is unable to be reached, responders are encouraged to monitor weather activity through WebEOC, National Weather Service Alerts, and CodeRed. The local and Rhode Island State Police provide National Weather Service Alerts over the Openfox Messenger Service.

Stormwater Management Plan

Stormwater Management Ordinance prohibits discharge or cause to be discharged into the municipal separate storm sewer system or watercourses any pollutant or non-stormwater discharge unless as allowed as a non-stormwater discharge. It also prohibits the construction, use, maintenance or continued existence of illicit connections to the municipal separate storm sewer system.

Warwick Comprehensive Plan

The Warwick Comprehensive Plan (adopted in 2014) discusses natural and cultural resources, the vision for livable neighborhoods, economic development, sustainable systems, future land use, and stewardship. It provides a vision for future community development by identifying updated goals, policies, and implementation actions. It is

expected that new revisions will continue to include elements of hazard mitigation and climate change, using this document as a reference.

Warwick Water Emergency Response Plan

The goal of the emergency management water division is to respond accordingly to different scenarios that are presented by utilizing all available resources, both local and state, to minimize impacts to the water system and its users. The degree of response is based on the losses of critical system components which necessitates a tiered response from various city departments and/or state agencies.

Zoning Ordinance

Among other things, the Warwick Zoning Ordinance (adopted in 1992) aims to promote public health, safety, and the general welfare of the city; provide guidance for orderly growth with respect to the natural characteristics of the land; and promote safety from fire, flood, and other natural or manmade disasters.

Enhanced Flood Inundation Maps

Flood inundation maps have been developed for Warwick using state of the art, fully coupled high resolution surge and wave models, applied to the coastal Warwick study area as part of the North Atlantic Coast Comprehensive Study. The new maps highlight the importance of developing better estimates of surge dynamics and the advancement in nearshore mapping of waves in flood inundated areas.

DEPARTMENTS AND ORGANIZATIONS

Building Department

The Warwick Building Department is comprised of building inspectors, property maintenance, the zoning department officials, and the building board of review. The Department provides guidance to residents, realtors, contractors, and attorneys on compliance with the City's Zoning Ordinance.

Chamber of Commerce

A non-profit organization established to build and strengthen the community by providing predictable leadership as a dependable partner. The Chamber provides information to business owners, networking opportunities, and continual learning and marketing support.

Emergency Management (EM)

The mission of the City of Warwick's Division of Emergency Management is the local public safety organization providing comprehensive, risk-based, and coordinated emergency management operations. Warwick's EMA primary mission has been to reduce the loss of life and property and to protect Warwick's infrastructure from all types of dangers through a program of mitigation, preparedness, response, and

recovery. The Warwick Emergency Management Agency Director is a member of the Police Department.

The permanently established Emergency Operations Center (EOC) is located at the Fire Department Headquarters at 111 Veterans Memorial Drive. The EOC has 1 diesel generator servicing the entire building.

Warwick uses the CodeRED emergency telephone notification system to provide important emergency information to citizens.

Emergency Medical Services (EMS)

The EMS Department operates out of Fire Station 1 and provides pre-hospital emergency medical treatment and transport of the injured to the hospital.

Fire Departments

Warwick businesses and residents are protected from fires, medical, hazardous material or environmental mishaps either on land or water. The City is served by 190-212 firefighters at ten fire stations. Overall equipment inventory includes:

- 12 engines
- 4 ladder vehicles
- 3 special hazard trucks
- 3 boats
- 6 ambulances

Planning Department

The Planning Department serves many functions related to the physical development of the community. The department is responsible potential developers and City departments and agencies with professional guidance and service with regard to the overall physical, social and economic development of the City. The Principal Planner and the EMA Director led the recent hazard mitigation plan update process. It is likely that they will retain that role in the future.

Planning Board

The nine-member Planning Board has the authority to adopt, modify, and amend rules and regulations governing and restricting the plotting or other sub-division of land in the city and to control the sub-division of land pursuant to such rules and regulations. The Planning Board is the lead for reviewing and updating the Zoning Ordinance, Subdivision Regulations, and the Comprehensive Community Plan.

Police Department

The Police Department's mission is to create a partnership with the community to provide quality policing for the protection of life and property, the investigation and

prevention of crime, and the maintenance of public safety. The Warwick Police Department is staffed by 172 sworn police officers and supported by 54 civilian employees.

The Department operates twenty-four hours a day and responds to all criminal complaints, calls for service and city-wide emergencies. The Department is located at 99 Veterans Memorial Drive and has the following equipment:

- 86 patrol vehicles (47 AWD and 39 RWD)
- 12 specialty vehicles
- 7 traffic motorcycles

Public Works

The Warwick Public Works Department consists of Administration, Highway, Sanitation, Automotive, Building Maintenance, Engineering, Recycling/Compost, and Parks and Recreation.

The mission of the Department of Public Works is to provide a responsive and high quality public service to all Warwick residents in the maintenance and improvement of city-owned property and infrastructure through positive interaction, interdepartmental relationships, and cost-effective management.

The Public Works facility is located at 925 Sandy Lane. This property houses all the City's public works maintenance equipment, vehicle repair facilities, sand and salt storage, and fueling facilities.

Public Works maintains the following ongoing mitigation strategies: snow plowing, ice management, storm drain and culvert maintenance, administering the stormwater and soil erosion program, Town vehicle repair, road inventory and reconstruction, street sweeping, and tree trimming (in partnership with the utility companies).

The Public Works department helps the City improve resiliency and reduce damages and cost from hazards by reviewing every site that is proposed for new development and/or redevelopment to ensure the sewer, water and stormwater regulations are followed during the design, the construction and the final acceptance of the site. During major storms, crews are dispersed to safe locations throughout the City to ensure that storm clean-up can be commenced as soon as the storm event is over.

School Department

The Warwick School District's Maintenance Department, is responsible for organizing the maintenance and security of the City's public schools. The School Department has the resources in-house to keep entrances, roofs, and sidewalks free of snow and ice.

The Warwick Public School Department has created a Safety/All Hazards Plan to prepare for and respond to various types of hazards.

In addition to being able to utilize the City's CodeRed system, the School Department has an internal communication network (Mutualink) for emergencies. They coordinate their storm response efforts through Warwick DPW and Police Department.

Mayor and Warwick City Council

The Mayor provides executive management, policy direction, and oversight of day-to-day municipal operations. The office is responsible for representing and promoting Warwick, and the Mayor and his staff work collaboratively with local, state, and federal officials, as well as civic, religious, and non-profit organizations to address areas of mutual concern throughout Warwick.

The City Council is made up of nine elected members committed to providing an effective and efficient government for residents and businesses. The City Council approves local hazard mitigation plans. The Town Council also reviews and approves goals and objectives for public safety.

Warwick Sewer Authority

Located at 125 Arthur W. Devine Boulevard, the Warwick Sewer Authority (WSA) oversees the City's sewerage program and wastewater treatment facility. The Warwick Sewer Authority is a member of the Rhode Island Water and Wastewater Agency Response Network (RIWARN). The City maintains 48 sewage pump stations to convey wastewater. The WSA has a variety of vehicles and equipment including 17 vehicles, 2 trailers, 4 dewatering pumps, 2 air compressors, a loader, and a fork lift. If needed, the Warwick Sewer Authority has 7 towable generators (2 of which are very old and not reliable) to keep pump stations online.



New levee to protect wastewater treatment plant from 500-year floods (2017).



ElevConimicut Lighthouse

Elevation of 11 Harris Avenue.

floods (2017).

Water Division

The Warwick Water Division provides safe drinking water to nearly 27,000 water customers. The Division is responsible for upgrading, replacing, and rehabilitating the existing transmission and distribution system. Warwick's drinking water is purchased from the Providence Water Supply Board. The Water Division has executed their authority by shutting off water in coastal areas where the pipes become exposed and threaten to break. This reduced the chance of contaminants entering the system through a crack in the line.

Zoning Board of Review

The Warwick Zoning Board of Review, consisting of five-voting members, hears and determines appeals from the granting or refusal of building permits. The Board has the authority to allow exceptions or variations in accordance with State law. The Warwick building official serves as staff to the Board.

STATE PROGRAMS

Rhode Island Coastal Resource Management Council

The Coastal Resources Management Council (CRMC) is a management agency with regulatory functions. Its primary responsibility is for the preservation, protection, development and where possible the restoration of the coastal areas of the state via the implementation of its integrated and comprehensive coastal management plans and the issuance of permits for work with the coastal zone of the state.

Rhode Island Enhanced 9-1-1 Telephone System

Warwick utilizes the state's E-911 system which provides 24-hour public safety communication services from one answering point in North Scituate. Each call is routed to the appropriate response team. The system processes both landline and wireless 9-1-1 calls.

Rhode Island State Building Code

All municipalities within the State of Rhode Island share a single building code ([RIGL 23-27.3-100 et. al.](#)). The Code itself (which incorporates the International Building Code) was last amended in 2015 and provides comprehensive construction requirements designed to mitigate the impacts from natural hazards, such as high wind events. The Code is enforced by the Warwick Building Department and provides an additional layer of regulatory control to those discussed above.

Rhode Island State Fire Code Regulations

Warwick has adopted the RI Fire Safety Codes to safeguard life and property from the hazards of fire and explosives in accordance with safe practice. The Code is enforced by the Warwick Fire Departments and provides reasonable minimum requirements for fire prevention and protection.

Rhode Island State Dam Safety Program

The City of Warwick participates in the State Dam Safety Program because of the high hazard and significant hazard dams in the town. The State Dam Safety Program was created to facilitate the enforcement of the primary dam inspection law (RIGL 46-19, Inspection of Dams and Reservoirs). RIGL 46-19 states that dam owners are responsible for the safe operation, maintenance, repair, and rehabilitation of a dam, which are the essential elements in preventing dam failure; furthermore, dam owners are liable for the consequences of accidents or failures of their dams. According to the State of Rhode Island 2016 Dam Safety Program Report, the following have been identified as program limitations: unclear ownership of numerous high hazard dams, construction of buildings within inundation areas below dams, lack of funding to repair or remove privately owned dams, inadequate spillway capacities and engineering analyses, lack of Emergency Action Plans across the state, inadequate staffing, increase in rainstorm intensities. None of the 3 of the high and significant hazard dams in Warwick have Emergency Action Plans on file.

Rhode Island DEM Division of Law Enforcement

The Rhode Island DEM Division of Law Enforcement serves to protect the natural resources and ensure compliance with all environmental conservation laws through law enforcement and education.

Rhode Island DEM Wetland Regulations

The Rhode Island Department of Environmental Management (DEM) is responsible for regulating alterations of the freshwater wetlands throughout the State. Since many floodplains are also wetlands, appropriately managing these resources help maintain proper floodplain function. These regulations ensure that actions in this plan which will alter the physical landscape will not do so at the expense of wetlands.

Rhode Island Department of Health

The Rhode Island Department of Health (HEALTH), not only strives to prevent disease and increase health and safety, but they also promote the Special Needs Emergency Registry. By voluntarily enrolling in this list, local police, fire, and other local first responders can better prepare for and respond to an individual's needs during a disaster.

Rhode Island Emergency Management Agency

The Rhode Island Emergency Management Agency (RIEMA) is the State agency assigned to reduce the loss of life and property for the whole community while ensuring that as a state we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all natural, human-caused, and technological hazards. RIEMA is also the pass-through agency for FEMA mitigation funding.

OTHER

Community College of Rhode Island (CCRI)

The CCRI Knight Campus enrolls about 18,000 students annually. The college has an emergency alert system that delivers text messages and email messages to members of the CCRI community. Registered students, faculty, and staff are automatically enrolled in the Rave Emergency Alert system. The college also has an emergency response guide to aid responders during a range of emergency situations.

MBTA Commuter Train at T.F. Green Airport

The Massachusetts Bay Transportation Authority (MBTA) provides commuter rail services from T.F. Green Airport to Providence and Boston's South Station. During an emergency, these trains could be used to evacuate large numbers of people.



Commuter Rail

Kent County Hospital

Located at 455 Toll Gate Road, the Kent County Hospital serves the medical needs of patients in the area. Among other documented procedures, the hospital has its own ingress plan as well as an emergency evacuation plan.

