City of East Providence, Rhode Island

Local Hazard Mitigation Plan

A Multi-Hazard Mitigation Strategy

2022

Riverside, August 4, 2015. Photo: East Providence Department of Public Works

East Providence Hazard Mitigation Committee

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ACKNOWLEDGEMENTS

City of East Providence, Rhode Island
Local Hazard Mitigation Plan

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Maps
Rhode Island Emergency Management Agency
East Providence Planning Department
GIS Shapefiles: Rhode Island Geographic Information System (RIGIS)

State Hazard Mitigation Committee

The State Hazard Mitigation Committee, overseen by the Rhode Island Emergency Management Agency (RIEMA), was established to identify current hazard mitigation needs, to review project applications and set priorities, and to update recommendations. The committee consists of representatives of various state agencies, many of which are listed below.

- Rhode Island Building Code Commission
- Rhode Island Coastal Resources Management Council
- Rhode Island Department of Administration
- Rhode Island Department of Business Regulations
- Rhode Island Department of Environmental Management
- Rhode Island Department of Transportation
- Rhode Island State Fire Marshal's Office
- Rhode Island State Police
- University of Rhode Island
- Select municipal officials

ADOPTION DOCUMENTATION

Recommended for City Council Adoption by the Planning Board: To Be Determined
Adopted by the East Providence City Council: To Be Determined

This process is underway.

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EXECUTIVE SUMMARY

Purpose

The purpose of the East Providence Local Hazard Mitigation Plan (hereafter referred to as "Plan," or "Plan update") is to provide comprehensive guidance for hazard mitigation in the City of East Providence. The City has experienced its share of natural disasters in recent years with four Federal natural disaster declarations since the start of 2010. This Plan serves the people of East Providence by providing the impetus for making homes, businesses and communities more resilient to the impacts of hurricanes, floods, severe local storms, winter storms, temperature extremes, and other natural hazards. In response to these events, hazard mitigation actions are designed and implemented to reduce or eliminate long term risk from hazards and their effects. The Plan also provides our constituents with information regarding the overall capabilities of the City and the State to reduce or eliminate natural hazard threats and vulnerabilities.

In general, the City's most significant vulnerabilities are related to water. Urban flooding is the most common naturally caused hazard. Destructive coastal flooding is very infrequent, but is a major vulnerability for the City that would present itself in the event of a direct hit from a hurricane. Coastal erosion is an ongoing vulnerability and concern as illustrated by recent loss of beach areas and the failure of the Rose Larisa Park seawall. These vulnerabilities and many more are discussed in detail in the Plan.

Hazard Mitigation Planning in East Providence

The City completed its initial Hazard Mitigation Plan in 2004, and performed extensive updates to the Plan in 2010 and in 2016. This Plan update was guided by the East Providence Hazard Mitigation Committee RIEMA, and FEMA resources including the FEMA Local Hazard Mitigation Planning Handbook, using a format provided by RIEMA. The State of Rhode Island 2019 Hazard Mitigation Plan was used as an additional guide to formatting and content, and many other resources were used as noted within the Plan. The Hazard Mitigation Plan consists of the following sections and appendices:

Section 1: Introduction and Background describes Hazard Mitigation Planning in general and in East Providence, and discusses general characteristics of the City and recent significant natural hazard incidents.

Section 2: Planning Process discusses plan development and input from local leadership and other stakeholders including City residents and local commercial interests. The schedule for plan implementation and maintenance is described briefly, with more detail on this aspect of the plan in Section 6, Plan Adoption, Implementation and Maintenance.

Section 3: Hazard and Risk Assessment describes the natural hazards that threaten the City in detail, with historical information on various hazards and a generalized categorization of the degree of risk that each represents to the City. Also included are descriptions of areas of physical vulnerability to natural hazards including floodplains, industrial areas, historic properties, City facilities and recreational areas, and future development. The City's National Flood Insurance Program (NFIP) repetitive loss areas are addressed within this section. A detailed matrix breaks down vulnerability to hazards by location, public or private ownership, hazard type, impacts, mitigation benefits, and/or potential for incident occurrence.

Section 4: Capability Assessment reviews current local government hazard mitigation and emergency management mechanisms including the Community Rating System (CRS), and partnerships with State and Federal agencies, other communities, and non-profit agencies. This section also incorporates integration with other local plans including the City's Comprehensive Plan, Emergency Operations Plan, and others; and looks at recent successes along with future needs and challenges with an eye toward increasing our hazard resilience.

Section 5: Mitigation Strategy lists and describes mitigation goals and objectives that can be reasonably undertaken or investigated during the five-year operational time frame of this plan. These action items include suggestions for responsible parties, available resources, a general timeline and a current status on each item as appropriate. There is also a review of previous Hazard Mitigation Plan action items and progress made during the most recent hazard mitigation planning cycle.

Section 6: Plan Adoption, Implementation, and Maintenance reviews the process of plan review and adoption and provides information on tracking implementation progress and keeping the Hazard Mitigation Plan up-to-date.

Appendices: The Appendix section includes hazard mapping; technical and financial assistance resources with website and contact information; evidence of public outreach and participation during the planning process; documentation with regard to FEMA plan approval and City adoption; references; and the FEMA "Local Mitigation Plan Review Tool."

Scope of the Plan

Section 3, Risk Assessment addresses all natural hazards which pose a significant threat to the City of East Providence. Each hazard has been assessed using the same methodology with information including historical significance, vulnerability, exposure and potential losses, as available, for all hazards in the Plan. The following types of hazards are analyzed and discussed in the Plan:

- Wind Related Hazards- Including hurricanes and storm surge, severe local storms including tornadoes, and larger-scale high wind events;
- Winter Related Hazards- Including heavy snow, ice, and extreme cold;
- Flood Related Hazards- Including coastal and riverine flooding, urban flooding, local flash flooding, coastal erosion, dam breach, and climate change/sea level rise;
- Geologic Related Hazards- Including earthquakes; and
- Additional Hazards- Including wildfires, drought and extreme heat.

Hazard Mitigation Plan – Updated Strategies List

A list of recommended Mitigation Strategies for the upcoming five-year hazard mitigation planning cycle can be found on Page 9, below. Section 5 of the Plan details these items including descriptions, relative priorities and suggested timelines, possible funding sources as appropriate, the items' mitigation benefits, and a status of each initiatives as of 2016. Hazard mitigation planning is a fluid process; priorities and timelines indicated are based on the best available information as of the development of this Plan update, and can be adjusted during the course of the planning cycle.

Hazard Mitigation Mission, Goals, and Specific Strategies

Mission: East Providence is prepared for natural hazards and has the resources to mitigate, prepare for, respond to, and recover from a disaster.

Goal 1: Reduce the vulnerability of our residences, businesses and government to natural disasters.

Strategies:

1. **Implement mitigation activities in repetitive loss areas and other locations vulnerable to flooding.**
2. **Perform stormwater improvements in areas prone to frequent urban stormwater flooding.**
3. **Reduce vulnerability of municipal infrastructure to natural hazards.**
4. **Increase outreach to commercial interests.**
5. **Increase emergency sheltering capability, and knowledge of sheltering options and evacuation routes.**
6. **Expand post-disaster Continuity of Operations/Continuity of Government Plans.**
7. **Ensure continued quality water supply and a redundant system for water provision for City residents and businesses.**
8. **Perform maintenance projects at the James V. Turner Reservoir Dam as recommended by the RI Department of Environmental Management.**

Goal 2: Increase local capacity regarding hazard mitigation and incident and disaster preparedness, response, and recovery

Strategies:

9. **Preserve open space to the extent possible in special flood hazard areas and other environmentally sensitive areas.**
10. **Develop a recovery and reconstruction ordinance for post-disaster rebuilding.**
11. **Perform emergency/disaster planning for the City's historic properties.**
12. **Establish a comprehensive tree program.**
13. **Develop coastal erosion mitigation options.**
14. **Maintain/coordinate Emergency Action Plans for local high hazard dams and coordinate with upstream communities.**

Goal 3: Maintain FEMA National Flood Insurance Compliance to compliance to ensure the availability of Federally-backed flood insurance for City residences and businesses, and further to ensure City eligibility to apply for preparedness and mitigation grants through FEMA.

Strategies:

15. **Engage constituents in City-wide climate change and hazard mitigation priority identification.**
16. **Maintain the City's participation in FEMA's Community Rating System as at least a Class 8 Community.**
17. **Perform annual maintenance and a five-year update on the City's Hazard Mitigation Plan.**

SECTION 1 – INTRODUCTION AND BACKGROUND

Section 1.1- Hazard Mitigation and the Hazard Mitigation Plan Update

Definition of ***Hazard Mitigation***: An action of a long-term, permanent nature that reduces the physical, social, and economic loss from a hazardous event.

It is intended that this plan will serve as the foundation for policies and actions to be undertaken by the City in order to reduce the physical, social, and economic loss that can result from a natural disaster. Physical, social, and economic losses include the loss of life, debilitating injuries and their inherent costs, destruction of property, disruption of transportation systems, loss of communication systems, loss/interruption of jobs, damage to local businesses, and the loss of historically significant structures. Natural hazards that have been taken into consideration for the purpose of this plan include: hurricanes, tornadoes, severe thunderstorms, hail, nor'easters, snowstorms, ice storms, extreme cold, flooding, storm surge, coastal erosion, dam breach, climate change and sea level rise, earthquakes, wildfire, drought, and extreme heat.

Formal City adoption and FEMA approval of this Hazard Mitigation Plan update reaffirms the City's eligibility to apply for federal grants for hazard mitigation efforts under FEMA's Hazard Mitigation Assistance Programs. Additionally, Plan adoption will allow the City to maintain credit points under FEMA's Community Rating System (CRS) program, which provides discounts on NFIP flood insurance premiums for residents of the City who carry flood insurance.

The mitigation strategies recommended in Section 5 of this Plan are intended to:

- Save lives and reduce injuries;
- Prevent or reduce property damage for residential and commercial interests;
- Strengthen existing emergency plans;
- Enhance public education/outreach;
- Develop pre- and post-mitigation opportunities;
- Incorporate hazard mitigation into the City's Comprehensive Plan;
- Incorporate hazard mitigation into the development plan review process;
- Protect critical facilities and infrastructure; and
- Protect cultural, historical, natural, and economic resources.

According to Code of Federal Regulations (CFR) Title 44, Sec 201, "The local mitigation plan is the representation of the jurisdiction's commitment to reduce risks from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards. Local plans will also serve as the basis for the State to provide technical assistance and to prioritize project funding". Additionally, "A local government must have a mitigation plan approved pursuant to this section in order to apply for and receive mitigation project grants under all other mitigation grant programs."

Previous Hazard Mitigation Plan Documents

The City's original *"Strategy for Reducing Risk from Natural Hazards in East Providence, Rhode Island"* (hereafter, Hazard Mitigation Plan) was produced by the East Providence Planning Department in 2004, and was updated in 2010 followed by subsequent FEMA approval in May of 2011. The Plan was then updated in 2016 with subsequent FEMA approval on April 6, 2017.

Section 1.2 - Community Planning Area

Map 1: East Providence Street and Locator Map

1.2a Location and Geography

The City of East Providence is situated along the eastern border of Rhode Island and represents the start of the transition from the urban environment of Providence to suburban and rural areas southeastern Massachusetts to the east and northeast, and to Rhode Island's East Bay region to the southeast. Much of the City is bordered by bodies of water; The Seekonk and Providence Rivers to the west, Narragansett Bay to the southwest and south, and the Runnins and Ten Mile Rivers (including Central Pond and the James V. Turner Reservoir) along most of its eastern border. The City has 13.24 square miles of land area and 3.21 square miles of water area. Approximate dimensions are 7 to 8 miles north-to-south, and about 2 miles west-to-east. Topography is relatively low, though a very large majority of the land area is at an elevation higher than the coastal and inland Special Flood Hazard Areas.

1.2b Demographics and Housing

According to the 2020 U.S. Census Bureau decennial census, the City of East Providence has a population of 47,139 persons. The City's population has generally been very stable near or a little under the 50,000 mark for several decades. The resulting population density of the City is 3,552 persons per square mile of land area. Persons 65 years and over make up 19.7% of the population, higher than the statewide average of 17.7%. East Providence has traditionally had one of the highest over-65 percentages in Rhode Island. The 2010 housing unit total was 21,373. The average household size is 2.35 persons. The rate of homeownership in East Providence is 61%, which is higher than the state average of 60.8%.

1.2c Land Use and Infrastructure

The character of the City consists largely of residential neighborhoods, with numerous commercial corridors along with several manufacturing facilities and scattered business parks. With a couple of exceptions, the interior of the City is close to build-out capacity. Population density is highest in the west-central portion of the City within about one-half mile north and south of Interstate 195, where there is the highest percentage of multi-family housing and a predominance of small parcel sizes; however, there are many single-family properties in the mix. Elsewhere in the City, single-family properties are the more common residential land use. Waterfront residential areas are found mainly in the southernmost portion of the City. Farther north along the waterfront are open areas, two wastewater treatment facilities, some industrial development and, in a few areas, the remains of the former waterfront industry. This will be changing, with both commercial and residential waterfront developments either planned or in various stages of development (see Section 1.2d below).