Salve Regina (Warwick Campus)

Salve Regina's campus in Warwick is satellite location of the main campus in Newport. The Warwick campus offers graduate programs and continuing adult education courses. Salve Regina has in place campus emergency procedures which cover a variety of emergency situations; from fire and weather emergencies to hostage situations and medical emergencies. Procedure reference guides are available throughout the Warwick campus.

United Way 2-1-1

United Way 2-1-1 in Rhode Island is a free, confidential service that provides information, referrals, and is available in multiple languages. This service connects

residents with community services they may need such as childcare, housing, health insurance, and tax preparation.

FEDERAL PROGRAMS

Federal Emergency Management Agency

The Federal Emergency Management Agency (FEMA), an agency of the U.S. Department of Homeland Security, coordinates disaster response when local and state resources are maxed out. The agency also provides grant funding for pre-and post-disaster mitigation projects.

United States Coast Guard

The U.S. Coast Guard Auxiliary is the uniformed, all-volunteer component of the United States Coast Guard. Members conduct waterborne patrols in southern Narragansett Bay and Rhode Island Sound, run public education classes, and conduct free vessel examinations. The City of Warwick supports the efforts of the United States Coast Guard Auxiliary. During storm events, emergency on-the-water requests will be forwarded to the nearest Coast Guard Station. The local station is across Narragansett Bay in Bristol.



Conimicut Lighthouse

6

Mitigation Actions

Mission

The purpose of the Warwick Multi-Hazard Mitigation Strategy is to:

1. Provide a coordinated consistent set of goals for reducing or minimizing: human and property losses; major economic disruption; disruption of City services; degradation of ecosystems and environmental critical habitats; and destruction of cultural and historical resources from natural disasters;
2. Provide a basis for intergovernmental coordination in natural hazard mitigation programs at the state and local level;
3. Develop partnerships between the City and private sector, local communities and non-profit organizations in order to coordinate and collaborate natural hazard mitigation programs;
4. Identify and establish close coordination with local government departments and agencies responsible for implementing the sound practices of hazard mitigation through building standards and local land use development decisions and practices; and to
5. Provide for a continuing public education and awareness about the risks and losses from natural disasters, in addition to natural hazard mitigation programs, policies and projects.

Mitigation Goals

The goals of the Warwick Multi-Hazard Mitigation Strategy are to:

1. Protect public health, safety and welfare;
2. Reduce property damages caused by natural disasters;
3. Minimize social dislocation and distress;
4. Reduce economic losses and minimize disruption to local businesses;
5. Protect the ongoing operations of critical facilities;
6. Reduce the dependence and need for disaster assistance funding after natural disasters;
7. Expedite recovery disaster mitigation efforts during the recovery phase;
8. Promote non-structural flood and coastal erosion measures to reduce the risk of damage to the surrounding properties and environmental habitats;
9. Establish a local Hazard Mitigation Committee to support, implement and revise the Warwick multi-hazard mitigation strategy and to provide the support necessary for an ongoing forum for the education and awareness of multi-hazard mitigation issues, program, policies and projects; and to
10. Provide for adequate financial and staffing resources to implement the Warwick Hazard Mitigation Strategy.
11. Maintain an updated, FEMA-approved Local Mitigation Plan in accordance with 44 CFR 201 such that the City of Warwick is eligible to apply and receive assistance under federal hazard mitigation assistance programs.

Status of Proposed Actions from the 2011 Hazard Mitigation Plan

Table 27 Status of Proposed 2011 Actions

Action	Status	Reason why it is not complete (shift in focus, funding, etc.)	Other comments
Drainage Inventory- convert GPS data to GIS database.	Complete – needs data improvements.		Ongoing project. http://www.mainstreetmaps.com/ri/warwick/public.asp
Road Inventory - convert GPS data to GIS database.	Complete		On MainStreetMaps.
Infrastructure Inventory of all structures in the floodplain.	Ongoing		Structure count was completed. Roll infrastructure count into 2019.
Protect sewer pump stations from flooding	Ongoing		2 Completed (Bellows Street and Alteiri Way) 3 Near Completion (Knight St. and East Natick 1 & 2) 1 Needs funding (Oakland Beach)
Offer financial aid (through FEMA) to Conimicut/Oakland Beach residents to elevate structures.	Completed		Reached out to SRL and RL owners. Very few interested property owners.
Purchase, demolish, or mitigate an estimated 25 high risk residential properties to prevent further repetitive losses.	Ongoing		City conducted multiple outreach to Severe Repetitive Loss property owners. One project (Harris Ave) completed with FEMA funding – elevated an SRL property out of SFHA w/ 3.5' of freeboard. Continue action in 2019 plan.
Develop a plan to manage floodwaters in the Pawtuxet River through coordinated flow control at existing public/private dams.	Complete		Partial removal of dam at its confluence with the Cove was a State-led effort.
Evaluate the feasibility of upgrading the existing WWTF levy to prevent repetitive losses of equipment/facilities, and interruptions in critical sewage collection/treatment.	Complete		Levee installed.

Action	Status	Reason why it is not complete (shift in focus, funding, etc.)	Other comments
Identify and secure agreements with owners of properties outside flood plain where boats could be relocated during major storm events.	Incomplete	Marine trades initiative, other priorities since 2011.	Discussions w marinas have occurred, but transportation of boats may be an issue. Lack of manpower of resources to take down fly bridges in a quick turnaround time. May be worth revisiting discussion. May be an issue of improving ramps. Education and outreach with RI Marine Trade Association.
Relocate 42-inch water main valve subject to inundation to allow 1) access to the valve during flooding and, 2) ability to isolate 42-inch main under Pawtuxet River during flood events.	In design phase. Ongoing.	Lack of resources.	Project has been 75% designed. Need funds to compete it. Move to 2019.
Develop and evaluate alternatives for flood mitigation in the industrial park area on Bellows Street.	Incomplete	Prioritized pump station.	New hardened pump station (500yr flood). Nothing has been done with the businesses. Move to 2019.
Identify/secure/equip alternate location for Emergency Management command in case primary is inaccessible/damaged during a disaster.	Completed		Warwick Fire Dept Station 10 was identified as an alternate Emergency Operations Center. Station 1 is primary EOC.
Relocate the Bellows Street sewer pump station out of flood-prone area.	Completed		Elevated.
Relocate the Knight Street sewer pump station out of flood-prone area.	Complete		Floodproofed/elevated.

Shaded actions were carried over into this current 2019 hazard mitigation plan.

Mitigation Actions

The Warwick Hazard Mitigation Plan Committee decided to propose actions that addressed certain vulnerabilities that were identified earlier in the planning process. See Chapter 4.

The text following the table below summarizes the specific problem and proposed possible solution, details the primary tasks to be undertaken, identifies an appropriate lead and anticipates financing options. Each action was given a priority ranking of low, medium, or high as determined by the Committee. Higher weight was given to actions that would benefit the greater City as a whole. This helps to generally prioritize needs when funding becomes available or budgeted. Funding and staff time will be the determining factors on when various actions are completed. The Committee understands that implementation of many of these proposed actions require the Town to secure external funding.

There are necessary planning elements that need to be completed before additional mitigation actions can be considered. The Committee has identified a range of actions below, some of which are planning activities. However, there is a mitigation action identified for each vulnerable area where applicable.

Priority Level

High: Reduces the greatest risks, is important to accomplish first

Medium: May need other actions to be completed first

Low: Less of an impact on safety and property

Time Frame (from date of plan adoption)

Short Term: within 1-3 years

Medium Term: within 3-5 years

Long Term: greater than 5 years

VULNERABLE AREA: Flood Prone Drainage Systems, Streets, or Infrastructure

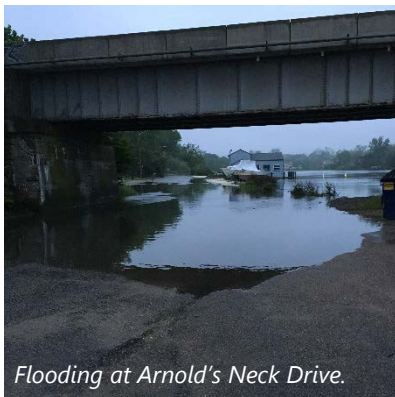
MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
1. Improve flood safety messaging for motorists.	<input type="checkbox"/> Local Plans and Regulations	<input checked="" type="checkbox"/> 1 <input type="checkbox"/> 7	<input type="checkbox"/> High
a) Place permanent alternate route signage on Arnold's Neck Drive.	<input type="checkbox"/> Structure and Infrastructure	<input type="checkbox"/> 2 <input type="checkbox"/> 8	<input type="checkbox"/> Medium
b) Place evacuation route signage on Conimicut.	<input type="checkbox"/> Natural Systems Protection	<input checked="" type="checkbox"/> 3 <input type="checkbox"/> 9	<input checked="" type="checkbox"/> Low
	<input checked="" type="checkbox"/> Education and Awareness	<input type="checkbox"/> 4 <input type="checkbox"/> 10	ACTION STATUS
		<input type="checkbox"/> 5 <input type="checkbox"/> 11	New
		<input type="checkbox"/> 6	

RATIONALE- WHY IS THIS IMPORTANT?

Motorists can become trapped if they drive through low-lying flooded roads. Visitors to Arnold Neck Road may not know of alternate routes during a flood event. Conimicut Point can become isolated during a flood.

BENEFITS	OBSTACLES	
Public safety and less damage to road infrastructure.	Other City priorities.	
LEAD/CHAMPION	SUPPORT	
Warwick DPW		
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
DPW Operating Budget	\$3,000	<input checked="" type="checkbox"/> Short Term (0-3 years) <input type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES



Flooding at Arnold's Neck Drive.

VULNERABLE AREA: Flood Prone Drainage Systems, Streets, or Infrastructure

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
2. Reduce riverine flood damage in the Bellow Street industrial park area. a) Educate building tenants about floodproofing options.	<input type="checkbox"/> Local Plans and Regulations <input type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input checked="" type="checkbox"/> Education and Awareness	<input type="checkbox"/> 1 <input type="checkbox"/> 7 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input checked="" type="checkbox"/> 4 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> 11 <input checked="" type="checkbox"/> 6	<input type="checkbox"/> High <input type="checkbox"/> Medium <input checked="" type="checkbox"/> Low
			ACTION STATUS 2011

RATIONALE- WHY IS THIS IMPORTANT?

The nearby Pawtuxet River has flooded this area in the past. Previous mitigation actions have addressed the residential parts of the neighborhood. Businesses that are situated in the flood hazard area have the option to employ dry floodproofing techniques.

BENEFITS	OBSTACLES	
Reduce economic losses and disruption of services.		
LEAD/CHAMPION	SUPPORT	
Planning	Economic Development, Building Department	
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
		<input checked="" type="checkbox"/> Short Term (0-3 years) <input type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

Dry floodproofing of non-residential structures include strengthening walls, sealing openings, or using waterproof compounds or plastic sheeting on walls to keep water out. Tenants can also use best management practices of elevating their merchandise/equipment/supplies off the floor.

Low priority because occupants know flooding is a problem.

Currently the Building Department tells the building occupants about the flood hazard when they go to City Hall for permits. This mitigation action suggests providing building owners with floodproof ideas.

See FEMA Technical Bulletin 3, Non-Residential Floodproofing - Requirements and Certification (1993).

<https://www.fema.gov/media-library/assets/documents/3473>

VULNERABLE AREA: Bridges

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
3. Maintain the usefulness of Warwick's bridges. a) Establish a local bridge inspection program for municipally owned bridges. b) Prioritize repairs to failing bridges. c) Consider bridge elevation when undergoing structure maintenance/improvements.	<input checked="" type="checkbox"/> Local Plans and Regulations	<input checked="" type="checkbox"/> 1 <input type="checkbox"/> 7	<input type="checkbox"/> High
	<input checked="" type="checkbox"/> Structure and Infrastructure	<input type="checkbox"/> 2 <input type="checkbox"/> 8	<input checked="" type="checkbox"/> Medium
	<input type="checkbox"/> Natural Systems Protection	<input type="checkbox"/> 3 <input type="checkbox"/> 9	<input type="checkbox"/> Low
	<input type="checkbox"/> Education and Awareness	<input checked="" type="checkbox"/> 4 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	ACTION STATUS
			New

RATIONALE- WHY IS THIS IMPORTANT?

Future sea level rise conditions and associated storm surge may flood or damage approaches to area bridges. Incorporating mitigation measures to align with the design life of the bridge can extend their usefulness.

BENEFITS	OBSTACLES	
More resilient infrastructure.	Funding	
LEAD/CHAMPION	SUPPORT	
Warwick DPW	Planning Department	
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
a) DPW Operating Budget b) DPW Operating Budget c) FEMA HMGP funding, FHWA highway funding	a) Staff time b) Staff time c) Depends on bridge needs	<input type="checkbox"/> Short Term (0-3 years) <input checked="" type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

This is a medium priority for the City, most of the bridges in Warwick are owned by the State.

VULNERABLE AREA: Wastewater

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
4. Improve sewer pump station resiliency.	<input type="checkbox"/> Local Plans and Regulations	<input checked="" type="checkbox"/> 1 <input type="checkbox"/> 7	<input type="checkbox"/> High
a) Identify and secure funding for the Oakland Beach sewer pump station.	<input checked="" type="checkbox"/> Structure and Infrastructure	<input type="checkbox"/> 2 <input type="checkbox"/> 8	<input checked="" type="checkbox"/> Medium
b) Prioritize remaining pump stations for elevation.	<input type="checkbox"/> Natural Systems Protection	<input type="checkbox"/> 3 <input type="checkbox"/> 9	<input type="checkbox"/> Low
c) Obtain 8 backup generators (short term action)	<input type="checkbox"/> Education and Awareness	<input checked="" type="checkbox"/> 4 <input type="checkbox"/> 10	ACTION STATUS 2011
d) Elevate prioritized pump stations.		<input checked="" type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	

RATIONALE- WHY IS THIS IMPORTANT?

Flooding or severe storms that lead to power outages can cripple the wastewater treatment system. Functioning pumps keep operations moving and protect human health.

BENEFITS	OBSTACLES	
More resilient infrastructure. Continuity of public services. Safeguarded human health.	Funding Resident buy-in at Oakland Beach	
LEAD/CHAMPION	SUPPORT	
Warwick Sewer Authority	Warwick DPW	
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
CDBG, EDA FEMA Mitigation grants	a) Elevate: \$500,000 b) Staff time c) \$25,000/generator d) Varies	<input type="checkbox"/> Short Term (0-3 years) <input type="checkbox"/> Medium Term (3-5 years) <input checked="" type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

VULNERABLE AREA: Water Supply

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
5. Fund and implement the Build phase of relocating 42-inch water main valve subject to inundation to allow 1) access to the valve during flooding and, 2) ability to isolate 42-inch main under Pawtuxet River during flood events.	<input type="checkbox"/> Local Plans and Regulations <input checked="" type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input type="checkbox"/> Education and Awareness	<input checked="" type="checkbox"/> 1 <input type="checkbox"/> 7 <input type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input checked="" type="checkbox"/> 4 <input type="checkbox"/> 10 <input checked="" type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input checked="" type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low
			ACTION STATUS
			2011

RATIONALE- WHY IS THIS IMPORTANT?

Flooding or severe storms that lead to power outages can cripple the wastewater treatment system. Functioning pumps keep operations moving and protect human health.

This waterline is also the main feed for water supplying the Warwick Sewer Authority.

BENEFITS	OBSTACLES	
More resilient infrastructure. Continuity of public services. Safeguarded human health.		
LEAD/CHAMPION	SUPPORT	
Warwick Water Department	Providence Water Resources Board	
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
RI Infrastructure Bank Capital Funds Providence Water's Infrastructure Replacement Program (IFR)	\$1 million	<input checked="" type="checkbox"/> Short Term (0-3 years) <input type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)
OTHER NOTES		

VULNERABLE AREA: Dams

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
6. Communicate to the State/Federal government the issue of flood control at existing upstream dams- outside of Warwick.	<input type="checkbox"/> Local Plans and Regulations <input type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input checked="" type="checkbox"/> Education and Awareness	<input checked="" type="checkbox"/> 1 <input type="checkbox"/> 7 <input type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input type="checkbox"/> High <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Low ACTION STATUS New

RATIONALE- WHY IS THIS IMPORTANT?

The failure of large dams upstream of Warwick are a concern for the Hazard Mitigation Plan Committee.

BENEFITS	OBSTACLES	
Understanding the safeguards in place outside of their jurisdiction will help local officials plan for flood disasters.		
LEAD/CHAMPION	SUPPORT	
Warwick DPW/Planning		
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
DPW and Planning Operating Budget	Staff time	<input type="checkbox"/> Short Term (0-3 years) <input checked="" type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)
OTHER NOTES		

VULNERABLE AREA: Marinas/Docks

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
7. Provide more dependable locations to take out boats prior to a storm.	<input type="checkbox"/> Local Plans and Regulations <input checked="" type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input checked="" type="checkbox"/> Education and Awareness	<input type="checkbox"/> 1 <input type="checkbox"/> 7 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> 11 <input checked="" type="checkbox"/> 6	<input type="checkbox"/> High <input type="checkbox"/> Medium <input checked="" type="checkbox"/> Low
a) Review the list of ramps from the Harbormaster			ACTION STATUS
b) Prioritize conditions of all ramps, not just City owned facilities.			2011
c) Improve/fix prioritized ramps.			

RATIONALE- WHY IS THIS IMPORTANT?

Current ramp conditions may hinder boat pull outs immediately prior to a summer hurricane.

BENEFITS	OBSTACLES	
Having more usable boat ramps will get more people off the water quickly when danger is imminent.		
LEAD/CHAMPION	SUPPORT	
Harbor Management Commission	Planning Department	
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
a) and b) Volunteer time c) Warwick Capital budget, DEM grants	c) varies	<input checked="" type="checkbox"/> Short Term (0-3 years) <input type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

Consider Sediment Maintenance/Mitigation of Oakland Beach.

VULNERABLE AREA: Marinas/Docks

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
8. Coordinate education and outreach efforts with the RI Marine Trade Association to distribute messaging about the dangers of watercraft turning into destructive debris during a storm.	<input type="checkbox"/> Local Plans and Regulations <input type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input checked="" type="checkbox"/> Education and Awareness	<input type="checkbox"/> 1 <input type="checkbox"/> 7 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input type="checkbox"/> High <input type="checkbox"/> Medium <input checked="" type="checkbox"/> Low <hr/> ACTION STATUS New

RATIONALE- WHY IS THIS IMPORTANT?

Boat owners may just be concerned about their own vessel, and not consider how it can be ripped from the dock and tossed inland.

BENEFITS	OBSTACLES	
Better educated boat owners.		
LEAD/CHAMPION	SUPPORT	
Harbormaster	RI Marine Trade Association, local boating associations, RIDEM	
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
RIDEM grant Private funds from associations		<input checked="" type="checkbox"/> Short Term (0-3 years) <input type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

Options: Bill stuffer with registration info, Email blast from RIDEM which manages boater registration, flyers at marinas.

This is a low priority; boat owners want to protect their investment and are generally aware of the dangers. This effort could be part of a widespread messaging campaign prior to a severe storm or prior to the boating season.

See FEMA Recovery Policy for debris removal from waterways : https://www.fema.gov/pdf/government/grant/pa/9523_5.pdf

VULNERABLE AREA: Critical Facilities

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
9. Maintain continuity of services at City Hall and Management Information Services (MIS) during a power outage. a) Conduct a generator needs assessment b) Secure necessary funding c) Purchase and install generator	<input type="checkbox"/> Local Plans and Regulations <input checked="" type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input type="checkbox"/> Education and Awareness	<input type="checkbox"/> 1 <input type="checkbox"/> 7 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input checked="" type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input checked="" type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low ACTION STATUS New

RATIONALE- WHY IS THIS IMPORTANT?

City Hall and MIS are without backup power sources.

BENEFITS	OBSTACLES	
Protect ongoing operations.	Funding. Achieving a reasonable Benefit Cost Analysis necessary to qualify from some federal funding.	
LEAD/CHAMPION	SUPPORT	
MIS	EMA Director, Building Maintenance	
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
FEMA Emergency Management grants FEMA Hazard Mitigation Grants	a) Staff time b) Staff time c) \$150,000 for platform, wiring, and equipment	<input checked="" type="checkbox"/> Short Term (0-3 years) <input type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

VULNERABLE AREA: Critical Facilities

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
10. Maintain supplemental power at Pilgrim High School which serves as a warming/cooling center.	<input type="checkbox"/> Local Plans and Regulations <input checked="" type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input type="checkbox"/> Education and Awareness	<input type="checkbox"/> 1 <input type="checkbox"/> 7 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input checked="" type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input checked="" type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low
a) Secure necessary funding to replace the generator			ACTION STATUS
b) Purchase and install new generator			New

RATIONALE- WHY IS THIS IMPORTANT?

The current generator is manually operated and fueled. Not an ideal set up during extreme conditions.

BENEFITS	OBSTACLES	
Keep warming/cooling center open. Protect the safety of shelter workers.	Funding. Achieving a reasonable Benefit Cost Analysis necessary to qualify from some federal funding.	
LEAD/CHAMPION	SUPPORT	
School Department Maintenance	Warwick EMA, School Superintendent	
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
FEMA Emergency Management grants FEMA Hazard Mitigation Grants	a) Staff time b) \$25,000 for equipment	<input checked="" type="checkbox"/> Short Term (0-3 years) <input type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

VULNERABLE AREA: Critical Facilities

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
11. Maintain supplemental power at Fire Station 4.	<input type="checkbox"/> Local Plans and Regulations <input checked="" type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input type="checkbox"/> Education and Awareness	<input type="checkbox"/> 1 <input type="checkbox"/> 7 <input type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input checked="" type="checkbox"/> 5 <input type="checkbox"/> 11 <input checked="" type="checkbox"/> 6	<input checked="" type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low
a) Identify funding to either repair or replace existing generator			ACTION STATUS
b) Install new generator			New

RATIONALE- WHY IS THIS IMPORTANT?

The Fire Department's Station 4 generator is not a reliable backup power source.

BENEFITS	OBSTACLES	
Continuity of emergency operations during a power outage.	Achieving a reasonable Benefit Cost Analysis necessary to qualify from some federal funding.	
LEAD/CHAMPION	SUPPORT	
Fire Department	Building	
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
FEMA Emergency Management grants FEMA Hazard Mitigation Grants City Capital Budget	a) Staff time b) \$25,000	<input checked="" type="checkbox"/> Short Term (0-3 years) <input type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

VULNERABLE AREA: Critical Facilities

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
12. Improve the resiliency of the Public Works garage on Sandy Lane. a) Install a new roof b) Purchase and install a new generator	<input type="checkbox"/> Local Plans and Regulations <input checked="" type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input type="checkbox"/> Education and Awareness	<input type="checkbox"/> 1 <input checked="" type="checkbox"/> 7 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input checked="" type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input checked="" type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low
			ACTION STATUS
			New

RATIONALE- WHY IS THIS IMPORTANT?

The current roof is nearing its useful life, is susceptible to wind damage and is actively leaking.
The existing generator is beyond its useful life and has proven to be undependable.

BENEFITS	OBSTACLES
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Reduce property damage. Maintain usefulness of the facility for pre- and post-disaster response.	Funding.
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LEAD/CHAMPION	SUPPORT
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Warwick DPW	
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POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
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Warwick Capital Budget	a) \$500,000	<input checked="" type="checkbox"/> Short Term (0-3 years)
FEMA Emergency Management grants	b) \$75,000	<input type="checkbox"/> Medium Term (3-5 years)
FEMA Hazard Mitigation Grants		<input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

VULNERABLE AREA: Critical Facilities

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
13. Retire and replace aging vehicles. a) Purchase a new bucket truck to aid the existing truck that has been in service for 15 years. b) Replace the 6-wheel dump truck and 4-wheel drive pick-up truck that are showing signs of excessive wear.	<input type="checkbox"/> Local Plans and Regulations <input checked="" type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input type="checkbox"/> Education and Awareness	<input type="checkbox"/> 1 <input checked="" type="checkbox"/> 7 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input checked="" type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input type="checkbox"/> High <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Low <hr/> ACTION STATUS New

RATIONALE- WHY IS THIS IMPORTANT?