1.2d Community Development and Development Changes

Both commercial and residential development in East Providence were significantly affected by the slowdown in the economy from 2008 through 2013. Development activity showed a slow increase by the beginning of 2014, especially in the commercial, manufacturing, and medical sectors. Several manufacturing firms have either moved into or expanded in the City in recent years. The City now has a robust Economic Development staff that is actively pursuing additional manufacturing, other commercial, and housing projects. So-called "advanced manufacturing" has become a notable component of the City's economy (See section 3.3b below).

New housing, which had slowed to a virtual halt during the recession, has picked up, and several new major residential or mixed use developments are moving forward. Multi-family housing in the form of modern apartments and condominiums have been constructed or are planned at locations from Rumford through the center City and into Riverside. Single-family housing development has been slower to pick up, but there was also movement in that sector going through 2022. To this point, development

has occurred on land that had either been previously developed, or was within areas that already contained similar uses. None of the recent development projects have occurred in the SFHA.

New residential units, to this point, have balanced off what otherwise would have been a slight loss of the City's population due to other factors. It has been determined that increases in population, impervious surfaces, and development density in these locations will not result in significant environmental issues, nor impact the ability of the City to provide engineering and public safety services.

Manufacturing and residential multi-unit development continues on an incremental basis in the City's Waterfront Special Development District. Development proposals are reviewed with an eye toward sustainability and public access, and with consideration for the potential effects of climate change and sea level rise. City Emergency Management and Engineering Divisions will be consulted with regard to the risk from natural hazards as a result of new development. Up to now, structural development has occurred well above the coastal floodplain, with areas closer to the shore left open or improved minimally for passive recreation purposes.

1.2e Commercial, Industrial, and Academic Sectors

East Providence's economy is comprised of a diverse mix of employment sectors, with significant employment in health care, manufacturing, retail trade, professional service industries, construction, social services, banking, finance, insurance, warehousing, arts, entertainment and food services.

Various commercial projects including new and expanded facilities will generate significant job growth over the next decade. In addition to the creation of temporary construction related jobs as these projects are developed, the City is expected to see substantial job growth in high tech and light manufacturing, the service and hospitality industries, and in professional services.

East Providence is home to Bradley Hospital, a residential psychiatric facility for children and adolescents, which includes a school. East Providence Emergency Management Agency (EMA) and Fire Department personnel are part of the Hospital's emergency committee and have attended meetings at the facility. The Emergency Management Agency has provided information to inform the development of their natural hazard matrix. The City will continue to work with Bradley Hospital on emergency initiatives both natural and man-made in nature.

The City has a total of twelve public schools including seven elementary schools and an early-learning center, two middle schools, and a new high school which opened for the 2021-2022 academic year and includes a career and technical school.

There are several private and catholic schools in the City including St. Margaret's School for grades pre-K through 8 in Rumford; Sacred Heart School in central East Providence near City Hall for grades K through 8; Bay View Academy on Pawtucket Avenue in the Boyden Heights area, a pre-K through 12 Catholic school for girls; the private pre-K through 8 Gordon School near Martin Street and South Broadway; Providence Country Day School for Grades 5-12 on Waterman Avenue; and the Wolf School, a K through 8 school in on Ferris Avenue in Rumford serving students with learning challenges.

None of the City's public or private schools are in a Special Flood Hazard Area. School risk analysis and assessment are included in Section 3.4 of the Plan.

1.2f Historic Resources

The City of East Providence has numerous historic properties from different eras in the State's history, including over 20 structures, properties, or districts that are listed in the National Register of Historic Places. These tend to be scattered around the city as either individual properties or small groupings of properties. The East Providence Historic District Commission and the City's Planning Department have done extensive work in recognizing and documenting neighborhoods with good collections of relatively unmodified homes from the early part of the 20th Century in Riverside. Additionally, two historic districts have recently been recognized in Rumford. One of these is in the residential area of Pawtucket Avenue, Greenwood Avenue, and Pleasant Street. Another historic district in the Phillipsdale section along Roger Williams Avenue contains a large mill complex and a cluster of unique mill housing, and is home to the Nathanial Daggett house, one of the oldest in the State. Two other areas with well-preserved period homes are found just off of the northern portion of Willett Avenue in Riverside. Most of these historic properties are well maintained, and none are directly in a Special Flood Hazard Area, though some in the Phillipsdale district are on properties that are clipped by the very floodplain along Omega Pond and the Seekonk River.

1.2g Natural Resources

The City has numerous natural areas that have been preserved, including some that are likely to remain relatively untouched, and others that include trails and serve as valuable passive recreation areas. Five of these areas are particularly noteworthy.

Central Pond/Turner Reservoir: The City's Water Division owns dozens of parcels totaling about 60 acres of land in a narrow strip of varying width immediately abutting Central Pond and the James V. Turner Reservoir, which are part of the Ten Mile River system. Part of this land includes the **Turner Reservoir Loop Trail**. This 2.7 mile trail, mostly in East Providence, but with a portion in Seekonk, MA, includes several distinct sections, most of which are woodland trails. There are sidewalk segments, mainly in Seekonk, and three raised walkway sections through a wetland area.

Photo 2. Turner Reservoir Trail raised walkway segment. Photo: Wayne Barnes

Hunts Mills Historic Area: Hunts Mills is a 44-acre property along the Ten Mile River, located a short distance downstream from the Turner Reservoir. The property includes the historic 1750 Hunt House which is home to the East Providence Historical Society, a stone-construction Pump House that was used when the Turner Reservoir was the source of the City's water, and a popular one-mile hiking trail. This was the site of a small amusement park around the turn of the 20th Century. The site contains interpretive signage that locates long-vanished structures, including a dance hall and buildings that housed midway games and a Carousel. This is a popular area for hiking and picnicking and occasionally hosts a community event. A community garden has recently been established here, adding to the activity on this property. The floodplain of the Ten Mile River extends onto parts of the property.

Boyden Heights Conservation Area: Briefly the site of a waterfront amusement park in the very early 1900's, this 11-acre Conservation Commission property in the Boyden Heights neighborhood of Riverside includes blazed woodland trails and a wetland boardwalk, has frontage on Narragansett Bay, and is directly on the East Bay Bike Path. The Commission and area residents have helped to maintain

the property as a passive recreation area. The wetland areas and the wetland boardwalk are within the coastal special flood hazard area, but much of the property is elevated.

Willett Pond: Located along Willett Avenue in Riverside, Willett Pond is surrounded by a narrow strip of City property that includes a nature trail. A good variety of wildlife is found here considering its close proximity to suburban commercial and residential development. Recent work on the property including pavement removal and trail improvements have made it a popular neighborhood park.

Southeast Drainage Area: Located along the southeastern edge of the City's interior, this very large forested area includes many acres of forest and wetlands along with a solar farm in its northwest corner, and a neighborhood playground in the southeast corner. The Playground has been recently upgraded and other relatively small recreational enhancements are planned includes walking trails.

Section 1.3 - NFIP Community Highlights

The City of East Providence participates in the NFIP, along with the other 38 municipalities in Rhode Island. The City has an active local floodplain program and answers resident inquiries regarding flood insurance and FEMA flood zones. East Providence is enrolled in FEMA's CRS program as a "Class 8" community in fulfillment of one of the high-priority action items of the 2011 and 2017 Hazard Mitigation Plans. City EMA, with assistance from the Department of Public Works, the Planning Department, and RIEMA, will take measures to maintain our CRS enrollment during this Hazard Mitigation Plan cycle.

Section 1.4 Significant Natural Hazard Events since the Last Plan Update

Since the date of FEMA's approval of the 2017 Hazard Mitigation Plan (April 6, 2017), there have been no natural hazard events that have received Federal Disaster declarations in Providence County. Below are some of the more significant weather events to occur in the area over the last five years.

October 29-30, 2017
A major fall storm brought strong winds and widespread power outages to much of New England including the Rhode Island area, with some local customers without power for several days due in part to the need for restoration across a very large area of the Northeast from eastern PA and NJ, through eastern NY and southern and central New England.

January 4, 2018
A major snowstorm brought 10-15 inches of snow to the area. Strong winds caused near blizzard conditions. Major flooding resulted along the Massachusetts east coast.

January 12-13, 2018
A strong winter storm that passed west of New England brought gusty southerly winds and about 3.5 inches of rain to the area. Minor tree and power line damage occurred along with some street and property flooding in the State Street neighborhood of East Providence.

March 2018
A series of three nor'easters dropped a total of about 4.6 inches of melted precipitation. The first of these was the most severe. Wind gusts of 50-60 mph caused widespread power outages that lasted for a few days for many residents, and around 2.5 inches of rain fell causing minor flooding along the Runnins

River. The third storm in the sequence, on the 13th, brought 10 inches of wet snow, gusty winds and additional power outages.

October 23, 2018
Strong thunderstorms from a cold front spawned an EF1 tornado in Lincoln, RI around 3:30 pm EDT, causing damage to trees and homes, and an EF0 tornado landed nearby in North Providence causing mainly tree damage. Waterspouts were reported within the state, though there was no reported damage. No injuries were reported from the tornadoes.

January 20-24, 2019
Consecutive storms brought a total of about 4.5 inches of rain. In between storms, a very brief Arctic blast made Martin Luther King Day one of the coldest days in many years with daytime temperatures in the single numbers with strong winds. A brief ice storm followed, then heavy rainfall on frozen ground resulted in very efficient run-off and local river flooding affecting streets and properties near the Runnins River.

December 24-25, 2020
A strong storm brought heavy rain and unseasonably warm temperatures to all of New England. The rain, combined with snowmelt, caused widespread street flooding along with minor river flooding to typical flood-prone areas.

August-September 2021
Tropical Storms Henri (August 22) and Ida (September 2) affected New England within two weeks of each other with heavy rain and local gusty winds. Henri turned out to have less impact than anticipated, while Ida had greater impact with more power outages and close to 4 inches of rain that caused localized flooding.

November 14, 2021
Three tornadoes touched down during the late afternoon hours ahead of a strong cold front. An EF-1 was reported near Stonington CT which moved into Westerly, RI; an EF-0 hit in North Kingstown; and another EF-0 touched down in Plainfield, CT and moved into Foster. RI. No deaths or injuries were reported. Trees and utility poles were damaged, a few accessory buildings were destroyed, and there was minor exterior damage to some houses. No storm damage was reported in East Providence, but this was a close call for the City considering the infrequency of tornadoes in Rhode Island.

January 29, 2022
A major nor'easter affected the City featuring strong winds and around 20 inches of dry, windblown snow. Temperatures near 20 during the storm made any accumulation on trees or power lines negligible, thus power outages in RI and nearby Massachusetts were minimal. The main impact to communities was with regard the cost and availability of weekend staffing for snow removal operations, including secondary complete removal or "push-backs" of large snowpiles that made for very poor sight lines at many intersections. On May 12, 2022, this storm received a major disaster declaration from FEMA.

SECTION 2 – PLANNING PROCESS

Section 2.1 - Purpose, Overview and Background

2.1a Purpose of Local Hazard Mitigation Plan
The purpose of this Hazard Mitigation Plan is to recommend policies and actions to be undertaken by the City of East Providence in order to reduce the physical, social, and economic loss that can result from a natural disaster. Revisions will be made to this plan by the East Providence Hazard Mitigation Committee and submitted to RIEMA and FEMA in order to ensure consistency with state and national goals. The process was also integrated with that of the 2022 East Providence Comprehensive Plan Update.

2.1b Plan Updates
Strategy for Reducing Risk from Natural Hazards in East Providence, Rhode Island (East Providence Hazard Mitigation Plan) was prepared by the East Providence Planning Department in 2004, adopted by the East Providence City Council, and approved by FEMA in 2005. The plan was updated during 2010, with that update adopted by the City Council in January of 2011, and approved by FEMA on May 10, 2011. The plan was updated again for City Council adoption in March 2017, and FEMA approval on April 7, 2017.

The 2022 Plan update includes elements of the 2017 plan that remain pertinent, including the base hazard information. Significant changes to the Plan include:

- Updated lists of personnel in the Acknowledgements section at the beginning of the document, along with new resources lists in the Appendix section, with updated contact information and web addresses;
- An updated *Natural Hazard Profile* section to take into account recent hazard occurrences and add a Sea Level Rise section;
- Updates to the *Risk Assessment Matrix* as based on evaluation by City Emergency Management, Engineering, and Planning personnel, and comments received from stakeholders;
- 2017 *Action Items* as reviewed and evaluated to determine implementation progress, with a status chart added, and
- 2022 proposed action items.

Section 2.2 - Building Support: Community Involvement, Roles & Responsibilities

2.2a Planning Team, Technical Assistance and Local Leadership
The City's Hazard Mitigation Planning Team consists of the City Manager as Public Safety Director, along with high-ranking personnel from the Planning, Police, and Fire Departments and the Department of Public Works (DPW). This group, and invitees including the Information Technology Director, a high-ranking School Department official, and the Public Buildings Superintendent, have met on the dates below to discuss emergency management initiatives including hazard mitigation, post-incident activity, emergency preparedness, and security.