Maintaining a working fleet helps the Public Works department staff do their jobs more effectively.

BENEFITS	OBSTACLES	
More reliable vehicles to aid in recovery efforts.	Funding.	
LEAD/CHAMPION	SUPPORT	
Warwick DPW		
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
DPW Operating Budget Warwick Capital Budget	a) \$175,000 b) \$89,000 for dump truck, \$42,000 for pick-up truck	<input checked="" type="checkbox"/> Short Term (0-3 years) <input type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

VULNERABLE AREA: Critical Facilities

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
14. Purchase a wood chipper and a rear loading yard waste truck.	<input type="checkbox"/> Local Plans and Regulations <input checked="" type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input type="checkbox"/> Education and Awareness	<input type="checkbox"/> 1 <input checked="" type="checkbox"/> 7 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input checked="" type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input type="checkbox"/> High <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Low <hr/> ACTION STATUS New

RATIONALE- WHY IS THIS IMPORTANT?

These additional assets will improve the department’s storm prep and post-event clean-up. Replace aging equipment.

BENEFITS	OBSTACLES	
No longer dependent on renting the equipment.		
LEAD/CHAMPION	SUPPORT	
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
DPW Operating Budget Warwick Capital Budget	\$25,000	<input checked="" type="checkbox"/> Short Term (0-3 years) <input type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

The City recognizes that that this action does not necessarily reduce the magnitude of natural hazards, it does aid pre- and post-disaster efforts.

VULNERABLE AREA: Critical Facilities

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
15. Purchase a new Harbor Master Boat.	<input type="checkbox"/> Local Plans and Regulations <input checked="" type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input type="checkbox"/> Education and Awareness	<input checked="" type="checkbox"/> 1 <input checked="" type="checkbox"/> 7 <input type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input type="checkbox"/> High <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Low ACTION STATUS New

RATIONALE- WHY IS THIS IMPORTANT?

To replace an older vessel.

BENEFITS	OBSTACLES	
The boat will improve water rescue response, aid in debris removal, and allow for easier access to the Conimicut Point Lighthouse which is a critical facility (houses weather equipment, and navigational aid and NOAA tide monitoring station)	Finding available funding.	
LEAD/CHAMPION	SUPPORT	
Harbor Master		
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
City Operating Budget Donation	\$150,000	<input type="checkbox"/> Short Term (0-3 years) <input checked="" type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

The City recognizes that that this action does not necessarily reduce the magnitude of natural hazards, it does aid in response and clean-up post-disaster.

VULNERABLE AREA: Populations

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
16. Reduce the number of flood claims in Warwick. a) Create an inventory of private structures in the floodplain.	<input type="checkbox"/> Local Plans and Regulations <input checked="" type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input type="checkbox"/> Education and Awareness	<input checked="" type="checkbox"/> 1 <input type="checkbox"/> 7 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input type="checkbox"/> High <input type="checkbox"/> Medium <input checked="" type="checkbox"/> Low
			ACTION STATUS 2011

RATIONALE- WHY IS THIS IMPORTANT?

Knowing where the most at-risk areas are can help target flood mitigation efforts.

BENEFITS	OBSTACLES	
Better documentation and understanding of vulnerable areas.		
LEAD/CHAMPION	SUPPORT	
Warwick Planning Department	Building/CRS Department, Warwick DPW	
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
Planning Operating budget	Staff time	<input checked="" type="checkbox"/> Short Term (0-3 years) <input type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

VULNERABLE AREA: Populations

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
17. Reduce the number of flood claims in Warwick. a) Determine appropriate structural activities (including participation in a voluntary acquisition program) for high risk residential properties.	<input type="checkbox"/> Local Plans and Regulations <input checked="" type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input type="checkbox"/> Education and Awareness	<input type="checkbox"/> 1 <input type="checkbox"/> 7 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 8 <input checked="" type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input type="checkbox"/> High <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Low
			ACTION STATUS 2011

RATIONALE- WHY IS THIS IMPORTANT?

Severe Repetitive Loss properties are a financial drain to the National Flood Insurance Program. By reducing their vulnerability, once flood prone homes can reduce future costs and damages.

BENEFITS	OBSTACLES	
Reduce the need for dependence and need for post-disaster assistance.	Funding.	
LEAD/CHAMPION	SUPPORT	
Warwick Planning Department	Building/CRS Department, Warwick DPW	
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
FEMA Pre-Disaster and Mitigation grant funds Homeowner funds	Varies by project	<input checked="" type="checkbox"/> Short Term (0-3 years) <input checked="" type="checkbox"/> Medium Term (3-5 years) <input checked="" type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

This will be an ongoing project for the City.



VULNERABLE AREA: Populations

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
18. Confirm emergency plans for senior housing and nursing homes.	<input type="checkbox"/> Local Plans and Regulations <input type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input checked="" type="checkbox"/> Education and Awareness	<input checked="" type="checkbox"/> 1 <input type="checkbox"/> 7 <input type="checkbox"/> 2 <input type="checkbox"/> 8 <input checked="" type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input type="checkbox"/> High <input type="checkbox"/> Medium <input checked="" type="checkbox"/> Low
a) Suggest generator hook ups if necessary.			ACTION STATUS
b) Suggest infrastructure changes if current emergency sheltering facilities are inadequate.			New

RATIONALE- WHY IS THIS IMPORTANT?

First responders may want to know the facilities capacities and how well they can manage a storm or power outage.

BENEFITS	OBSTACLES
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Public safety.

LEAD/CHAMPION	SUPPORT
---------------	---------

EMA Director

Dept. Nursing Homes, Senior Center Director

POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
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EMA Operating budget

Staff time

- Short Term (0-3 years)
- Medium Term (3-5 years)
- Long Term (more than 5 years)

OTHER NOTES

In 2018 all Warwick nursing homes were assessed for their emergency needs. None required additional assistance. This action furthers that initiative by including senior housing.

VULNERABLE AREA: Recreation Facilities

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
19. Encourage visiting sport referees and coaches to sign up for Warwick’s Code Red to be alerted to local emergencies.	<input type="checkbox"/> Local Plans and Regulations <input type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input checked="" type="checkbox"/> Education and Awareness	<input checked="" type="checkbox"/> 1 <input type="checkbox"/> 7 <input type="checkbox"/> 2 <input type="checkbox"/> 8 <input checked="" type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input type="checkbox"/> High <input type="checkbox"/> Medium <input checked="" type="checkbox"/> Low <hr/> ACTION STATUS New

RATIONALE- WHY IS THIS IMPORTANT?

Lightning storms can develop quickly and people from outside the area may not get the notification if there is a threat or warning in the immediate area.

BENEFITS	OBSTACLES	
Public safety.		
LEAD/CHAMPION	SUPPORT	
Warwick Parks and Recreation		
POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
Staff time		<input checked="" type="checkbox"/> Short Term (0-3 years) <input type="checkbox"/> Medium Term (3-5 years) <input type="checkbox"/> Long Term (more than 5 years)

OTHER NOTES

Suggested outreach methods: billboard at a park, printed flyer at Parks and Recreation Department, posted on Parks and Recreation website.

VULNERABLE AREA: Natural Resources

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
20. Remove debris (silt, and vegetation) from Buckeye Brook to reduce flooding and allow for Warwick Pond to retain more flood waters.	<input type="checkbox"/> Local Plans and Regulations <input type="checkbox"/> Structure and Infrastructure <input checked="" type="checkbox"/> Natural Systems Protection <input type="checkbox"/> Education and Awareness	<input type="checkbox"/> 1 <input type="checkbox"/> 7 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input checked="" type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low
			ACTION STATUS
			New

RATIONALE- WHY IS THIS IMPORTANT?

Buckeye Brook flows from Warwick Pond but is currently overgrown with phragmites and full of silt. Nearby roads and airport infrastructure are impacted by more frequent flooding.

BENEFITS	OBSTACLES
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Flood reduction

Improved stream health

Community coordination.

LEAD/CHAMPION	SUPPORT
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Warwick DPW

Community groups

POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
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DPW Operating budget

FEMA Pre Disaster Mitigation grants

\$850K

Short Term (0-3 years)

Medium Term (3-5 years)

Long Term (more than 5 years)

OTHER NOTES

Initial efforts are already underway. By including this action in the Hazard Mitigation Plan, the City aims to make it an ongoing maintenance project to improve the natural flood capacity. This will also reduce localized street flooding.

VULNERABLE AREA: Historic Resources

MITIGATION ACTION	MITIGATION TYPE	ALIGNMENT WITH PLAN GOALS	ACTION PRIORITY
21. Develop and implement a plan to protect historic structures, collections, and public records. a) Make records electronic b) Create additional electronic storage	<input type="checkbox"/> Local Plans and Regulations <input checked="" type="checkbox"/> Structure and Infrastructure <input type="checkbox"/> Natural Systems Protection <input type="checkbox"/> Education and Awareness	<input type="checkbox"/> 1 <input type="checkbox"/> 7 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 8 <input type="checkbox"/> 3 <input type="checkbox"/> 9 <input type="checkbox"/> 4 <input type="checkbox"/> 10 <input type="checkbox"/> 5 <input type="checkbox"/> 11 <input type="checkbox"/> 6	<input type="checkbox"/> High <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Low <hr/> ACTION STATUS

RATIONALE- WHY IS THIS IMPORTANT?

Public and historic records are not very well protected from water damage or fire.

BENEFITS	OBSTACLES
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Maintain City's history and as-built records.

LEAD/CHAMPION	SUPPORT
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MIS

City Clerk

POTENTIAL FUNDING SOURCES	ESTIMATED COST	TIMELINE
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City's General Budget
 FEMA

\$100,000-
 cataloging

Short Term (0-3 years)
 Medium Term (3-5 years)
 Long Term (more than 5 years)

OTHER NOTES

Discussions and prelim scans by a third party have begun.

7

Implementation and Adoption

Prioritization of Mitigation Actions

Implementing the Plan

The City of Warwick and the Warwick Hazard Mitigation Committee realize that successful hazard mitigation is an ongoing process that requires implementation, evaluation, and updates to this plan. The City also understands the importance of integrating appropriate sections of the plan into the City's Comprehensive Plan, Emergency Operations Plan, and site plan review process. It is intended that this plan and the ongoing efforts of the HMC will preserve and enhance the quality of life, property, and resources for the City of Warwick.

Adoption of this mitigation plan increases Warwick's eligibility for federal hazard mitigation grants. These grants originate from FEMA's Pre-Disaster Flood Mitigation Assistance (FMA), Pre-Disaster Mitigation (PDM) and post-disaster Hazard Mitigation Grant (HMGP) Programs.

Monitoring

The HMC, under the leadership of the City's Emergency Management Director, will meet annually (or more frequently if necessary), to monitor and evaluate the actions contained in the plan. This meeting will likely occur when annual FEMA mitigation grant funding availability is announced. At each meeting, the committee members will discuss the actions assigned to them to ensure continual progress with mitigation

efforts. The status of each mitigation action will be documented, and minutes recorded for the record. The HMC will also continue to re-evaluate membership on the committee to ensure effective engagement of the appropriate parties. New members may be invited to serve on the HMC as priorities shift.

Evaluation

At the annual meetings, the HMC will evaluate both the actions and the planning process. The HMC will base its evaluation on whether or not the actions have met the following criteria: increased public awareness/education, reduction in hazard damage, actions being implemented in the designated time frames, and actions staying within the cost estimate. The committee will document and report its findings to the Planning Board and City Council. The HMC will involve the public in the action evaluation process by holding an annual advertised public meeting in order to review the evaluation and solicit input.

During the annual evaluation process, the plan will be promoted online, in the local library, at City Hall for public review. Comments and suggests can be sent directly to the Emergency Management Director or brought up at the advertised public meeting.

Revisions

Recognizing that this is a living document, the HMC will make changes to it after each annual revision or a disaster, as conditions warrant. These revisions will also reflect changes to priorities and funding strategies that may have been implemented.

A full revision of the plan will commence a year in advance of the current plan expiration date in order to ensure the City always has an approved plan. The update will be completed every five years and will incorporate a formalized process for prioritizing actions and weighing the cost/benefit of such actions. All updates or revisions to the plan will be submitted to the RIEMA. The City Council will involve the public in the plan revision process by holding an annual advertised public meeting to present recommended revisions and solicit input. Revised plans will also be sent to the neighboring communities for comment.

All future meetings will again be open to the public and it is the hope of the HMC that once the public education and outreach actions begin, public involvement in the Plan will increase and will be reflected in future revisions. The HMC will involve the public in the annual meeting by posting it on the website, in the local library, and in the local newspaper to encourage involvement.

Adoption

After each evaluation cycle (every 5 years), the Warwick hazard mitigation plan will be presented to and adopted by the City Council. The associated ordinance documentation will be kept as part of this plan.

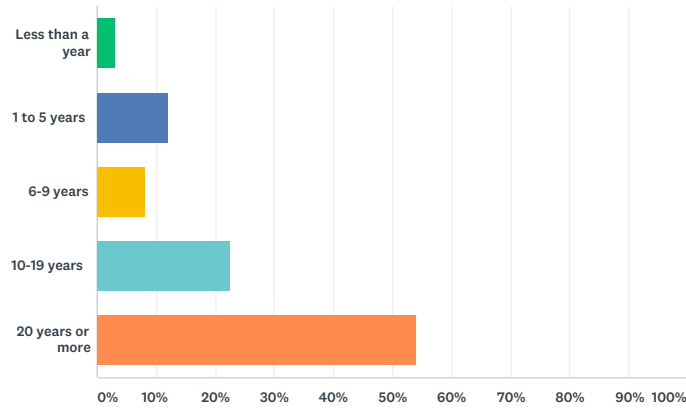
Appendices

- A** Survey Results
- B** Public Notices
- C** Resources Map
- D** Additional Resources

Appendix A: Survey Results

Q1 How long have you been in Warwick, Rhode Island?

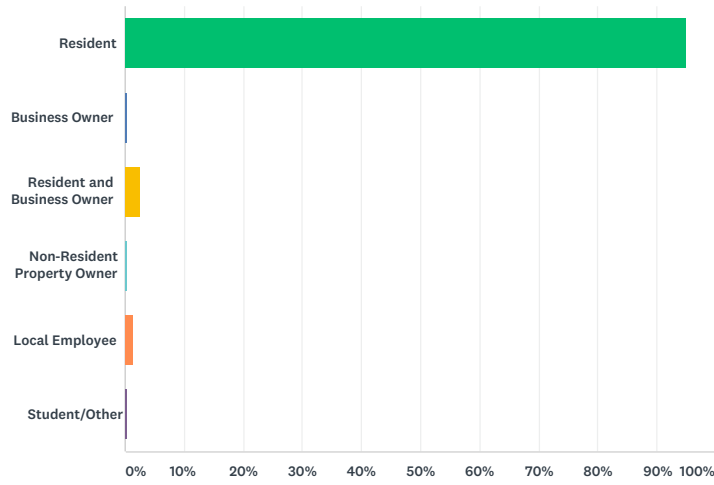
Answered: 282 Skipped: 5



ANSWER CHOICES	RESPONSES	
Less than a year	3.19%	9
1 to 5 years	12.06%	34
6-9 years	8.16%	23
10-19 years	22.70%	64
20 years or more	53.90%	152
TOTAL		282

Q2 What is your primary connection to Warwick?

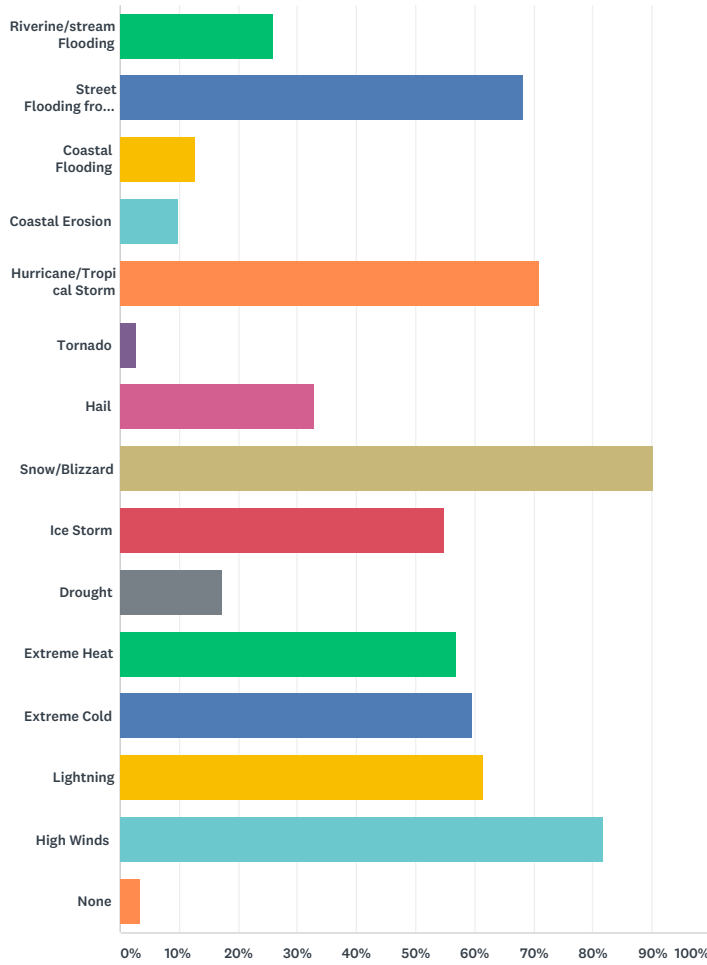
Answered: 281 Skipped: 6



ANSWER CHOICES	RESPONSES	
Resident	95.02%	267
Business Owner	0.36%	1
Resident and Business Owner	2.49%	7
Non-Resident Property Owner	0.36%	1
Local Employee	1.42%	4
Student/Other	0.36%	1
TOTAL		281

Q3 What types of disasters have you experienced in Warwick? Check all that apply.

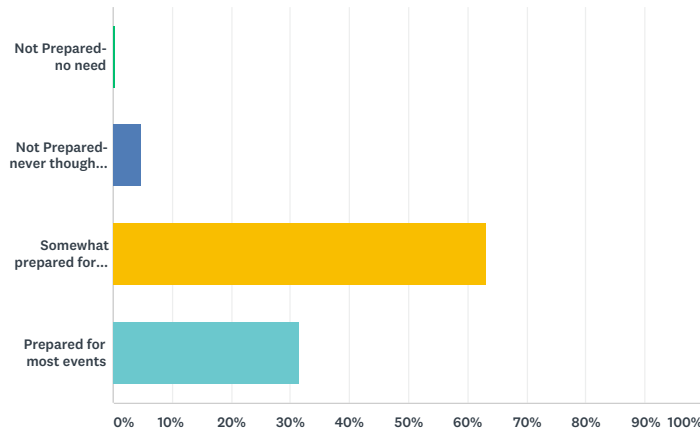
Answered: 265 Skipped: 22



ANSWER CHOICES	RESPONSES	
Riverine/stream Flooding	26.04%	69
Street Flooding from Heavy Rain	68.30%	181
Coastal Flooding	12.83%	34
Coastal Erosion	9.81%	26
Hurricane/Tropical Storm	70.94%	188
Tornado	2.64%	7
Hail	32.83%	87
Snow/Blizzard	90.19%	239
Ice Storm	54.72%	145
Drought	17.36%	46
Extreme Heat	56.98%	151
Extreme Cold	59.62%	158
Lightning	61.51%	163
High Winds	81.89%	217
None	3.40%	9
Total Respondents: 265		

Q4 How prepared do you feel that you and your household/business are for the probably impacts of natural hazards?

Answered: 266 Skipped: 21

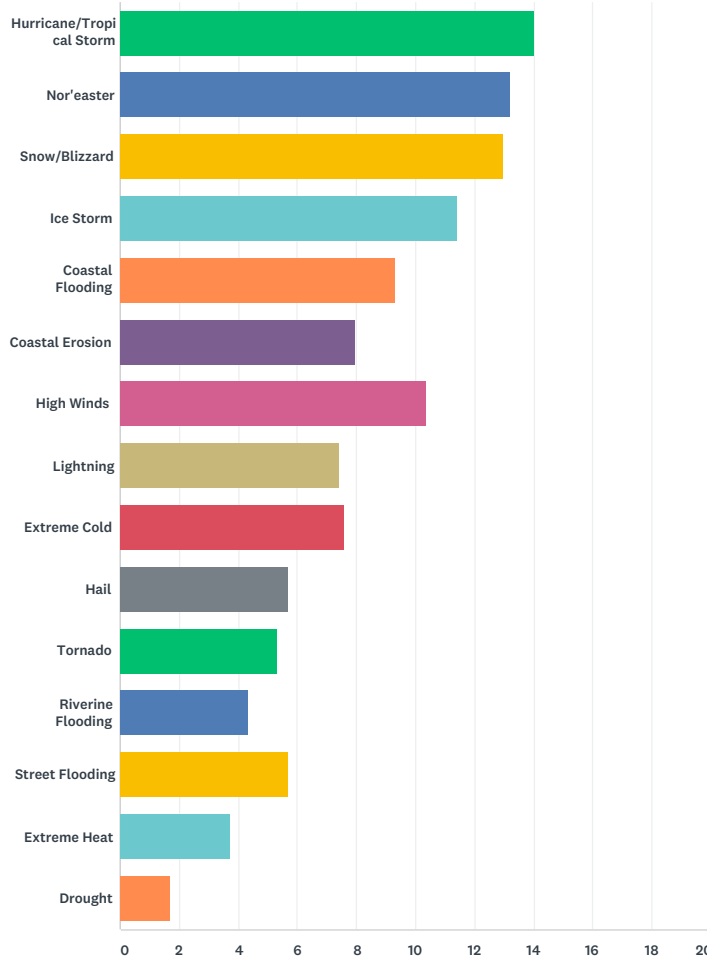


ANSWER CHOICES	RESPONSES	
Not Prepared- no need	0.38%	1
Not Prepared- never thought about it	4.89%	13
Somewhat prepared for some events	63.16%	168
Prepared for most events	31.58%	84
TOTAL		266

City of Warwick, RI Public Survey for Hazard Mitigation Plan Update

Q5 Click and drag the each hazard so that the ones that you are most concerned about are in the top 3 spots.