- August 28, 2018: Rhode Island Emergency Management Agency Community Assistance Visit (CAV) with RIEMA officials, City Emergency Management, and City Building Official. This flood-oriented meeting dealt with NFIP issues including floodplain administration, along with flood mitigation opportunities in the City.
- December 13, 2018: FEMA Community Rating System Cycle Visit including discussion on Hazard Mitigation plan progress report.
- January 18, 2019: Weather-based meeting including Emergency Management, the Mayor, Fire, Police, and DPW officials to discuss impending emergency natural hazard procedures and touch on hazard mitigation topics for the benefit of the new City administration.
- January 17, 2020: Planning Department/Emergency Management Hazard Mitigation Plan meeting to go over current plan, and timelines for maintenance and required updates.
- March 23, 2020: City Hazard Mitigation and Community Rating System meeting between Emergency Management, Fire Department, and DPW including 2019 progress report on Hazard Mitigation Plan goals and objectives.
- January 13-14, 2021: Emergency Management Review of Hazard Mitigation Plan goals and objectives, and 2020 progress report.
- March 5, 2021: City Emergency Management and Fire Department meeting, partly COVID-related, included discussion of Hazard Mitigation Update timeline and potential mitigation actions/hazard areas known to the Department.
- November 3, 2021: Hazard Mitigation Plan meeting to discuss update and writing timeline, public involvement, and survey questions.
- January 11-12 2022: Emergency Management Review of Hazard Mitigation Plan goals and objectives, and 2021 progress report.

Additionally, Command Staff incident after-action meetings and reports have been a source for both future preparedness actions and mitigation options. This group will maintain an open dialog regarding mitigation and preparedness, including a regular schedule of meetings in the future.

The City's Emergency Management Agency (EMA) is a division of the Fire Department and has a presence in the Planning Department. Planning staff contributed economic development, historic property, land use, and demographic information along with comprehensive planning survey results to this Plan update. EMA collaborated with City Command Staff regarding determination of risks and hazards, and on potential mitigation actions. The DPW Engineering Division and the Finance Department's Assessment Division provided mapping technical assistance and property value data for purposes of economic vulnerability and incident damage estimation.

2.2b Public Involvement

Comprehensive Plan Survey

An online community survey was available from January through March of 2021, and was re-opened for June and July of 2021. It was heavily promoted in City social media, local print media, and via mailers in City utility bills. There were 468 respondents to the survey as a whole, though not all responded to every question. When asked about environmental concerns, a large majority (74 percent of 459 respondents to the question) were concerned about the loss of natural areas and open space. Forty percent indicated concern about coastal erosion, while between 32 and 38 percent were concerned about natural hazards including frequency of flooding, increasing number of damaging storms, and sea level rise.

Hazard Mitigation Survey
A hazard mitigation survey was made available from late January through February 14, 2022, similarly promoted as above. The survey yielded 52 responses. The main concerns evident from the survey responses relate to hazards experienced relatively recently, but there is also concern about the potential from a strong hurricane of the type that we have not experienced in many decades. In general, high wind generating events are a major concern to residents as some neighborhoods have had a rather high frequency of power outages in recent years. About a quarter of respondents have purchased an emergency generator, in some cases directly as a result of one or more specific lengthy outages. Flooding also ranks relatively high as a concern but less so that high-wind events.

The frequency of high wind events is likely also a driver in strong resident interest in tree inventories and tree maintenance, as damaged trees adjacent to utility lines during storms is a primary cause of power outages

Coastal erosion and sea level rise have been a concern for those who may be directly affected (such as coastal property owners) for years, but awareness and concern for these issues have been increasing among the general populace in recent years. Comprehensive Plan and Hazard Mitigation surveys indicate that climate change, coastal erosion, and sea level rise are longer "niche" issues only applicable coastal or riverfront property owners.

Responses to the survey question by percentage are included in Appendix D, starting on page 108.

Section 2.3 Discovery and Gathering of Resources

The Hazard Mitigation Plan Committee utilized multiple resources in updating our Hazard Mitigation Plan. The lengthy tenure of most members of the group results in substantial institutional knowledge, which only increases as staff works through actual natural hazard incidents. In addition to commonly used sources of information and data including the United State Geological Survey (USGS), various National Oceanic and Atmospheric Administration (NOAA) resources, and statewide resources from RIEMA and the Rhode Island Coastal Resources Management Council (CRMC), City staff now have numerous incident after-action reports which offer insight as to future preparedness and mitigation possibilities.

Coordination with Neighboring Municipalities
East Providence borders four communities; Providence to the west across the Seekonk and Providence Rivers, Pawtucket to the north, Seekonk, MA to the east and Barrington to the south. It is to the advantage of neighboring jurisdictions to coordinate activities with each other as natural hazards have little regard for municipal and state boundaries.

Among the more important issues requiring cooperation with neighboring towns is emergency storm sheltering. The American Red Cross has designated East Providence High School as a regional shelter in their statewide sheltering plan. In addition, the State of Rhode Island Shelter and Coordination Plan (2015) has identified East Providence High School, as well as East Providence Senior Center and Riverside Middle School, as State shelter locations to be used by residents of East Providence and neighboring communities in the event of a major emergency. For example, a direct hurricane hit that causes significant storm surge flooding would have major or perhaps catastrophic implications for Barrington, as large sections of the town are in flood and inundation zones. Evacuation routes would

likely include roadways in East Providence. Therefore, sheltering and evacuation routes should be coordinated between the two communities.

Concurrent with RIEMA's review of this Plan update, the Plan has been made available online with notifications made on social media and by e-mail to emergency managers in Barrington, Warren, Pawtucket, and Providence, as well as to the Town Planners in Barrington and in Seekonk, MA for a solicitation to review and comment.

Section 2.4 - Plan Maintenance

2.4a Method, Responsibilities, and Schedule

Plan Update Review, Adoption, and Approval
The City of East Providence, Rhode Island Local Hazard Mitigation Plan will be submitted to the East Providence Planning Board for their review and a recommendation to the City Council for adoption at a future meeting, timing of which to be determined by the RIEMA and FEMA review processes.

Monitoring, Evaluation, and Updates
The 2017 Plan Update has been available on the City's Emergency Management webpage for public review since its adoption, with the invitation to provide comments and suggestions. Respondents may comment via e-mail or by phone directly to the Deputy EMA Director as Hazard Mitigation Committee Chair (contact information provided on EMA webpage). No comments were submitted during this time. This new Plan update, once adopted by the Council, will remain on the webpage, with copies available to review at the Department of Planning in Room 309 at City Hall and at the City's public libraries.

The East Providence Hazard Mitigation Committee, under EMA leadership, will meet annually to monitor, evaluate and update the plan. There will be an annual solicitation of plan review from the Committee, with a particular focus on the following plan components, based on circumstances present at the time of the review:

- Natural Hazard Profile: Account for any major disasters, particularly if they result a presidential disaster declaration;
- Mitigation Action Items: Review status of and progress on action items and revise as necessary, identify any implementation issues; and
- Risk Assessment: Evaluate matrix, especially with respect to hazard impacts and hazard ranking.

Public notice regarding any Plan revisions will be submitted to the East Bay Newspapers group (locally, the East Providence Post, distributed free at locations throughout the City) and the monthly East Providence Reporter which is mailed free to all City households. Such notice will also be posted in the lobby of City Hall, at the public libraries, the City's webpage, and on City and EMA social media sites.

The Committee will also meet following a hazardous event that has resulted in the loss of life and/or damage to property within the City. This practice has been followed in the wake of all recent major storm incidents.

2.4b Accounting for Ongoing and Anticipated Changes in Development

Development has ebbed and flowed over the last 10 years in many places including East Providence. In 2021 and 2022, there was increased economic activity as the COVID pandemic eased and more consumers resumed activities outside of their homes. In collaboration with the East Providence Planning Department, the Hazard Mitigation Committee will monitor development activities and determine any resulting changes in vulnerabilities that natural hazards will present. The anticipated development in the City's Waterfront Special Development District over the next five to ten years will add to the population and infrastructure that is at least somewhat more vulnerable to hazards. These trends and their interplay with our expected natural hazards will be monitored closely during the course of the cycle of this Hazard Mitigation Plan.

2.4c Continued Public Involvement

An update of the City's Hazard Mitigation Plan is required within five years of the adoption of the currently-valid plan. The Hazard Mitigation Committee will commence review of the Hazard Mitigation Plan roughly 18 months in advance of the expiration date of the adopted plan. Review and revision will be based on State and Federal guidelines current to the time of the update. Invitations for review and comment will be sent to local organizations including the East Providence Chamber of Commerce, and others as available. Public meetings will be scheduled and advertised via print and social media. The revised Plan will be submitted to RIEMA and FEMA as required for their approval.

In addition to a running solicitation for public review and comment via the City's website, East Providence Emergency Management will host public meetings to speak with constituents on an individual (or group, as interest determines), basis regarding the City's natural hazards. Emergency Management, in capacity as the City's Floodplain Coordination Office, will continue to offer our flood zone and flood insurance informational service as we have over the last five years.

SECTION 3 – HAZARD AND RISK ASSESSMENT

Section 3.1 - Introduction

3.1a Population at Risk
Depending upon the severity and extent of a natural hazard, all residents of the City of East Providence are potentially at risk; especially the elderly, those with functional needs, and children in daycare facilities. Specific information regarding risk to our population is included within the Extent sections within each hazard discussion, as well as in Section 3.4, Risk Analysis and Risk Assessment Matrix.

Section 3.2 - Natural Hazard Analysis

3.2a Hazard Identification
Local jurisdictional natural hazards considered for inclusion in this Plan update were determined by analyzing the list of natural hazards that were included the 2019 Rhode Island Hazard Mitigation Plan, considering any additional hazards upon consult with the City's Hazard Mitigation Committee, and utilizing historical significance and local institutional knowledge of natural hazards that had been presented in the past. The results of this analysis provided the Plan with additional hazards to be profiled within the Hazard and Risk Assessment Section. These additional natural hazards include: severe thunderstorms, including hail; and nor'easters.

Wind Related Hazards	Winter Related Hazards	Flood Related Hazards	Geologic Related Hazards	Additional Hazards
Hurricanes	Snowstorms	Riverine Flooding	Earthquakes	Wildfire
Tornadoes	Ice storms	Flash Flooding		Drought
Severe Thunderstorms	Extreme Cold	Urban Flooding		Extreme Heat
Nor'easters		Coastal Flooding		
		Storm Surge		
		Coastal Erosion		
		Dam Breach		

Table 1. Natural Hazards Identification

Table 1 reflects the natural hazards that were included within the Plan update, as these are the natural hazards that are commonly recognized to affect East Providence and the City's planning efforts.
The natural hazards that were omitted from this Plan, including tsunami and landslides, were not specifically addressed due to each hazards extremely low probability of future occurrence, as well as lack of historical data and previous occurrences in East Providence and the surrounding areas. Should this change, future Plan updates will address these hazards.

3.2b Natural Hazard Profile Notes and Organization
Natural hazard profiles, as developed for this Plan update, have been organized as follows:

Description: Detailed descriptions of each hazard from a local and regional meteorological perspective, or a general hazard description for non-meteorological phenomenal such as earthquakes.

Location: An idea of the general physical scale of impact for each hazard within East Providence, including more likely specific locations when possible. In the case of some hazards, the scale of hazard events is such that no one area is more, or less, favored for impact. In other instances, the scale of the hazard incident may be very small, right down to neighborhood-scale, but no one area is more susceptible to impact than any other.

Extent: Information regarding the strength or magnitude of a hazard on a qualitative and, where possible, quantitative basis, with indication of potential worst case scenario.

Previous Occurrences: An up-to-date listing if significant events for each hazard as localized as possible, but generally by Providence County, Providence *and* Bristol Counties, or the State of Rhode Island.

Probability of Future Events: For purposes of this Plan update, probabilities of hazard occurrence have been assigned as follows:

Low:	Expected occurrence interval of less than once in 50 years.
Medium:	Expected occurrence interval of between once in 50 years and once in 5 years.
High:	Expected occurrence interval of once or more in 5 years (one full Hazard Mitigation Plan update cycle).

3.2c Natural Hazard Profiles

Wind Related Hazards

1. Hurricanes

Description

Hurricanes present a very serious threat to all of southern New England including the City of East Providence. August and September are considered the peak months for hurricane activity in the region, but the Atlantic hurricane season officially runs from June 1st through November 30th. Our area has been affected by tropical weather systems during this entire period and, in rare instances, in December. Hurricanes present multiple major hazards for the City including tidal flooding, storm surges, damaging winds, and excessive rainfall causing riverine and poor drainage flooding. All hurricanes, and most tropical storms, that make landfall in southern New England will feature each of these hazards somewhere in the region. The degree to which each affects the City is dependent on the storm's strength and track. A track to the west of Narragansett Bay will result in a more severe storm surge up the Bay and more powerful winds, while a track to the east may produce a lower surge and somewhat less wind, but will likely result in substantially heavier rainfall and an enhanced threat of riverine and urban flooding.