Answered: 233 Skipped: 54



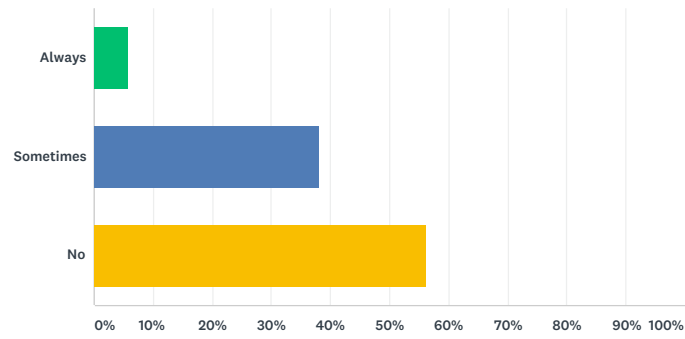
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hurricane/Tropical Storm	56.89% 128	16.44% 37	13.33% 30	6.22% 14	3.11% 7	1.33% 3	2.22% 5	0.00% 0	0.44% 1	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0
Nor'easter	20.18% 46	35.53% 81	17.98% 41	12.72% 29	5.26% 12	4.39% 10	2.19% 5	1.32% 3	0.00% 0	0.00% 0	0.44% 1	0.00% 0	0.00% 0	0.00% 0
Snow/Blizzard	10.27% 23	25.89% 58	36.61% 82	15.18% 34	4.02% 9	6.25% 14	0.89% 2	0.89% 2	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0
Ice Storm	4.19% 9	8.37% 18	10.23% 22	29.77% 64	26.51% 57	8.84% 19	5.58% 12	3.26% 7	0.93% 2	0.47% 1	0.93% 2	0.47% 1	0.00% 0	0.00% 0
Coastal Flooding	1.90% 4	4.29% 9	2.38% 5	5.24% 11	26.67% 56	17.62% 37	11.43% 24	10.00% 21	5.24% 11	3.81% 8	2.38% 5	4.76% 10	0.00% 0	2.86% 6
Coastal Erosion	0.48% 1	0.95% 2	2.38% 5	1.43% 3	3.33% 7	27.14% 57	19.05% 40	10.48% 22	10.00% 21	6.19% 13	4.76% 10	3.33% 7	4.29% 9	1.90% 4
High Winds	3.76% 8	6.57% 14	11.27% 24	9.86% 21	12.21% 26	9.86% 21	29.11% 62	9.86% 21	4.69% 10	2.35% 5	0.47% 1	0.00% 0	0.00% 0	0.00% 0
Lightning	0.00% 0	0.00% 0	0.48% 1	1.93% 4	2.90% 6	5.31% 11	6.28% 13	38.65% 80	20.77% 43	8.70% 18	7.73% 16	4.35% 9	0.48% 1	1.45% 3
Extreme Cold	0.96% 2	1.91% 4	1.91% 4	2.39% 5	5.74% 12	6.22% 13	7.18% 15	8.13% 17	37.80% 79	16.27% 34	5.26% 11	2.87% 6	1.44% 3	1.91% 4
Hail	0.00% 0	0.00% 0	0.00% 0	0.49% 1	1.46% 3	0.49% 1	3.40% 7	2.91% 6	6.31% 13	44.17% 91	24.27% 50	10.19% 21	4.85% 10	0.97% 2
Tornado	1.44% 3	1.44% 3	0.96% 2	1.92% 4	2.40% 5	3.37% 7	0.96% 2	2.88% 6	2.88% 6	5.77% 12	40.38% 84	14.42% 30	10.58% 22	4.81% 10
Riverine Flooding	1.94% 4	1.94% 4	0.49% 1	1.46% 3	0.97% 2	0.49% 1	0.97% 2	1.46% 3	0.49% 1	1.94% 4	7.28% 15	45.63% 94	21.84% 45	6.80% 14
Street Flooding	1.93% 4	0.48% 1	6.28% 13	5.80% 12	2.42% 5	4.35% 9	5.31% 11	5.31% 11	4.35% 9	0.48% 1	2.42% 5	4.35% 9	45.89% 95	9.66% 20

City of Warwick, RI Public Survey for Hazard Mitigation Plan Update

Extreme Heat	0.49%	0.97%	1.46%	1.46%	0.97%	1.46%	2.43%	3.40%	4.37%	5.83%	0.97%	7.28%	5.34%	61.17%
	1	2	3	3	2	3	5	7	9	12	2	15	11	126
Drought	0.00%	0.00%	0.00%	0.00%	0.00%	0.97%	0.97%	0.00%	0.97%	3.40%	1.94%	1.94%	4.85%	8.25%
	0	0	0	0	0	2	2	0	2	7	4	4	10	17

Q6 Does your street flood when it rains?

Answered: 242 Skipped: 45



ANSWER CHOICES	RESPONSES	
Always	5.79%	14
Sometimes	38.02%	92
No	56.20%	136
TOTAL		242

Q7 If yes, please provide the street name and nearest cross street. Or tell us of a place you know that floods.

Answered: 70 Skipped: 217

Q7 If yes, please provide the street name and nearest cross street. Or tell us of a place you know that floods.

Answered: 70 Skipped: 217

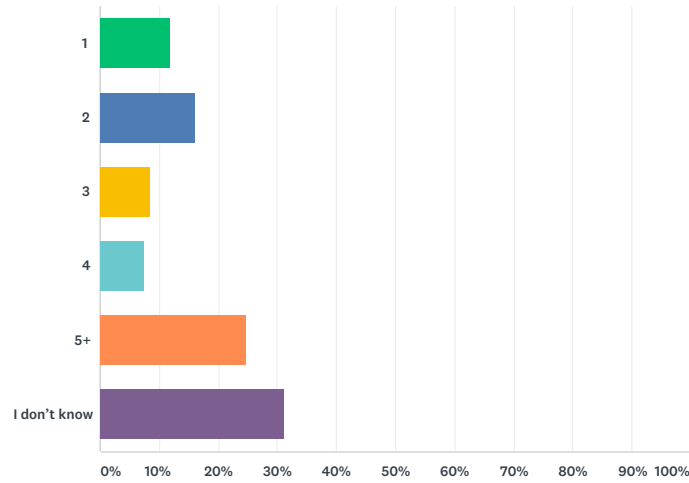
#	RESPONSES	DATE
1	Highland Ave Post Road	11/20/2018 11:48 AM
2	old mill blvd - where intersects with higney	11/20/2018 7:55 AM
3	Grassmere	11/19/2018 2:23 PM
4	Rose St and Kendall Ln	11/15/2018 6:00 PM
5	Cowessett Green	11/10/2018 3:06 PM
6	Byron Blvd, Dryden blvd, Warwick ave	11/5/2018 11:14 PM
7	hampton and gray	11/5/2018 5:55 PM
8	Midget Ave - cross street is Nausauket	11/5/2018 4:50 PM
9	heath and first	11/2/2018 4:09 PM
10	12 Lakecrest Circle (culdesac)	11/2/2018 7:59 AM
11	Lawrence Ave, between N & S Fair when there is a large amt of rain	10/30/2018 9:22 PM
12	brentwood ave, adrian street	10/29/2018 7:09 AM
13	Street does not generally flood, just large puddles when it rains heavily . Irving rd at Dryden blvd	10/27/2018 4:26 PM
14	tyler street and atlantic	10/25/2018 2:16 PM
15	Shawomet Avenue	10/22/2018 10:40 AM
16	Crockett St at Strand Ave (Oakland Beach)	10/20/2018 8:31 PM
17	Norfolk Rd always becomes a river during heavy rain.	10/20/2018 5:58 AM
18	Lincoln Ave	10/18/2018 12:10 PM
19	The train bridge underpass on Lincoln Ave next to Michigan Ave floods out with heavy rain.	10/17/2018 9:32 AM
20	Corner of Falcon and Ralston	10/17/2018 6:46 AM
21	Cread PL	10/17/2018 5:06 AM
22	mckinley/hayes	10/16/2018 9:26 PM
23	Only flash flooding. Riverside and longmeadow	10/16/2018 8:56 PM
24	Potowomut Rd	10/16/2018 8:41 PM
25	Shawomet Ave and Symonds	10/16/2018 8:38 PM
26	Sharon Street between Hillard and Greenwood floods during very heavy downpours when the street basins are overwhelmed	10/16/2018 8:34 PM
27	Norwood	10/16/2018 8:20 PM
28	Harrington Ave and Second	10/16/2018 8:07 PM
29	Bellman and fulton	10/16/2018 7:42 PM
30	Loring rd	10/16/2018 7:00 PM
31	Blackburn street	10/16/2018 6:59 PM
32	Budlong @ Pawtuxet	10/16/2018 6:26 PM
33	Normandy Drive / West Shore Road	10/16/2018 5:55 PM

City of Warwick, RI Public Survey for Hazard Mitigation Plan Update

34	Chestnut St	10/16/2018 4:59 PM
35	Mystic drive	10/16/2018 4:55 PM
36	Crestwood Rd / post rd	10/16/2018 4:45 PM
37	Northup and seaview intersection	10/16/2018 4:35 PM
38	Temple Ave off Warwick Ave	10/16/2018 4:07 PM
39	Fourth ave cross st is Rhodes	10/16/2018 2:54 PM
40	Easton Ave and Rhodes St.	10/16/2018 2:50 PM
41	Sandpond rd at this he roadway	10/16/2018 12:38 PM
42	Cedar Swamp Rd. (Off Sandy Ln.)	10/16/2018 12:33 PM
43	Tenth Ave / Buttonwoods Ave	10/16/2018 12:09 PM
44	Grace Avenue. Water does not drain and backs up in my driveway	10/16/2018 11:57 AM
45	Mohawk ave at uncas st	10/16/2018 11:01 AM
46	Not necessarily flooding but, the road is uneven/dipped at the top of Fuller St/West Shore Rd so that water collects there. Becomes a big problem in the winter with ice when heading that way and trying to get out onto WSR.	10/16/2018 10:56 AM
47	Manning St. Near Colburn St.	10/16/2018 10:20 AM
48	Gordon ave in the dip close to taplow st	10/16/2018 10:07 AM
49	McGarry Ave cross st West Shore Rd	10/16/2018 10:02 AM
50	Pinegrove	10/16/2018 9:47 AM
51	Fisher and Caulderwood	10/16/2018 9:29 AM
52	Diamond hill and 117	10/16/2018 9:10 AM
53	Hanover/Tarawa. Storm drain often blocked. Tree nearby recently removed by City.	10/16/2018 9:08 AM
54	1 View Ave. Off of George Arden Ave and Bingham. Close to West Shore Rd.	10/16/2018 9:05 AM
55	Warwick Ave and Church Street	10/16/2018 8:56 AM
56	corner of Narragansett and Thayer	10/16/2018 8:55 AM
57	Dahlia Street and Manor; miantonimo And Canna; these don't close the street off but large areas of water pool in various spots on the streets.	10/16/2018 8:49 AM
58	Third & Gould	10/16/2018 8:29 AM
59	Washington Street between Monroe Street and Jackson Street	10/16/2018 7:54 AM
60	Kenway Ave (dead end side). Oakland Beach ave.	10/16/2018 7:45 AM
61	Apponaug	10/16/2018 7:40 AM
62	Squantum drive	10/16/2018 7:30 AM
63	Lerner St/Park View Ave	10/16/2018 7:29 AM
64	Vancouver Ave and Andover Dr	10/16/2018 6:57 AM
65	Charlotte Drive	10/16/2018 6:45 AM
66	Seems better since they fixed the brook but still floods some. Lake shore drive	10/16/2018 6:43 AM
67	Steele ave	10/16/2018 6:24 AM
68	Grassmere and Viscount	10/16/2018 6:12 AM
69	Bragger Street	10/16/2018 5:43 AM
70	test street	10/10/2018 1:48 PM

Q8 How many times has that street flooded in the last 12 months?

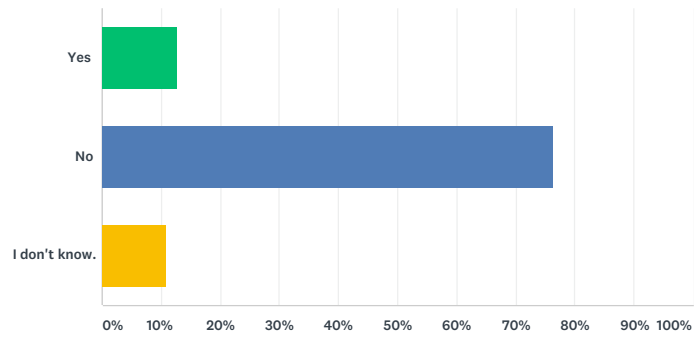
Answered: 93 Skipped: 194



ANSWER CHOICES	RESPONSES	
1	11.83%	11
2	16.13%	15
3	8.60%	8
4	7.53%	7
5+	24.73%	23
I don't know	31.18%	29
TOTAL		93

Q9 Do you currently have flood insurance on your house?

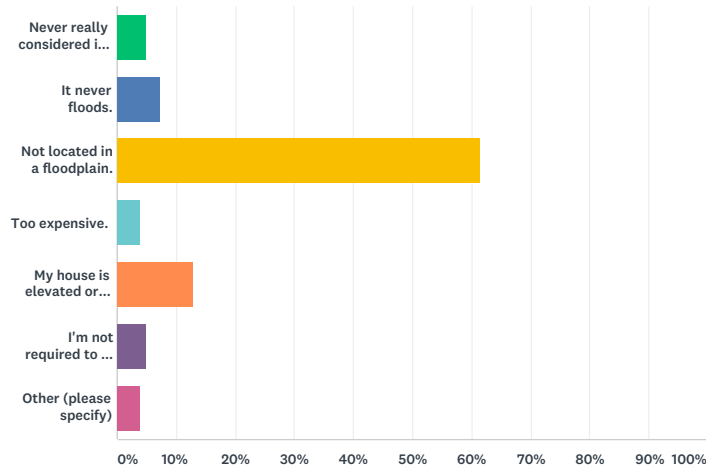
Answered: 237 Skipped: 50



ANSWER CHOICES	RESPONSES
Yes	12.66% 30
No	76.37% 181
I don't know.	10.97% 26
TOTAL	237

Q10 If you don't have flood insurance, please indicate why.