Characteristics of New England Hurricanes

Hurricanes that reach the New England area have certain characteristics that make them somewhat different from those in the tropics and sub-tropics. Changes occur in the satellite signature (shape) and structure of hurricanes as they move into the mid-latitudes. As they approach our region, hurricanes begin (and in the case of Sandy, nearly complete) the transition from tropical to "post-tropical" storm and take on characteristics of a very strong nor'easter. The satellite photos below illustrate the typical difference in satellite appearance between tropical and mid-latitude hurricanes.

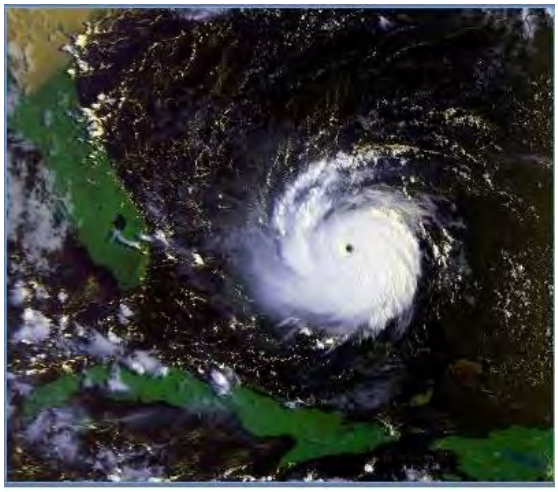


Photo 3. Hurricane Andrew, 1992[2]

Photo 4: Hurricane Bob, 1991. Local hurricane archive.

Hurricane Andrew, shown here east of Florida and moving into the Bahamas, was a classic low-latitude hurricane with a round, buzz-saw shape and a well-defined eye. Hurricane Bob, still centered south of New England on this photo, displayed a typical mid-latitude satellite signature with more cloudiness to the left of and ahead (in this case to the west and north) of the storm's track, along with a cold-frontal structure to the south of the storm. The end result is that nearly all hurricanes that reach our region contain very heavy rainfall to the left (generally west) of the storm's path, and the very strongest winds and worst storm surge along and to the right (generally, east) of the storm's path. This is not to discount effects of rain and wind on the other sides of the storm, but as a planning tool it is reliable to expect flooding rain left of the storm's path, and very strongest winds and surge to the right.

Some East Coast hurricanes that aim for New England are preceeded by a line, or "trough", of low pressure that extends up the coast from the storm. This is always something to watch for when tropical systems threaten. It can result in one to three days of locally heavy rainfall ahead of the storm, refered to as a "predecessor rain event", and greatly increase the threat of urbane and river flooding. This occurred with the 1938 hurricane, where rainfall as the storm blew by was less then one-quarter inch at Providence, but three inches fell the previous day. Perhaps the heaviest predecessor rain event in modern times occurred ahead of Tropical Storm Belle in August of 1976, when 5 inches of rain preceeded the storm. Belle's landfall well to the west near Bridgeport CT took the near-storm rainfall through western New England, with only a trace recorded in Providence on the actual day. In the Previous Occurrences chart below, "predecessor rain events" are indicated as "+(rain total)".

Location

Most hazards associated with hurricanes will have at least a residual effect on the entire city. The most widespread hazard that would affect the entire City would be the damage caused by strong winds. The degree of storm surge, and riverine and flash flooding will depend on the storm's track and strength. Please see the discussion on Storm Surge (Page 45) in the Flood Hazard section for specific locational information of these hazards as they relate to hurricanes and to other natural hazard incidents.

[2] Hurricane Photo: NOAA. Andrew, http://www.hurricanescience.org/history/storms/1990s/andrew/

Extent

Hurricane intensity is categorized based on the *Saffir-Simpson Hurricane Wind Scale* (see Table 2 below). The scale is based strictly upon wind speed and *does not* assign any other specific conditions such as central barometric pressure, storm surge, structural damage, or flooding effects to the categories.

Table 2. Saffir-Simpson Hurricane Wind Scale[3]

Saffir-Simpson Hurricane Wind Scale

The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 rating based on a hurricane's sustained wind speed. This scale estimates potential property damage. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Category 1 and 2 storms are still dangerous, however, and require preventative measures. In the western North Pacific, the term "super typhoon" is used for tropical cyclones with sustained winds exceeding 150 mph.

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph 96-112 kt 178-208 km/h	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph 113-136 kt 209-251 km/h	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Note that in the Saffir-Simpson classification (Table 2 on Page 27), storms of Category 3 and higher are further categorized as "Major."

A hurricane of any category would be sufficient to cause widespread tree and power line damage. An important seasonal aspect of hurricanes from a wind standpoint is that they occur when foliage on the trees is fully developed. This factor, added to the fact the New England tropical storms and hurricanes are commonly preceded by heavy rainfall, results in the likelihood of many uprooted

[3] "Saffir-Simpson Hurricane Wind Scale", NOAA- National Hurricane Center, accessed November 16, 2015, http://www.nhc.noaa.gov/aboutsshws.php.

trees and trees that are damaged above their trunks from a strong hurricane, causing extremely widespread power line damage. This not only creates massive debris and power issues, but also limits access to streets and neighborhoods, which hinders efforts to assist residents and begin clean-up and recovery operations. It is important to realize that a storm bringing winds of Category 3 and higher speed would damage or take down a majority of trees in the City and would likely result in nearly complete power failure. The City will remove debris with all of the resources available, but direct assistance from the electric utility provider and any other utility providers brought into the region will be required to clear the huge amount of debris that would contain utility wires. Because of the large regional scale of these storms, the outside assistance required would also be needed by *all* jurisdictions in the region, and, as a result, those resources will be stretched very thin. The extent of storm surge and flooding are discussed in the respective sections for those hazards later in the Plan.

Previous Occurrences

The major hurricanes of record for Rhode Island remain the 1938 Hurricane and Hurricane Carol in 1954. Both storms brought huge storm surges up Narragansett Bay which caused major flooding in this area, including completely flooding out downtown Providence. A similar storm today would, among many other things, flood waterfront properties along the entire Providence and Seekonk River frontages of East Providence, flood out a number of residential properties in parts of Riverside including along Bullocks Cove and near Sabin Point Park, result in severe bluff erosion along the western shore of Riverside, and close the heavily used Wampanoag Trail coming out of Barrington. Tree and power line damage would be massive, as above.

As of mid-2022, there had not been a direct hurricane hit for southeastern New England since Bob in 1991. There have been numerous tropical storms (including some former strong hurricanes) which have brought gusty winds and very heavy rainfall across the region. These can be expected in any given year, some years more than once. On average, they occur with some significant impact about once every three to five years.

Date	Name	Wind Speed(MPH)	Rainfall in inches (Providence total)	Property Damage ($ Millions)	Deaths
9/21/1938	Hurr. Of 1938	95+	.17 + 2.92	100	262
9/14/1944	Great Atlantic Hurr.	82	5.43 + 2.95	2	0
8/31/1954	Hurricane Carol	110	2.79	200	19
9/11/1954	Hurricane Edna	40	4.37	0.1	0
8/19/1955	Hurricane Diane	45	6.13	170	0
9/12/1960	Hurricane Donna	58	2.23	2.4	0
8/10/1976	T.S. Belle	60	.06 + 5.03	Unknown	0
9/27/1985	Hurricane Gloria	81	.10	19.8	1
8/19/1991	Hurricane Bob	75	2.67	115	0

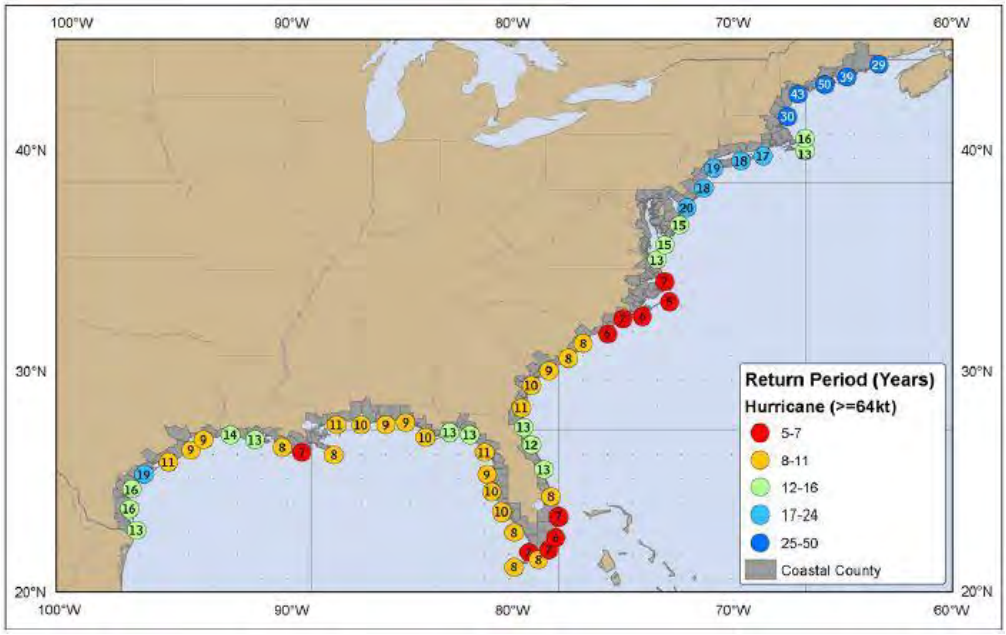
Table 3 (above). Significant Tropical Storms and Hurricanes affecting Rhode Island from 1935-2015.

Date	Name	Wind Speed(MPH)	Rainfall in inches (Providence total)	Property Damage ($ Millions)	Deaths
7/13/1996	T.S. Bertha	Up to 65	3.57	Unknown	0
9/17/1999	T.S. Floyd	Up to 70	.90 + 1.20	Unknown	0
9/6/2008	T.S. Hanna	Up to 40	4.10	Unknown	0
8/28/2011	T.S. Irene	Up to 60	1.98	.19	0
10/29/2012	Post-Tropical Sandy	Up to 70	1.38	8	0
7/4/2014	Hurr. Arthur	Up to 50	2.68	Less than .1	0
8/4/2020	T.S Isaias	Up to 55	.19	Less than .1	0
8/22/2021	T.S Henri	Up to 45	.91	Less than .1	0
9/2/2021	T.S.Ida	Up to 40	3.89	Unknown	0

Table 4. Other recent significant tropical weather systems affecting East Providence. In both tables, rainfall total following the + sign represents predecessor rain events (immediately ahead of the storm).

Probability of Future Events

Tables 3 and 4 above display 10 hurricanes that have affected our area since 1935. Note the uneven time distribution of these storms with three of them occurring in a two-year period during the mid-1950s. Map 2 provides well-researched recurrence intervals of hurricanes passing within 50 miles of defined areas along the Atlantic and Gulf of Mexico coasts. Such a track would have a strong and lasting impact on the area. Based on the significant influence of additional hurricanes that passed somewhat outside of this 50 miles radius (e.g. Hurricane Gloria for our area), it can be estimated that long-term recurrence intervals for hurricane impacts may be every 10 to 15 years, or in the medium category. It is important to note that while hurricanes do not have the highest of all probabilities of occurrence, the extreme impact of a hurricane direct hit in the area combined with the fact that it would affect our entire region makes hurricanes perhaps the most dangerous of all natural hazards for East Providence.



Map 2. Estimated return period in years for major hurricanes passing within 50 miles of various locations.[4]

[4] Eric S. Blake, Christopher W. Landsea, Ethan J. Gibney, "The Deadliest, Costliest, and Most Intense United States Tropical Cyclones from 1851 to 2010 (and Other Frequently Requested Hurricane Facts)", NOAA Technical Memorandum NWS NHC-6, http://www.nhc.noaa.gov/pdf/nws-nhc-6.pdf

2. Tornados

Description
A tornado is a violently rotating column of air extending from a cloud to the surface of the earth. Top winds in weaker tornadoes are 100 mph or less, but in the most violent (and fortunately least frequent) tornadoes, wind speeds can exceed 250 mph. Tornadoes typically track along the ground for a few miles or less and are commonly less than 100 yards wide, though some can remain in contact with the earth for well over fifty miles and exceed one mile in width.

Photo 5. Narragansett Bay waterspout, July 2008. Photo: Nicholas Caisse (used with permission).

Tornadoes are found within strong to severe thunderstorms, generally near the back edge of the storm with respect to its movement. On many occasions, they are "behind" the thunderstorm's rain shield, which is why so many of them are very clearly seen during daylight hours. Nighttime tornadoes are particularly dangerous, but fortunately for New England they are very rare in the region. Recent advancements in tornado research have led to much greater awareness of atmospheric conditions that are favorable for tornado development, and Doppler radar upgrades now allow for more timely detection and tracking of tornados and other severe weather.

Location
In general, southeastern New England including Rhode Island is less favored for tornadoes than most of the United States westward through the Midwest and the Plains states, and southward to the Gulf Coast. New England's generally accepted *Tornado Alley* consists of the Connecticut Valley in north central Connecticut and western Massachusetts and eastward into Worcester County, MA. This area also has a higher probability of a large tornado. Historically, tornadoes that have affected Rhode Island have been small, narrow, and for the most part short-lived.

Extent
Tornadoes can cause serious devastation amounting to millions of dollars in a small area. For East Providence, this could include any of the City's densely populated neighborhoods and result in significant loss of life , property, and utility infrastructure. Regarding statewide geographic probability of tornado occurrence, the possibility is slightly higher in the northern half of Rhode Island and west of Narragansett Bay, but they have occurred elsewhere. Waterspouts (funnel clouds over water) have formed in Narragansett Bay, and have even come ashore as tornadoes. There is no one section of the City that is more or less likely to experience a tornado than any other.

The *Enhanced Fujita (or EF) Tornado Scale* on Page 28 below classifies tornadoes into six categories ranging from EF 0 (EF "zero") to EF 5. This scale rates the intensity, and probable maximum wind speed, associated with a tornado based on damage to structures and vegetation using 28 damage indicators and 8 levels of damage. The indicators include types of vegetation and numerous structural variables including structure height, type, and building materials. The wind estimate is based on the maximum "3-second gust," as a single tornado's presence at any given point is of very short duration.

Table 5: Enhanced Fujita (EF) Tornado Scale

EF Rating	Wind Speeds	Expected Damage		
EF-0	65-85 mph	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.		
EF-1	86-110 mph	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.		
EF-2	111-135 mph	'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.		
EF-3	136-165 mph	'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.		
EF-4	166-200 mph	'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.		
EF-5	> 200 mph	'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.		

Previous Occurrences

The National Climate Data Center (NCDC) tornado database for Rhode Island lists 11 tornadoes in the State since 1970. Note that all of the reported tornadoes have occurred during July, August or September. While the warmest time of the year is by far the most favored period for tornadoes in our area, they have occurred in other seasons elsewhere in New England; in fact, one was recorded in December of 1951 on Martha's Vineyard. The most destructive recent tornado in New England occurred on June 1, 2011, when a long-lived tornado formed in West Springfield, MA and traveled eastward nearly 40 miles on its 70-minute trek into the Sturbridge area, causing $227 million in damage along the way. Later that day, another thunderstorm cell touched off three weaker tornadoes in the area of the Mass. Pike in the same part of the state. This outbreak illustrated that, while major tornado outbreaks don't occur in New England to the same magnitude as in the Great Plains and Midwestern U.S., multiple tornadoes can occur in the region from the same weather system. That was demonstrated in Rhode Island in August of 1986 when three tornadoes occurred in two days, including one in Cranston and Providence which caused $2.5 million dollars in damage.

Table 6. Tornadoes reported in Rhode Island since 1970[7]

Location	Date	Time (EDT)	Magnitude*	Deaths	Injuries	Property Damage
Bristol County	9/14/1972	5:45 PM	F-0	0	0	$0
Glocester	8/26/1985	3:00 PM	F-1	0	0	$0
Lincoln	8/7/1986	3:30 PM	F-1	0	0	$250,000
Cranston, Providence	8/7/1986	4:15 PM	F-2	0	20	$2,500,000
Burrillville	8/8/1986	10:15 AM	F-1	0	0	$250,000
Cranston	9/23/1989	3:30 PM	F-0	0	3	$250,000
Warwick	10/18/1990	11:10 PM	F-1	0	0	$250,000
Coventry	8/13/1994	6:30 PM	F-0	0	0	$0
Foster	8/16/2000	3:00 PM	F-0	0	0	$0
Barrington, Warren	7/23/2008	4:05 PM	EF-1	0	0	$45,000
Block Island	8/10/2012	3:54 PM	EF-0	0	0	$50,000
North Providence	10/23/2018	2:31 PM	EF-1	0	0	$1,000,000
Quonset Point	10/2/2019	3:45 PM	EF-0	0	0	$5,000
Plainfield CT-Foster RI	10/13/2021	4:48 PM	EF-0	0	0	n/a
Stonington CT-Westerly RI	10/13/2021	4:54 PM	EF-1	0	0	n/a
North Kingstown	10/13/2021	5:18 PM	EF-0	0	0	n/a
Totals:				0	23	$3,595,000

* **Note:** Prior to 2007, magnitude was based on the original Fujita (F) Scale. The Enhanced Fujita (EF) Scale has much larger and more detailed set of damage indicators, along with a more intuitive wind scale (see Table 6, Enhanced Fujita Tornado Scale chart on Page 31).

Probability of Future Events

A tornado has occurred in Rhode Island on an average of about once every 3.5 years since 1970, but there have been several in recent years including three in one day in November of 2021. None of these have directly hit East Providence. Due to factors that typically enhance thunderstorm development, western interior Rhode Island is slightly more likely to experience a tornado than areas closer to the water, but tornadoes can affect any part of the State. There is no one portion of East Providence that is more susceptible to a tornado than any other area. The probability of a tornado event in the City is in the medium category, but it is important to recognize that some years feature repeating patterns of severe weather and there can be multiple tornadoes somewhere in the State in the same year, or within a few days or less. Also of importance is that any tornado that does impact the City can cause devastating damage where it makes contact with the ground.

3. Severe Thunderstorms

Description

A severe thunderstorm is defined by the NOAA Storm Prediction Center as a thunderstorm that features one or more of the following: a wind gust of 58 mph or greater, one-inch or larger sized hail, or a tornado. Severe thunderstorms are less common in the Providence area than they are in

[7] "Storm Events Database", NOAA-NCDC, accessed October 26, 2015, http://www.ncdc.noaa.gov/stormevents/.

central and western New England, as storms often weaken moving eastward onto the coastal plain due to "downsloping" off of the hills to the west, and due to marine influences on the local air mass from the south or east. Despite these factors, East Providence can rely on experiencing a thunderstorm anywhere from about 15 to 30 days each year, including a few incidents of at least localized severe weather.

Thunderstorms are capable of producing strong wind gusts, torrential rainfall, fallen tree/limbs, downed power lines, flooding, and deadly lightning strikes. Notable severe thunderstorms in the immediate area include one in July of 2008, during which a lightning strike caused an explosion and major fire at the Port of Providence, and strong winds from the same cell caused extensive tree damage along a small area of Veterans Parkway in East Providence directly across the river from the port.

Photo 6. Severe thunderstorm in formative stage over central East Providence, July 2008. This storm moved northeastward causing damaging winds in parts of Seekonk and Rehoboth.

Photo: Wayne Barnes

While tornadoes do infrequently occur in our area (see tornado section above), the greatest hazard from severe thunderstorms here is generally straight-line wind gusts. Squall lines can result in strong gusts occurring across most or all of the City. Somewhat more common are discreet thunderstorm cells that produce strong wind gusts in a portion, but not all, of the city. These can be in the form of "microbursts" (less than 2.5 miles in width) or "macrobursts" (2.5 miles or greater in width) which are caused but a strong rush of relatively cold downward-moving air (a "downburst") than fans out when it hits the ground. The damaging August 4, 2015 storm, as seen in photo 8, qualified as a macroburst due to its width. Top winds from damaging downbursts can exceed hurricane-force, and are often determined after the fact by damage surveys. These surveys sometimes employ the EF-tornado scale damage indicators to determine wind speeds from a local downburst or microburst where wind-sensing equipment was not available.

As with many weather hazards, the frequency of strong to severe thunderstorms varies from year-to-year. The summer of 2008 featured a weather pattern that brought localized severe weather to the Rhode Island and southeastern Massachusetts area on numerous occasions, while the relatively dry and cool summer of 2014 featured almost no thunderstorms in East Providence.

Location

While thunderstorms often produce very localized severe weather, the atmospheric conditions that cause them are larger in scale. As a result, there is no portion of the City that is statistically more prone to the effects of severe thunderstorms than any other.

Extent

See the Hurricane section above for more general information on the potential extent of wind damage. Note that the damage extent is likely lower and more localized from thunderstorms than from a hurricane due to smaller scale and very duration of strong thunderstorm winds in comparison with that of hurricanes. Regarding lightning; building construction, location, and

proximity to trees will have a large impact on how vulnerable a location is to a lightning strike. 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 lightning can jump to.
Electrical and communications utility lines are also vulnerable to direct lightning strikes. Damage to these lines has the potential to cause power and communications outages for businesses, residences, and critical facilities.[10]

Photo 7. Damage from severe thunderstorm "Macroburst" along Terrace Avenue in Riverside on August 4, 2015. Photo: East Providence DPW

The August 2015 macroburst, if it affected a larger portion of the city to the extent that it did in the southernmost portion of Riverside, represents a model for a high-end thunderstorm event in the City as might be experienced from a strong squall line.

Previous Occurrences

Strong to severe thunderstorms have occurred in most years in Rhode Island and nearby Massachusetts. For instance, as noted above, they occur frequently in some years when a weather pattern features repeating strong atmospheric disturbances. Individual locations can see many years pass without experiencing a damaging thunderstorm, then have two or three incidents with damage in the same year. The late-spring and summer months are the most likely time to experience severe thunderstorms in our area, but they have occurred well into the fall and even winter with strong cold frontal passages.

Location	Date	Time	Deaths	Injuries	Wind Est. (mph)	Property Damage
Coventry, Cranston, E.Prov.	8/4/2015	5:45 AM	0	0	70	$220,000
Central, Northern RI	2/25/2016	3:20 PM	0	0	55	$45,000
Coventry- W. Warwick-Warwick	7/22/2016	10:50 PM	0	0	50	$20,000
Northern/Western Prov. County	8/12/2016	4:15 PM	0	0	50	$70,000
Providence and Western Metro	5/20/2019	4:50 PM	0	0	50	$12,000
N. Kingstown, Jamestown	8/25/2020	6:00 PM	0	0	65	$31,000
Northernmost RI, part of Prov.	10/7/2020	5:20 PM	0	0	50	$60,000
Burrillville- Cumberland	7/27/2021	6:40 PM	0	0	50	$22,000

Table 7. Impact Thunderstorms in Providence and Bristol Counties from 2015 into 2022 with winds of 50 mph or greater and reported property damage.

Probability of Future Events

Given the fact that most years feature 20 days or more with an occurrence of thunder, and that more years than not feature at least one incident of some damage in the City due to a thunderstorm, there is a high probability of such an occurrence in East Providence.

[10] "Rhode Island Hazard Mitigation Plan 2014 Update," Rhode Island Emergency Management Agency.

3a. Hail

Description
Hail, described by NOAA as "Showery precipitation in the form of irregular pellets or balls of ice more than 5 mm in diameter, falling from a cumulonimbus cloud,"[11] occurs occasionally within strong to severe thunderstorms in New England. Serious hailstorms are not common in southeastern New England due to the factors noted above that affect thunderstorms over the area, but they are a hazard. The minimum size of severe hail has recently been increased from ¾ inch to 1 inch by the NOAA Storm Prediction Center, as a result of extensive studies of damage from hailstorms.

Location
Large hail within a thunderstorm can occur anywhere in the City. These incidents tend to be very isolated and localized in our area. Damaging hail is unlikely to affect a large portion of the City on any single occasion and can, in fact, affect an area as small as several City blocks.

Storms featuring damaging hail *have* occurred in the Providence area. In recent years, numerous incidents of large hail were reported in June and July of 2008, a particularly active severe weather period. In one storm on June 24, golf ball sized hail damaged several windshields, dented cars, and smashed windows in the area surrounding the Pawtucket YMCA on Newport Avenue. In addition, hail piled up on the roof of a bank, causing a portion of the roof to collapse. A similar storm that same month caused a significant accumulation of hail in parts of Riverside (see Photo 9 below).

Extent
Structural 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 be damaged by denting. Exposed windows and vehicles are also susceptible to damage. 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 shelters. Individuals who immediately seek shelter in a sturdy building or metal-roofed vehicle are much safer than those who remain outdoors.

The TORRO Hailstorm Intensity Scale (or, H Scale, as below on page 34), developed by the UK-based Tornado and Storm Research Organisation, categorizes hail by size and assigns typical damage impacts to ten ranges of hail size. The H Scale has not widely caught on in the United States and does not appear to have been adopted for use in public forecast products or storm reports by NOAA's Storm Prediction Center (storm reports do include estimated hail size in inches), but the scale can be of value in estimating potential damage from hail in similar fashion to damage guidance from the Enhanced Fujita (EF) Tornado Scale or the Saffir Simpson Hurricane Scale.

[11] "Glossary", NOAA National Weather Service, http://w1.weather.gov/glossary/index.php?word=hail.