Answered: 177 Skipped: 110

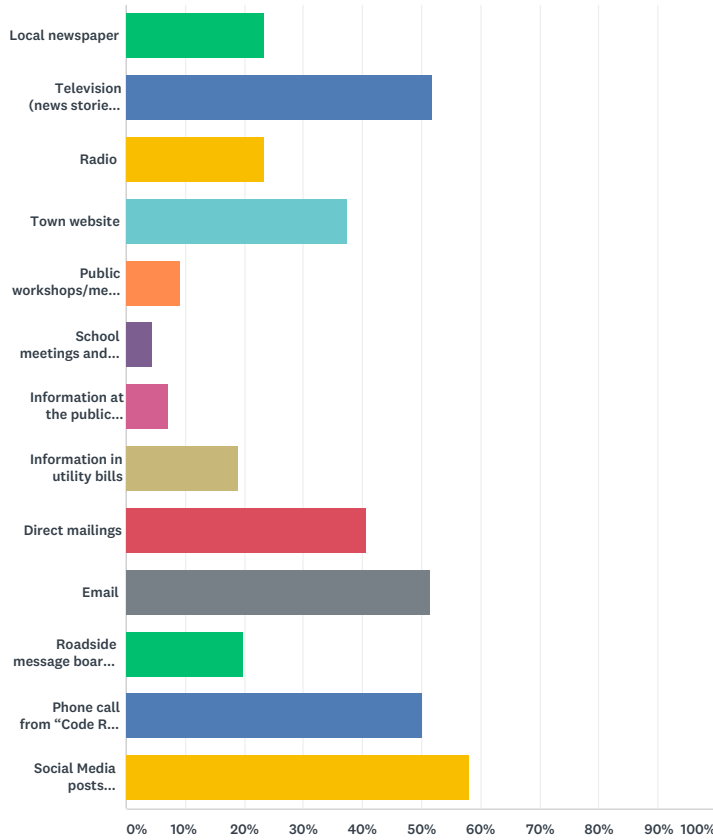


ANSWER CHOICES	RESPONSES	
Never really considered it. (Click here to see if you are located in a floodplain.)	5.08%	9
It never floods.	7.34%	13
Not located in a floodplain.	61.58%	109
Too expensive.	3.95%	7
My house is elevated or otherwise protected from floodwaters.	12.99%	23
I'm not required to do so (I don't have a federally backed mortgage).	5.08%	9
Other (please specify)	3.95%	7
TOTAL		177

City of Warwick, RI Public Survey for Hazard Mitigation Plan Update

Q11 How do you prefer to receive information about how to better protect your home, business, or neighborhood? Check all that apply. (Don't worry, we aren't adding you to a list.)

Answered: 227 Skipped: 60



ANSWER CHOICES	RESPONSES	
Local newspaper	23.35%	53
Television (news stories, Public Service Announcements)	51.98%	118
Radio	23.35%	53
Town website	37.44%	85
Public workshops/meetings	9.25%	21
School meetings and messages	4.41%	10
Information at the public library	7.05%	16
Information in utility bills	18.94%	43
Direct mailings	40.53%	92
Email	51.54%	117
Roadside message boards or billboards	19.82%	45
Phone call from "Code Red" Systems	50.22%	114
Social Media posts (Facebook, Twitter, etc.)	58.15%	132
Total Respondents: 227		

Q12 Please provide additional thoughts on how Warwick can better prepare for and recover from the next disaster.

Answered: 57 Skipped: 230

Q12 Please provide additional thoughts on how Warwick can better prepare for and recover from the next disaster.

Answered: 58 Skipped: 229

#	RESPONSES	DATE
1	Didn't even know Sandy Lane was closing and still do not know why, so better communications from you directly to all Warwick residents would be appreciated.	11/28/2018 8:56 AM
2	Post more info about emergency routes during floods. Notify citizens of areas that are flooded in near real-time.	11/27/2018 6:58 PM
3	Have city employees answer the phones instead of leaving a voice message.	11/26/2018 2:45 PM
4	would like to see an evaluation of what could be done to mitigate the erosion at the end of old mill blvd - specifically the area adjacent to # 32 old mill cove blvd (significant erosion there; also, the water level reaches up to first 3-4 houses on spadina during big storms	11/20/2018 7:58 AM
5	Snow plowing on my street is less than desirable. They pile snow on sidewalk where it is impossible to make clear for students to walk to school and is a hazard because it is in the line of site. He also only makes one path down the middle leaving the road only passable for one car.	11/18/2018 12:21 AM
6	the phone updates from previous administration as to issues and updates were extremely helpful and timely.	11/14/2018 12:00 PM
7	Exercises Trim trees away from power lines Clear storm drains Use solar streetlights	11/10/2018 3:07 PM
8	Text messages with updates	11/5/2018 4:51 PM
9	Consider community rating of flood plain properties as they are a community asset, if properly prepared for disaster.	10/31/2018 8:58 AM
10	Please edit question 4. I am happy with the services provided by Warwick. The only issue I have is with snow plow drivers. Because I am at the top of a hill cul-de-sac, when the plows start their turn on the curve, all the snow goes into my driveway and my neighbors driveway. Yet after the next house there is about 30 yds of curb with no DRIVEWAYS. The never adjust for this nor clear the 2 driveways. Common sense please and I know these drivers are probably 3rd party, but they are working for Warwick	10/25/2018 5:49 PM
11	Improving the announcement of areas where critical evacuation is or may be necessary	10/22/2018 10:43 AM
12	cell phone text	10/22/2018 5:53 AM
13	Better more consistent plowing during snow events	10/20/2018 6:01 AM
14	Develop a Hazard Mitigation Plan and have it approved by RIEMA/FEMA and the City Council	10/18/2018 8:44 AM
15	Tree pruning next to power lines really needs to be addressed. There are too many times when high winds (i.e. >40mph) drop tree limbs taking out power lines. Repair time is also horrible in this area.	10/17/2018 9:34 AM
16	Should be a plan in place to address each type of disaster, it depends on what the disaster is what the response should be.	10/17/2018 5:08 AM
17	Text alerts to residents about safety procedures and information regarding current situations.	10/16/2018 10:02 PM
18	Get a social media manager and cover your bases fully. Of course keep old school methods for the large group of tech free population.	10/16/2018 9:28 PM
19	Text messages	10/16/2018 8:57 PM
20	I think we are doing a good job	10/16/2018 8:38 PM
21	Power outages are a concern that should be addressed.	10/16/2018 8:35 PM
22	Increase Community Rating System class. Make substantial changes to the school committee and rework the city budget.	10/16/2018 8:09 PM

City of Warwick, RI Public Survey for Hazard Mitigation Plan Update

23	Not sure	10/16/2018 8:08 PM
24	We check on senior neighbors. A system of dated emergency food that has say 18 month shelf life sold every hurricane and blizzard season that van donated if unused to a foodbank would be useful	10/16/2018 7:48 PM
25	Be proactive, maintain buildings, schools, roads.	10/16/2018 7:11 PM
26	Establish it's own CERT Team	10/16/2018 7:02 PM
27	During riverine floods of 2010 I found myself following designated evacuation routes... away from the coast and directly INTO harm's way. Perhaps varying shapes and colors for evac routes based on the threat...	10/16/2018 7:01 PM
28	I know all are hard at work & THANK YOU 😊!	10/16/2018 6:55 PM
29	Work with residents to encourage them to maintain more than 3 days food / necessities supply. I saw numerous neighbors unprepared for the storms of the past 10 years.	10/16/2018 6:48 PM
30	Make sure that the main roadways are clear as soon as possible.	10/16/2018 6:13 PM
31	Keep a better eye on utility companies...we always see them "at rest". I understand that they cannot work around the clock, but they need to be more productive instead of congregating in local parking lots!!	10/16/2018 5:58 PM
32	Can't think of any right now. Seems as if you've covered it all in the past.	10/16/2018 5:16 PM
33	Engage experienced citizens with a participatory Recovery Program seminar...there are some non-FD/PPD Chief practitioners out here.	10/16/2018 4:59 PM
34	Quick passes through neighborhood streets in snow events. Escorting emergency services with plow trucks can somethings take a lot of time.	10/16/2018 4:37 PM
35	Use the social media platforms more to educate the public of up coming major weather events (share from NWS), preparedness measures, tips, Parking bans and trash delays for snow events. Major snow events should have a trash delay so bins aren't out when the plows are.	10/16/2018 3:17 PM
36	Offer pet available shelters. Treat the entire city as one, instead of leaving out Conimicut and Buttonwoods in the clean up plans. Get Nat'l Grid to help faster.	10/16/2018 12:16 PM
37	With regards to snow/blizzard...enforce the parking bans. Tow each and every car, NO EXCUSES! Teach the plow drivers how to actually plow...going down the middle of the street is not plowing! Many yards have been marked to show the property line and yet they still leave 3+ feet of snow on each side of the street. Makes for a single lane road and once the storm is over the cars are again parking on the street leaving it difficult at best to pass. That's a hazard.	10/16/2018 11:05 AM
38	I think with the alerts it is doing pretty well	10/16/2018 11:02 AM
39	Continue proactive tree trimming of branches over power lines. Prepare schools and other public buildings as temporary shelters.	10/16/2018 10:26 AM
40	put underground electricity/phone lines	10/16/2018 9:49 AM
41	Add a CERT team	10/16/2018 9:29 AM
42	Don't rely on local news. Push social media, web, and email channels. Modernizing communication is key. Consider a communication app in the event of large scale power outages.	10/16/2018 9:18 AM
43	Maintain the trees and clean storm drains	10/16/2018 9:08 AM
44	Clean drains on All streets	10/16/2018 9:07 AM
45	Information about preparedness kits. Utilize social media. (The Positive Warwick Page)	10/16/2018 9:06 AM
46	Repair our roads to help prevent many of the problem areas that pool water during heavy rain and provide safer driving conditions during inclement weather.	10/16/2018 8:51 AM
47	Better communication	10/16/2018 8:38 AM
48	Properly pave roads and fix potholes. The pothole in front of my home is so large it floods onto the sidewalk. In the winter the pothole and sidewalk flood then freeze	10/16/2018 7:55 AM
49	Better response from utility companies.	10/16/2018 7:41 AM

City of Warwick, RI Public Survey for Hazard Mitigation Plan Update

50	Rotate the order in which roads/neighborhoods are plowed. My neighborhood always seem to be plowed late in the day. I'm a nurse and every snowstorm I have to walk out to post rd and have security from the hospital pick me up in the morning because my street is not driveable. It happens so often that security now contacts me before a snow storm to see if I'm working and need a ride. And as we drive to the hospital I can see lots of other neighborhoods already plowed.	10/16/2018 7:34 AM
51	During the storm in October 2017 the dead end street we live on was completely blocked off by a fallen tree with no power. It took four days to clear the tree and a week for us to get power back. At the time I was pregnant and there were/are a number of children and elderly living on our street. Our street is on Greenwich Ave. And after calling a number of city departments, the WPD and fire company, as well as national grid no one came to help or would just tell us to call someone else. It was scary and frustrating. If an ambulance needed to get to someone, they wouldn't have been able to and nobody in the city seemed to care at all.	10/16/2018 6:46 AM
52	I honestly feel the next disaster will be a storm/hurricane/noreaster, and best thing we can do to prepare for it, would be to trim back tree branches from electrical wires. Last winter we were without power (and heat) for almost a week.	10/16/2018 6:41 AM
53	By being proactive before a storm. For example, cut problem trees before storms.	10/16/2018 6:41 AM
54	Awareness. People "...don't like to think about that stuff. It's depressing..." However, it needs to be discussed before a disaster happens....I mean, people STILL drive through flooded roads thinking they're getting through, then end up on the roof of their car wondering why their floating.	10/16/2018 6:28 AM
55	I've been very pleased with Warwick's response and communications during storms and other events--keep up the good work! Would love to see the city have a dedicated Twitter feed, not only for EMA but also for other city info. Twitter is my go-to during emergencies.	10/16/2018 6:27 AM
56	More tree trimming and old tree removal is key as there are many old trees in the city. And making sure electrical lines are updated.	10/16/2018 6:26 AM
57	Pave the roads.	10/16/2018 6:25 AM
58	test	10/10/2018 1:48 PM

Appendix B: Public Notices

Appendix B: Public Notices

WARWICK RHODE ISLAND

Home Government Online Resources Business Visitors Calendar Photos **FIND IT Fast**

Buttonwoods Municipal Annex and Community Center Now Open, located at 3027 West Shore Road
Read more »

Bulletins News Calendar Public Service Announcements

HAZARD MITIGATION PLAN UPDATE FOR PUBLIC COMMENT, August 14, 2019 - Click for more details

Mayor Joseph J. Solomon

Mayor Solomon's commitment to the City of Warwick has been demonstrated by his championing of fiscal responsibility, promotion of economic development, ensuring superior City services, especially for the City's senior community, and the protection of and accessibility to the City's 39 miles of coastline.