Scale	Intensity category	Typical hail diameter (inches)	Typical damage impacts
H0	Hard hail	.2	No damage
H1	Potentially damaging	.2 to .6	Slight general damage to plants, crops
H2	Significant	.4 to .8	Significant damage to fruit, crops, vegetation
H3	Severe	.8 to 1.2	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	1.0 to 1.6	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.2 to 2.0	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	1.6 to 2.4	Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	2.0 to 3.0	Severe roof damage, risk of serious injuries
H8	Destructive	2.5 to 3.5	(Severest recorded in the British Isles) Severe damage to aircraft bodywork
H9	Super Hailstorms	3.0 to 4.0	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	> 4.0	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Table 8: TORRO Hail Intensity Scale[12], modified to remove "probable kinetic energy" and to convert millimeters to the nearest 1/10 of one inch.

Previous Occurrences

According to the NCDC database, hail of a diameter of one inch or greater (considered "severe hail" by the National Weather Service) has been reported an average of 4-5 times a year since 2000 in Rhode Island. The majority of these incidents have occurred in Providence County, which makes sense as interior portions of New England, including Rhode Island, are somewhat more prone to severe thunderstorm activity than coastal areas. Due to the localized nature of hail storms, incident reporting is less consistent for hail than for most other weather hazards, since multiple incident reports can result in densely populated areas compared to a similar event in a rural area where relatively few people live. Table 9 below on page 35 lists recent occurrences of severe hail in Rhode Island.

[12] https://www.torro.org.uk/research/hail/hscale

Location	Date	Time	Estimated Diameter (Inches)	Injuries	Deaths
Pawtucket/Woodlawn	4/22/2010	2:26 PM	1	0	0
Burrillville/Pascoag	5/26/2010	10:19 PM	1	0	0
E. Prov/Kent Heights	6/9/2011	1:15 AM	1	0	0
Glocester/Chepachet	7/1/2012	2:37 PM	1	0	0
Scituate	7/1/2012	2:51 PM	1	0	0
Burrillville/Pascoag	7/18/2012	2:02 PM	1.75	0	0
Smithfield/Spragueville	7/18/2012	2:15 PM	1.75	0	0
Cumberland	7/18/2012	2:18 PM	2	0	0
Burrillville/Mohegan	7/18/2012	3:16 PM	1	0	0
West Barrington	9/3/2013	3:24 PM	1	0	0
Scituate	6/29/2019	2:51 PM	1.75	0	0
Warwick/Apponaug	6/30/2019	2:27 PM	1.25	0	0
Woonsocket	3/29/2020	8:20 PM	1.00	0	0
Wakefield	7/14/2020	2:19 PM	1.25	0	0

Table 9: Occurrences of Severe Hail in Rhode Island 2010-2021.

Probability of Future Events

According to the NCDC Database, there were 14 reports of severe hail (one-inch diameter or greater) from 2010 through late 2021 in Rhode Island, of which one of these occurrences was in East Providence. None of the incidences from 2010 forward resulted in reported property damage or casualties, but as discussed above hail has caused significant property damage on a localized basis in the past. Given the recent history of hail incidents, its chance of occurrence in the City is medium.

4. Nor'easters and Other Synoptic (Regional) Scale Storms

Description

The coastal Northeastern U.S. is very prone to regional-scale mid-latitude storm systems, which are often several hundred miles wide and can produce a very wide variety of weather at any given time in our region. As an example, a storm that is causing heavy snow with very cold temperatures in western and northern New England could be producing damaging ice accretion in central New England, and warm, wind-driven heavy rain here in the coastal plain. The term "Nor'easter" is derived from storms which pass along the coast or offshore to our east, where the counter-clockwise circulation around the storm center results in (generally cold) northeasterly winds in our area. Occasionally, one of these storms will move northward to the west of Narragansett Bay and bringing with it strong (and relatively warm) southerly winds. These storms are sometimes referred to as "inside runners" as they travel inland with respect to our location.

Location

Given the relatively large scale of these storms, effects of any given storm are felt throughout the City and statewide. During southerly events, as described above, coastal locations of East

Providence are somewhat more prone to damaging wind gusts given the open exposure to the south.

Extent
Many nor'easters and mid-latitude storms do not produce wind gusts that are strong enough on their own to cause major tree or structure damage, nor do they routinely produce enough rain, snow or both to cause unusual consequences that are beyond the capability of the City to handle. Below are three examples of very different types of storms which illustrate severe conditions that are well beyond the average storm expectation.

1. Snowstorms accompanied by temperatures a few degrees of more below freezing are typically not as problematic since this sort as the snow tends not to stick to above-ground features. However, the accumulation of wet snow or ice on trees and power lines, when combined with strong winds, can cause substantial damage and create very widespread power outages, as was illustrated during the blizzard of February 8-9, 2013. Most of this storm featured temperatures near freezing along with heavy snow and 50-plus mph wind gusts which caused widespread tree and power line damage.

2. Storms which pass west of the City and Narragansett Bay can cause strong southerly winds which can result in at least localized damage to trees and power lines, and can also produce a couple of feet of storm surge, which needs to be watched if it comes during a time of high tide. A strong surge from these storms is not common as the southern fetch (distance of strong winds over the water) tends to be smaller than that of tropical systems. The portion of New England from the Narragansett Bay/Providence area eastward can expect a few of these southerly wind producing storms each year, favoring (though not confined to) late fall and the first half of the winter. A storm in December of 2008 caused a small storm surge that came close to coastal roadways and knocked out power on a localized basis due to fallen trees and large branches.

3. A three-day cold nor'easter in December of 1992 tapped into some tropical moisture and dropped 5.8 inches of precipitation on the City, including over 5 inches in about 36 hours. No other winter storm over the last 50 years (at least) has resulted in that magnitude of total precipitation. Fortunately, some of this fell as snow and sleet, lowering the run-off somewhat, but there was still widespread street flooding and minor local river flooding.

Probability of Future Events
Nor'easters and other non-tropical storms are a primary concern for Rhode Island residents due to the disruption and damage potential in larger storms. These storms are considered to have a high frequency in our area.

Winter Related Hazards

Winter weather hazards includes heavy snow, ice, mixed precipitation types, and extreme cold, and affects the entire State. Heavy snow is generally defined as a fall of 8 inches or more in less than 24 hours. Heavy snow can bring a community to a standstill by disrupting transportation, knocking down trees and utility lines, and causing structural collapse in buildings not able to withstand the weight of snow and ice. The latter impact is uncommon locally but has occurred on rare occasions. Repair and snow removal costs can be very high and surpass annual municipal salt and snow removal budgets before the end of a season. A winter storm warning is issued when snowfall is

expected to accumulate more than 4 inches in 12 hours or 6 inches in 24 hours; and/or a quarter inch or more of freezing rain accumulation (also referred to as "ice accretion").

5. Snowstorms

Snowfall, while lower here than in areas farther inland, is an important component of winter weather in East Providence. Seasonal snowfall averages 34 to 38 inches. Historically, storms featuring 6 inches or more of snowfall occur on average a little less than twice per season, while storms of 10 inches or more have occurred an average of about four times in ten years. Nearly every year, storms in East Providence start as snow and then change over to rain, commonly after a few inches of snow accumulation. The impact of these "changeover" storms depends heavily on temperatures just prior and immediately following the storm, as well as how far above freezing temperatures get while rain falls. On occasion, hard freezes immediately follow these changeover storms, disrupting transportation until roads can be treated.

Location
The entire City is equally prone to heavy snowfalls due to the large regional scale of these storms.

Extent
The City has experienced the closing of schools and businesses, disruption of transportation systems, fallen trees/wires leading to power outages, dangerous road conditions and roof collapses from snowstorms, as well as local flooding resulting from rapid snow melt. The Blizzard of 1978 remains the highest impact snowstorm to hit the Rhode Island area in the modern era. City schools, businesses, and roadways were closed for many days as a result of nearly 3 feet of snow and strong winds. During the storm, the Washington Bridge, which is the main transportation route to the State's hospitals from the East Bay, was closed. Another major impact storm was the "April Fools Storm" in 1997, when 18 inches of windblown wet snow that immediately following heavy rain closed roadways and took down power lines causing numerous outages. This storm also resulted in three school "snow days" to start the month of April.

Recent Occurrences

Date	Event	Comments
1/12/2011	Heavy Wet Snow	Second and higest impact of 3 snowfalls of around a foot in East Providence during this winter. Snowfall was lighter to the east and heavier just west of the City. This wet snowfall came in two bursts, prolonging snow removal efforts.
1/27/2011	Heavy Wet Snow	Wet and heavy snowstorm brought another 12 inches across the City with increasing concerns about roof collapses as snow continued to pile up. There was one partial roof collapse at a vacant shopping plaza unit in Riverside.
2/8/2013	Blizzard	"Blizzard of 2013" brought 20 inches of snow, mostly very heavy and wet, knocking out power to over 3/4 of the city at one point. A quick hard freeze followed, then a brief thaw which resulted in some street flooding.
1/26/2015	Blizzard	Huge nor'easter brought widespread very heavy snow and strong winds across the region. Snowfall of about 20 inches and winds gusting to 50 mph caused heavy drifting snow, but very cold temperatures prevented accumulations on elevated surfaces and there were no power problems.

2/14/2015	Heavy snow	Another in a long sequence of snowstorms dropped 10 inches of snow locally but much more toward Boston. This storm left the area with close to 30 inches of snow on the ground and increased roof loading concerns. Prolonged cold and additional snowfall would maintain snowcover in the area until the end of March.
1/7/2017	Heavy snow	A strong nor'easter brought the heaviest snowfall in nearly 2 years at around 14 inches.
1/4/2018	Heavy snow	Snowfall of around 14 inches in the middle of a prolonged Arctic cold outbreak caused dangerous road conditions as the extreme cold made it difficult to remove the bottm layer of packed snow and ice for several days.
3/13/2018	Heavy snow	About 10 inches of heavy wet snow and gusty winds resulted in widespread power outages across the regions.
1/29/2022	Blizzard	A major nor'easter brought widespread snowfall of 1-2 feet in eastern New England. Strong winds and very cold temperatures caused bliizard conditions for a number of hours. Power outages were confined to the Cape Cod area where temperatures were closer to the freezing point.

Table 10. Major Snowstorms from 2010-2022

Lesser storms can also cause major problems, as witnessed by a short-duration yet intense 10 inch snowfall in December 2007 that caused traffic jams lasting up to 8 hours in the Providence area when many schools and businesses released students and workers at once.

Most Recent Major Snowstorms

Blizzard of February 8-9, 2013

This well-predicted storm brought 18 to 20 inches of snow to the City, most of which occurred with temperatures at the freezing point, making it a very heavy, wet snow. Snow fell at a rate of 2 to 3 inches per hour with winds gusting to 50 mph at the height of the storm. This resulted in many downed branches and power lines along with transformer damage on utility poles. At one point, 78% of the City was without power and temperatures had dropped into the teens. The thick, slushy snow followed by a hard freeze during the storm created an extremely difficult snow removal operation; and while most power was restored by the morning of February 10th, there were some homes out for another two days. Fortunately, traffic problems were minimized as the storm started slowly and most people made it home before the very heavy snow arrived. This storm illustrated that power outages in cold weather are a driver of storm shelter use.

Blizzard of January 27-28, 2015 and Subsequent Storms

The January blizzard in 2015 also brought around 20 inches of snow and strong winds to the area. Advanced warning was limited for this storm as it was poorly modeled until about 48 hours ahead of time. It also differed from the 2013 storm in that temperatures throughout the storm were between 15 and 20◦F. This meant little or no snow accumulated on trees and power lines and there were no power issues in the City. School and business operations were interrupted and, as lesser snowstorms continued on a twice a week pace into early March, snow depths reached levels that are rarely seen in southeastern New England. Additionally, February of 2015 was the second coldest month on record for our area, with several mornings seeing temperatures below zero. Concerns around snow loading on roofs increased as snow piled up during the month, and eventually a couple of the City's schools had snow removed from their roofs upon inspection of those buildings.

Blizzard of January 29, 2022
This storm was unique in that it was a relatively quick hitter with most of the close to 20 inches of snow falling in about 12 hours, and also that it produced blizzard conditions for many hours. The storm was well-advertised and occurred on a Saturday, reducing school and workplace impacts. Non-essential travel was banned for the duration of the storm and many businesses closed for the day resulting in significant economic loss for area businesses.

Probability of occurrence
Given the frequency of accumulating snow during the winter season and the likelihood of several large storms occurring in any given five-year period, snowstorms are considered to have a high probability of occurrence in East Providence.

6. Ice Storms

Icing, generally thought of as an accumulation of ice on surfaces such as streets, trees, and power lines, occurs on occasion in southeastern New England but is much more likely farther inland (see "Location" discussion below). Icing is caused during rainfalls when temperatures are below freezing near the ground (and above freezing in a layer above ground).

"Black Ice," consisting of condensation then refreezing on pavements as air warms up after a cold snap is not common locally but is very dangerous when it does occur, causing serious accidents due to unseen ice on roadways. This phenomenon occurs much more frequently in colder areas in the interior Northeast and in other colder climate regions. The term "black ice" is now liberally used to describe all instances of ice on roadways including frozen puddles, evening re-freezing of snowmelt on roadways, and more, which are very common locally. DPW crews must often treat City streets for these occurrences. In any case, notification of black ice indicates the likelihood of hazardous icy roadways, which can develop without warning particularly when driving or walking at night.

Location
Severe ice storms are uncommon in East Providence due to the proximity to the relatively warm ocean water found along the south coast. Icing is more common across northwestern Rhode Island, and occurs much more frequently farther north and west especially from Worcester County, MA through the Connecticut River Valley in Massachusetts and northern Connecticut. Recent examples of ice storms in southern New England, both from the Worcester County area, include a widespread major ice storm from Worcester and northward into southern New Hampshire in December 2008, and a more localized ice storm incident in the Worcester area that caused a 65-vehicle pile-up in December of 2013. The 2008 ice storm left some homes in northern Worcester County without power for weeks.

Extent
Ice storms can be devastating 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. Fortunately, severe ice storms are a rarity in our area. The greatest threat from ice storms, in addition to motorist safety, is to essential utility and transportation systems, or "lifelines." Ice coats power and communications lines, trees, highways, bridges and other paved surfaces. Ice-weighted wires, antennae, and structures holding them can break and collapse. Downed trees and limbs can

also damage lines and block transportation routes and put pedestrians and automobiles passengers are at risk.

Previous Occurrences
A widespread ice storm in January of 1978 caused significant damage in the Providence area including downed power lines and tree damage and ice accretion of about a half-inch. This may be the heaviest storm with ice accretion to occur in East Providence in the last 50 years. Another notable storm occurred in January of 1994, affecting mostly southern portions of the City. In northern East Providence, glazing was lighter due to more sleet and snowfall on this occasion. This storm illustrated the localized nature of many icing incidents. Ice resulting from rapid temperature falls following a winter storm is a more common public safety hazard, especially from around late December through late February. An extreme recent incident of this type occurred on Valentine's Day of 2007, when 2.4 inches of cold rain on frozen ground was followed by an instantaneous drop in temperature into the 20s, resulting in a "flash freeze" that caused hundreds of accidents across the State within minutes as streets and highways froze instantaneously. More recently, a mix of sleet and freezing rain, late in what had been a rain storm on February 5, 2022, caused very icy roads and walkways as frigid weather immediately followed the storm.

Probability of Future Events
The NCDC does not identify any incidents of icing in Rhode Island since 2000 in their storm database, though icing has occasionally occurred on a localized basis. Given the infrequent occurrence of ice storms that cause a significant accretion of ice on elevated surfaces, the probability of future severe occurrences in East Providence is considered to be medium. Impact would be very high in the rare event if a lengthy period of ice accretion were to occur.

7. Extreme Cold

Description
Southeastern New England is generally protected from prolonged extreme cold due to a number of factors including proximity to the coast, modification of Arctic air by the Great Lakes, and the fact that air warms as it descends off of the higher terrain to our west and north. One factor *not* in our favor is that our coldest weather is often accompanied by wind, which compounds the effect. Most years, our coldest stretches of weather last for only a few days at a time. The coldest days locally generally have a high temperature in the teens. The coldest winter temperature in East Providence is below zero in about one year out of three, though 2015 saw at least six mornings with a low temperature below zero in parts of the City.

Location
Occurrences of extreme cold are regional or larger in scale and, as a result, will affect the entire City when they occur.

Extent
The greatest danger from extreme cold is prolonged human exposure, which can cause frostbite or hypothermia and become life threatening. The risk of hypothermia due to exposure greatly increases during episodes of extreme cold, especially when accompanied by wind. Infants and elderly people are most susceptible. House fires and carbon monoxide poisoning are also possible if people use supplemental heating devices improperly. Also possible during cold spells of unusual duration is damage to marine infrastructure, including docks and moorings, if there is significant

formation of ice in tidewater areas. A few tide cycles of rising and lowering ice can dislodge these structures from their anchoring systems.

An additional consequence of extreme cold is frozen water pipes. This is not a common occurrence locally, but does occur during the unusual occasions when temperatures get well below zero. Low temperatures approaching 10 degrees F. below zero produce a spike in frozen pipe incidents. Shutting the valve to the outside faucet for the winter and protecting it with a low-cost outside faucet cover will lower the possibility of such an incident.

The very coldest individual nights, where temperatures reach close to -10 degrees F, occur in East Providence on an average of about every 10 years. The coldest temperature recorded at T.F. Green Airport in the period of record dating back to 1904 was -17 degrees F in February of 1934.

Previous Occurrences

Brief cold spells where temperatures bottom out near or a little below zero happen every winter. Periods of prolonged below-average temperatures are unusual due to the nature of averages, for one, and the fact that coastal regions are less prone to extreme temperature than interior portions of the country. That being stated, there have been times where extended periods of unusual chill have occurred in southeastern New England. For purposes of documenting these periods for this Plan update, Table 11[14] (right) displays months when the average temperature has come in at less than 23 degrees F. at the official observation station at T.F. Green Airport. Such periods correlate well with development of significant tidewater ice. It is acknowledged that temperature patterns occur without regard to the monthly calendar, but all of these months represented periods of unusual and lasting cold. In some cases, including 1978, 1994, and 2015, the period of below-normal winter chill lasted two or more months; in others, including December of 1989, other winter months were much milder and came in well above normal on temperatures.

Month	Average Temp. (◦ F)
January 1970	19.6
January 1971	22.9
January 1977	20.9
February 1978	22.1
January 1981	20.3
January 1985	22.5
December 1989	21.8
January 1994	22.7
January 2004	21.4
February 2015	18.4

Table 11. Coldest months in the Providence area since 1970.

Probability of Future Events

At least brief periods of very cold weather occur nearly every year in our area, so the probability of occurrence is high. Severe impacts from cold air are not common. Tidewater ice formation sufficient enough to cause damage to marine infrastructure is assigned a medium probability as it occurs on average about once in 8-10 years.

[14] Source: NCDC climate records, East Providence EMA Winter Temperature Study.

8. Flood-Related Hazards

Photo 8. Ten Mile River flooding on Pawtucket Avenue, March 2010. Photo: East Providence DPW.

Flooding is a localized hazard that is generally the result of excessive precipitation, but can also be caused by a coastal storm surge. Flooding is the most commonly occurring natural hazard nationally and locally, due to the widespread geographical distribution of rivers and streams and coastal areas, and the attraction of human settlements to these areas. Floods are among the most frequently seen and most costly natural disasters in terms of human hardship and economic loss.

8a. Riverine Flooding

Riverine flooding is a function of precipitation and water runoff volumes within a stream or river. It is defined as the periodic occurrence of over-bank flows of rivers or streams resulting in partial or complete inundation of the adjacent floodplain. When land next to or within the floodplain is developed, these cyclical floods can become costly and dangerous events. In East Providence, areas along the Runnins River north of Route 195 and along the Ten Mile River, downstream from the Turner Reservoir Dam, are most prone to riverine flooding.

8b. Flash Flooding

A flash flood is the fastest-moving type of flood. It happens when heavy rain collects in a stream or gully, turning the normally calm area into an instant rushing current. Any flood involves water rising and overflowing its normal path. Flash floods appear and move quickly across the land with little warning, making them very dangerous.

Flash floods are the result of heavy rainfall concentrated over one area. Most flash flooding is caused by individual slow-moving thunderstorms, multiple thunderstorms that repeatedly move over the same area, or heavy rains from hurricanes and tropical storms. Dam failures can create the most damaging flash flood events (See Dam Failure section later in this Plan). When a dam or levee breaks, a large quantity of water is suddenly let loose downstream, destroying anything in its path.

Flash flood waters move at fast speeds. They have the power to move boulders, tear out trees, destroy buildings, and obliterate bridges. Walls of water can reach heights of 10 feet or higher, and generally carry a huge amount of debris with them. The best response to any signs of flash flooding is to move immediately and quickly to higher ground. Flash floods are not common in East Providence compared to more hilly areas of New England.

8c. Urban Flooding

Urban flooding occurs where there has been development within stream floodplains, or in other low areas that drain slowly. In many areas including parts of East Providence, floodways and wetlands that were at one time the natural storage basins for flood waters were filled to accommodate development. The price of this urbanization and accessibility to rivers and is an increase in the magnitude and frequency of floods via a greater amount of impermeable surface, increasing speed

of stormwater collection and reducing of “storage capacity” of the land, which can all combine to overwhelm stormwater and sewage systems. On occasion, when heavy rains occur, Rhode Island’s aging sewer systems or combined sewer overflows (CSOs) are overrun and this results in raw sewage flowing into Narragansett Bay, often creating Bay closures to shell-fishing and swimming.

8d. Coastal Flooding

Coastal flooding is typically a result of storm surge and wind-driven waves, which push water inland from the shore and erode the coastline. These conditions are produced by hurricanes (tropical storms) during the summer and fall, and nor'easters and other large coastal storms (extra-tropical storms) during the fall, winter, and spring. Storm surges (see below) push sea water up coastal rivers and inlets, blocking the downstream flow of inland runoff. Many acres of lands may be inundated by both saltwater and freshwater. Escape routes may be cut off, stranding residents in flooded areas and hampering rescue efforts.

8e. Storm Surge

The storm surge is potentially the most dangerous aspect of any hurricane. A storm surge is a dome of ocean water that can be up to 20 feet high at its peak and 50 to 100 miles wide over the open ocean. The surge has the potential to devastate coastal communities as it sweeps ashore. Historically, 9 out of 10 hurricane fatalities are attributable to the storm surge during a hurricane event. The Great New England Hurricane of 1938 and Hurricane Carol in 1954 stand out as two examples of storms where storm surges caused major devastation. These storms are still considered a model for what could happen locally from a direct hurricane hit. Not only do storm surges flood the areas and structures they affect, but the hydrostatic pressure from the rushing water and pounding waves can completely wipe out many structures and leave little behind.

Location – Storm Surges

The south coast of New England, including its bays and harbors, is particularly well-situated to receive the effects of hurricane storm surges. Locations to the right (generally east) of the storm track are most vulnerable to storm surges, as the counterclockwise circulation around storms drives winds and seas forward along with the storm’s movement. Shoreline areas of coastal bays and harbors like Narragansett Bay can experience higher storm surges than open coastal areas like the South County barrier beaches due to the tendency for water to “funnel” as the bay becomes narrower moving inland. This places East Providence in an area where the storm surge from a hurricane can push the water level to 10-15 feet or more higher than normal, with water velocity and wind-driven waves increasing the hazard. The City’s Hurricane Evacuation Zone Map, (See Appendix Map A-2), displays the best estimate currently available of the farthest extent of hurricane inundation by category of hurricane. Several factors play into the extent of storm surges beyond just wind speed including forward speed of the storm and the angle at which the storm makes landfall along the coast.

Mid-latitude storms including nor’easters are another (lesser) driver of storm surges in the South Coast region. While lower, these surges can cause significant coastal flooding on a non-routine basis as the storms can be slow-movers or even stall for a period of a few days. Storms of this type that are mostly likely to cause a surge affecting East Providence are “inside runner” storms that pass to our west, bringing a (usually brief) period of strong southerly winds that can top 50 mph. These incidents are high tide dependent, but can affect low lying areas including Watchemoket Cove, Bold Point and Sabin Point Parks, and the Narragansett Terrace beach and coastal bluff.

Location – General Flood Related Hazards

FEMA Flood Insurance Rate Maps (FIRMs) identify areas of the City that are within the 100 and 500 year flood plain. The 100-year and 500-year flood plains have an assigned probability of 1% and .2% of flooding during any given year, respectively. See Maps 1 and 2, "Risks in East Providence" and "Critical Facilities in East Providence," for areas within the City that are designated as 100 and 500 year flood plains and hurricane inundation zones. The following areas in East Providence have been identified by the Committee, in consultation with the Engineering Division of the DPW, as having a history of flooding caused by heavy rainfall and/or rapid snowmelt, or high tides/storm surge:

- Residential and commercial areas located north of Waterman Avenue, east of Rockaway Avenue, and west of Seekonk, Massachusetts border due to the flooding of the Runnins River (commonly referred to as the State Street neighborhood);
- Commercial area at the intersection of Commercial Way and Taunton Avenue due to a combination of heavy rains, low elevation, and poor drainage;
- Residential, private country club, and open space areas located along the Ten Mile River, either side of Pawtucket Avenue, east of North Broadway and north of Centre Street, including the Agawam/Fynn Playground, due to the flooding along the Ten Mile River. This includes a portion of Pawtucket Avenue;
- Commercial area along Newport Avenue between Moore Street and Vista Drive due to local poor drainage of heavy rainfall;
- Corner of Ferris Avenue and Circle Street due to local poor drainage of heavy rainfall;
- Western segment of Dewey Avenue due to local poor drainage of heavy rainfall;
- Residential area located between Grosvenor Avenue and I-195, west of North Hull Street, and east of North Rose Street due to undersized drainage lines located under I-195;
- Pawtucket Avenue in front of Bayview Academy due to poor drainage of heavy rainfall;
- Portion of Tripps Lane due to heavy rainfall;
- Veterans Memorial Parkway adjacent to Watchemoket Cove due to severe weather that coincides with high tides;
- The intersection of South Broadway and Lee Road;
- Sabin Point Park and surrounding area due to severe weather that coincides with high tides;
- Residential area along west shore of Bullocks Cove, and Crescent View Avenue in the area of the cove, due to severe weather that coincides with high tides; and
- Residential and commercial areas located east of Willett Avenue, south of Forbes Street, and north of Barrington town line due to flat terrain, poor drainage, and high water tables.