FAQs Documents @ Contact Us



WARWICK RHODE ISLAND

Home Government Online Resources Business Visitors Calendar Photos **FIND IT Fast**

Home » Planning Department

HAZARD MITIGATION PLAN UPDATE DRAFT PLAN AVAILABLE FOR PUBLIC COMMENT

The City of Warwick is currently updating the local Hazard Mitigation Plan in accordance with Federal Emergency Management Agency (FEMA) Guidelines. The purpose of the Plan is to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding in future disasters. Ultimately, hazard mitigation planning enables action to reduce loss of life and property, lessening the impact of disasters.

Public feedback on the draft Plan is important to this process. The Draft Plan download can be found below and an available hard copy at the Warwick Public Library Reference Desk (600 Sandy Lane). This plan will also be sent to neighboring communities for review.

All interested parties should review the draft plan and submit comments no later than August 14, 2019. (Please note: We will make every effort to consider all comments received after this date until such time the plan is forwarded to FEMA for approval).

- Email: Daniel.t.geagan@warwickri.com
- Phone (401) 738-2009
- Written Comments: Warwick Planning Department 3275 Post Road Warwick, RI 02886

Attachment	Size
Warwick Hazard Mitigation Plan draft for public comment July 24 2019	4.81MB

APPONAUG CIRCULATOR PROJECT

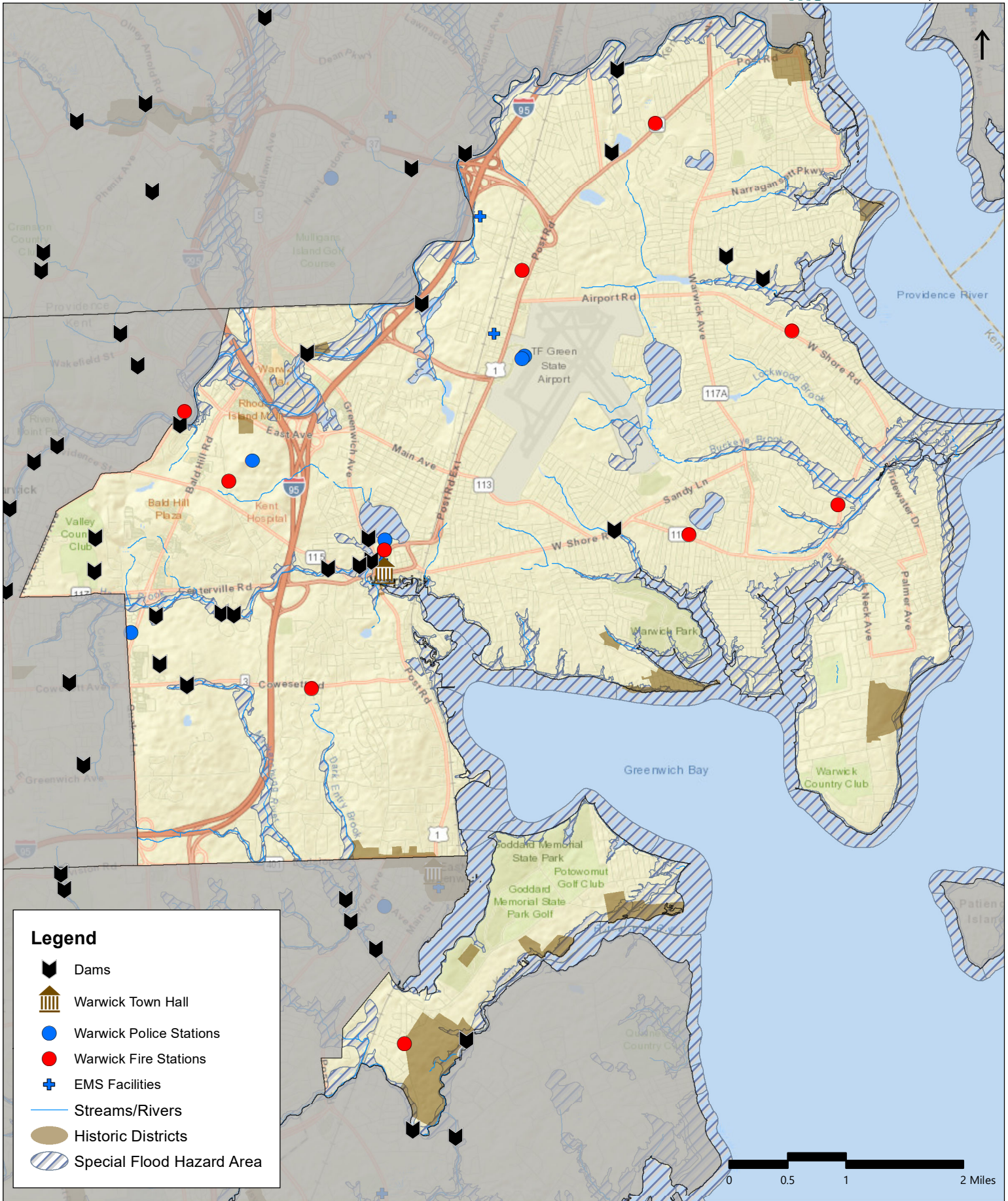
- Activities
- City Centre Warwick Master Plan
- City Centre Warwick design manual
- City Centre Warwick website
- Comprehensive Plan
- Development Review Regulations
- Hazard Mitigation and Flood Map Information
- Planning Board
- Web GIS Maps
- Zoning Ordinances

Contact Info

Phone:
(401) 738-2009

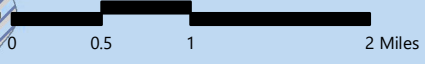
Address:
Buttonwoods Municipal Annex
3027 West Shore Road
Warwick, RI 02886
United States
See map: Google Maps

Appendix C: Resources Map



Legend

- Dams
- Warwick Town Hall
- Warwick Police Stations
- Warwick Fire Stations
- EMS Facilities
- Streams/Rivers
- Historic Districts
- Special Flood Hazard Area



Appendix D: Additional Resources

Technical and Financial Assistance for Mitigation State Resources

Coastal Resources Center

University of Rhode Island
Narragansett Bay Campus
Narragansett, RI 02882
(401) 874-6224

Coastal Resources Management Council

Stedman Government Center
4808 Tower Hill Road
Wakefield, RI 02879
(401) 222-2476

Department of Administration/Division of Planning

One Capitol Hill
Providence, RI 02908
(401) 222-6478

Department of Environmental Management

235 Promenade Street
Providence, RI 02908
(401) 222-6800

Rhode Island Banking Commission/Associate Director

233 Richmond Street
Providence, RI 02903
(401) 222-2405

Rhode Island Builders Association

Terry Lane
Gloucester, RI 02814
(401) 568-8006

Rhode Island Department of Business Regulations

233 Richmond Street
Providence, RI 02903
(401) 222-2246

Rhode Island Emergency Management Agency

645 New London Avenue
Cranston, RI 02920
(401) 946-9996

Public Utilities Commission

100 Orange Street
Providence, RI 02903
(401) 222-3500 Ext. 153

State Fire Marshal's Office

272 West Exchange Street
Providence, RI 02903
(401) 222-2335

State of Rhode Island Building Committee Office

560 Jefferson Boulevard
2nd Floor, Suite 204
Warwick, RI 02886
(401) 889-5550

Technical and Financial Assistance for Mitigation

Federal Resources

Economic Development Administration

Philadelphia Regional Office
The Curtis Center
601 Walnut Street, Suite 140 South
Philadelphia, PA 19106-3323
(215) 597-8822

Federal Emergency Management Agency

Mitigation Division

Mitigation Division
Region I Office
99 High Street
Boston, MA
(617) 223-9561

Small Business Administration

10 Causeway Street
Room 265
Boston, MA 02222
(617) 565-5590

U.S. Department of Agriculture

Natural Resources Conservation Service

451 West Street
Amherst, MA 01002
(413) 253-4362

U.S. Department of Commerce

National Weather Service Forecast Office

445 Myles Standish Boulevard
Taunton, MA 02780 (508) 823-2262

U.S. Department of Housing and Urban Development

Community Development Block Grants

Region I – O'Neill Federal Building
10 Causeway Street
Boston, MA 02222
(617) 565-5354

U.S. Department of the Interior

National Park Service

Rivers and Trails Conservation Program
Regional Office
15 State Street
Boston, MA 02109
(617) 223-5203

U.S. Environmental Protection Agency

Region I Offices
5 Post Office Square - Suite 100
Boston, MA 02109-3912
(617) 565 3400

U.S. Fish and Wildlife Service

Northeast Regional Office
U.S. Fish and Wildlife Service
300 Westgate Center Drive
Hadley, MA 01035-9587
(413) 253-8200

Other Resources

National/Regional Resources

The Association of State Floodplain Managers (ASFPM)

<http://www.floods.org>

A professional association with a membership of almost 1,000 state employees that, assists communities with the NFIP. ASFPM has developed a series of technical and topical research papers and a series of proceedings from their annual conferences. Many mitigation “success stories” have been documented through these resources and provide a good starting point for planning.

The Rhode Island Flood Mitigation Association (RIFMA):

<http://www.riflood.org>

The goal of the organization is to form a network of associates who could bring their ideas and experiences to a forum for people to share and learn from. The result of the Association is a network of floodplain managers who can improve the effectiveness and efficiency of all aspects of floodplain management in the State of Rhode Island. RIFMA regularly provides training opportunities and an annual floodplain conference.

Natural Hazards Center at the University of Colorado, Boulder

Tel: (303) 494-6818

<http://www.colorado.edu/hazards>

The Natural Hazards Center is an international/national information center that provides information on natural hazards and human adjustments to hazards and disasters, by providing information dissemination, free library and referral services, research, and an annual workshop.

Flood Relief Funds

After a disaster, local businesses, residents, and out-of-town groups often donate money to local relief funds. They may be managed by the local government, or by one or more churches. No government disaster declaration is needed. Local officials should recommend that the funds be held until an applicant exhaust all sources of public disaster assistance. Doing so allows the funds to be used for mitigation and other projects that cannot be funded elsewhere.

Volunteer Organizations

Organizations, such as the American Red Cross, the Salvation Army, Habitat for Humanity, Interfaith, and the Mennonite Disaster Service, are often available to help after disasters. Service organizations, such as the Lions, Elks, and VFW are also available. These organizations have helped others with food shelter, clothing, money, etc. Habitat for Humanity and the Mennonite Disaster Service provide skilled labor to help rebuild damaged buildings incorporating mitigation or flood proofing concepts. The offices of individual organizations can be contacted directly, or the FEMA Regional Office may be able to assist.

New England States Emergency Consortium (NESEC)

Lakeside Office Park

<http://www.serve.com/NESEC>

NESEC conducts public awareness and education programs on natural disaster and emergency management activities throughout New England. Brochures and videotapes are available on such topics as earthquake preparedness, mitigation, and hurricane safety tips.

Institute for Business and Home Safety (IBHS)

<http://www.ibhs.org>

An insurance industry-sponsored, nonprofit organization dedicated to reducing losses-deaths, injuries, and property damage-resulting from natural hazards. IBHS efforts are directed at five specific hazards: floods, windstorms, hail, earthquakes, and wildfires. Through its public education efforts and information center, IBHS communicates the results of its research and statistical gathering, as well as mitigation information, to a broad audience.