Extent – General Flood Hazards

Riverine, urban poor drainage and groundwater (generally basement) flooding are most common types experienced in East Providence and can cause major property damage; even leaving some homes uninhabitable until major repair work is completed to replace walls, floors, utility equipment and service, and necessary appliances. Riverine floodwaters, in particular, can carry chemicals, sewage, and toxins from roads, industrial properties, and farms; as such, property affected by the flood may be contaminated with hazardous materials.

High, wind-driven storm surges cause devastation of the areas they affect. As the surge moves inland, it carries with it most of the natural and structural debris that it took out closer to the shore, compounding its impact. The inland terminus of a major storm surge is marked by lines of this

debris, which can hamper rescue and recovery efforts in the stricken area. Debris lines can require an extended period of time to go through and clean up.

Recent Occurrences

Date(s)	Property Damage ($)	Remarks
3/15/2010	0	Third of series of heavy rain events, around 4 inches of rain, widespread urban flooding, minor to moderate flooding State Street neighborhood.
3/29 to 3/31/2010	32.5 M	Last of series of heavy rain events: up to 8 inches of rain. Widespread major to record flooding statewide. Major flooding, evacuations, damage in the State Street neighborhood. FEMA-Declared disaster.
9/8/2011	0	Cold front with moisture from Tropical Storm Lee cause widespread rain averaging 3-4 inches statewide. Local flooding mainly northern RI.
12/5/2011	0	Street/basement flooding, plus minor flooding in the State Street neighborhood. 2.5 inch rainfall following very wet late summer and autumn with rainfall 11 inches above average for that time period.
7/28/2012	40,000	Stalled cold front with locally heavy rain and areas of urban flooding.
6/7/2013	20,000	Widespread 3-5 inch rainfall from remnants of Tropical Storm Andrea caused local urban flooding.
8/31 to 9/2/2013	0	Stalled frontal system caused showers and thunderstorms over 3-day period, local urban flooding many locations Prov. area and East Bay.
7/28/2015	0	Stationary thunderstorms; up to 6 inches of rain to the East Bay. Brief widespread street flooding Bristol County RI and small part of Riverside near Barrington line. Little or no rain elsewhere in the City.
1/13/2018	0	Rainfall of over 3 inches and an additional inch of water content from melting snow, conbined with frozed ground, caused widespread urban flooding, and a quick rise in river levels caused flooding and street closures in the State Street neighborhood.
3/2 to 3/16/2018	0	Three major storms resulted in close to 5 inches water equivilent caus ing local river and stream flooding.
1/24/2019	0	Rainfall of over 2 inches was the last in a sequence of rainstorms going back 4 weeks that totaled over 9 inches of rain, causing urban and local river/stream flooding.
12/5/2020	0	Four storms over a two-week period dropped around 8 inches of rain causing urban and minor river flooding at common flood-prone locations.
12/25/2020	0	Three inches of rain combined with close to an inch water equivilent of snowmelt caused local flooding. River and stream levels were already higher than average given heavy rainfall in late November and early December.
9/3/2021	0	Rainfall of close to 4 inches from Tropical Storm Ida with rivers already running a little higher than normal for the season resulted in local urban flooding and very minor stream flooding.

Table 12. Flood events in Providence and Bristol Counties 2010-2021. NCDC.

The greatest coastal flood since 1900 was likely from the 1938 hurricane where a storm surge of 15 to as high as 20 feet pushed up Narragansett Bay. Worst-case scenario modeling of storm surge possibilities generally uses this event as the standard. The surge from Hurricane Carol in 1954 was almost equally high.

The March 2010 floods have come to represent the riverine flood of record for East Providence when 19 inches of rain over a period of 5 weeks resulted in river levels about 7 feet higher than average for that time of year.

Probability of Future Events
Given the frequency of flooding incidents in recent years and the proximity of residential and commercial areas to floodplains, the probability of at least a minor flood event of any type in East Providence is determined to be high. Table 12 on Page 44 lists some recent flooding events in the Providence and East Bay areas.

Specifically regarding types of floods, the probability of impact storm surge flooding in any given year is medium, but that impact would be very high if it were to occur. The probability of riverine flooding is medium, with impacts also potentially high. Urban/poor drainage flooding has a high probability of occurrence and can be expected most years, but in general the impact is lower and felt on a smaller and localized scale.

9. Coastal Erosion

Description
Coastal zones are dynamic areas that are constantly undergoing change in response to a multitude of factors, wave and current patterns, hurricanes, coastal flooding, and human influences including sea level rise.

Erosion has been wearing away bluffs and moving beaches and barriers along coastal areas from the powers of flooding, storm surge, rising sea levels, and high surf. In addition to these natural processes that cause erosion, human alterations are affecting erosion rates. As shorelines retreat inland, waterfront homes, and public infrastructure, such as roads, bridges, wastewater treatment facilities, and stormwater drainage systems, eventually become severely damaged. Most damage from coastal erosion will occur in low-lying areas, which are areas subject to the highest risk of flooding. Additional damage will also occur along coastal bluffs as high waves reach the shoreline and erode the toe of the bluff, with gravity taking its course.

Location
While all shoreline areas in East Providence are subject to erosion from storm surges and strong wind-driven waves, the most significant problem area for coastal erosion in East Providence is along the western shore of the City, south of the City's Wastewater Treatment Plant in Riverside. The entire residential area facing westward across the Providence River and Narragansett Bay south of this facility consists of a steep coastal bluff that is generally 25 to 35 feet above sea level. For the most part, areas in the floodplain along the remainder of the City's shoreline are undeveloped.

Extent
Coastal erosion threatens many residences in the southern portion of the City, as noted above. Some residents have undertaken approved measures to slow the erosion on individual properties,

but a substantial hurricane storm surge will almost certainly place some homes in danger of serious damage or destruction resulting from undermining of the coastal bluff. Farther north along the waterfront, recreational facilities including parts of the East Bay Bike Path could be damaged or destroyed by a storm surge and debris that the surge brings with it. A couple of City owned, natural areas could be altered and have passive recreational use impacted. Areas along the waterfront in central and northern East Providence slated for future development will be at risk from coastal erosion as well. Development planning in these areas, with careful consideration of the associated risks, is being performed in cooperation with CRMC and other appropriate agencies.

There is little evidence of the amount of coastal bluff erosion from the hurricanes that have had the strongest effect on the City. In theory, a hurricane with high storm surge and wave action could erode segments of the two-mile long coastal bluff to an extent that would undermine a number of homes close to the bluff edge. This would depend upon factors including distance of structure from the edge, nearby bluff hardening features, and the directional orientation of the bluff at any given point.

Previous Occurrences and Probability of Future Events
As noted above, damaging coastal erosion in the City has not been specifically documented, but all strong tropical systems hurricanes and the occasional major mid-latitude storm system can be expected to result in at least minimal coastal erosion, and hence erosion is assigned a medium probability of occurrence.

10. Sea Level Rise

Description:
A very gradual rise in sea level has been documented over the last century or so, based on increasing incidents of routine tidal flooding at very low points along the Rhode Island shoreline and also on the long record of the Newport and Providence tide gages. The rise in sea level can be attributed primarily to two factors: Warming air and sea temperatures contributing to increased melting rates of ice sheets and mountain glaciers, particularly in Greenland and Antarctica, and "thermal expansion', or the fact that warm water is more expansive than cold water[15]. Sea level as measured by the Providence tide gage rose at an equivalent rate of .79 feet per 100 years from 1938 through 2020[16], with many projections indicating that the rate sea level rise will increase during the upcoming decades. Sea level rise should be a consideration in long-term land use planning with respect to future development, transportation, consideration of critical facilities, protection of open space, and storm impact planning.

Location
All areas of the City adjacent to tidewater are prone to sea level rise and will be affected as routine water levels gradually reach higher levels than currently evident.

Extent
Rising sea levels will have impacts on important transportation routes in and adjacent to East Providence, most notably including:

- Veterans Memorial Parkway at Watchemoket Cove,

[15] http://www.beachsamp.org/wp-content/uploads/2016/09/climate_SLR_factsheet2013.pdf
[16] https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8454000

- Crescent View Avenue at Bullocks Cove
- Mink and School Streets from Wampanoag Trail to the Seekonk line; and
- Water Street and adjacent section of Waterfront Drive
- Wampanoag Trail near the Barrington line; and
- Wampanoag Trail in Barrington, impacting transportation into East Providence and evacuation routing.

Other expected impacts in East Providence from sea level rise include:

- Increased routine high tide flood threats to coastal properties;
- Increased impacts from severe storm events including hurricanes, and eventually from more routine storm events;
- Increased coastal erosion resulting from higher base water levels;
- Protective salt marsh degradation, particularly along the lower portion of the Runnins River above Hundred Acre Cove; and
- Threats to non-transportation critical infrastructure including some water and wastewater infrastructure.

The Rhode Island Division of Statewide Planning has produced a Coastal Sea Level Rise Transportation Fact Sheet[17] for all 39 municipalities in the state. This seven-page document includes a quick sea-level rise overview along with maps and lists or transportation infrastructure this is vulnerable to sea level rise, 100-year storm surge events, and combination of both. This is a valuable reference for long-term coastal planning with regard to future sea level rise.

Previous Occurrences Probability of Future Events

As noted above, sea level has risen at a rate of around 8 inches per 100 years at Providence since 1938, which is very likely representative of sea level change along the East Providence shoreline. Most indicators suggest that rate of change in sea level rise is gradually increasing, with little or no indication of a decreasing rate of rise or a leveling off. Forecasts of the amount of sea level rise through 2025 and through 2100 vary, but a continued rise is fully expected which will have impacts on East Providence as above. It will become increasingly important for policy makers to account for sea level rise with regard to long term planning for coastal areas of East Providence.

11. Dam Breach

Description

Dam failures can result from natural events, human-induced events, or a combination of the two. Failures due to natural events, such as prolonged periods of rainfall and flooding, can result in overtopping, which is the most common cause of dam failure. Overtopping occurs when a dam's spillway capacity is exceeded and portions of the dam that are not designed to convey flow begin to pass water, erode away, and ultimately fail. Other causes of dam failure include design flaws, foundation failure, internal soil erosion, inadequate maintenance, or misoperation. Complete failure occurs if internal erosion or overtopping results in a complete structural breach, releasing a high-velocity wall of debris-laden water that rushes downstream, damaging or destroying everything in its path.

[17] http://www.planning.ri.gov/documents/sea_level/fact/EastProvidencefs.pdf

Location

Dams are categorized by the hazard that their failure would present in the community. The definition of a High Hazard Dam is "a dam where failure or misoperation will result in a probable loss of human life." [18] There are two dams in the City of East Providence that are categorized as "High Hazard Dams;" the City-owned Turner Reservoir Dam and the Bucklin Point Dam, both in Rumford. The Turner Reservoir Dam, located along the Ten Mile River along the City's eastern boundary, impounds the Turner Reservoir and, to some extent, Central Pond, which is immediately to the north of the reservoir. The Bucklin Point structure is a low impoundment of shallow water located within the Narragansett Bay Commission's Bucklin Point Wastewater Treatment Plant property.

Photo 9. Turner Reservoir Dam. Photo: Wayne Barnes

Neither of the high-hazard dams was deemed to be "unsafe" in the latest available report on the statewide Dam Safety Program, released in July of 2021.

Other City-owned dams, also along the Ten Mile River, include the Hunts Mills Dam and the Omega Pond Dam. The former is a low horseshoe-shaped structure located just above a short stretch of rapids and roughly one-quarter mile downstream of the Turner Reservoir, and the latter is a 10-foot high structure located at the point where the Ten Mile River spills into the tidal Seekonk River.

A complete list of dams in East Providence as provided by the Rhode Island Department of Environmental Management's Dam Safety Program (Office of Compliance and Inspection) is found below.

EAST PROVIDENCE	TEN MILE RIVER	CENTRAL POND	404	LOW
EAST PROVIDENCE	TEN MILE RIVER	HUNTS MILL POND	405	LOW
EAST PROVIDENCE	TEN MILE RIVER	OMEGA POND	406	LOW
EAST PROVIDENCE	TEN MILE RIVER	JAMES V TURNER RESERVOIR	407	HIGH
EAST PROVIDENCE	RUNNINS RIVER	STANDARD OIL POND	410	LOW
EAST PROVIDENCE	SEEKONK RIVER-TRIB	BUCKLIN POINT	446	HIGH
EAST PROVIDENCE	WILLETT BROOK	WILLETT POND UPPER	590	LOW
EAST PROVIDENCE	WILLETT BROOK	WILLETT POND LOWER	591	LOW
EAST PROVIDENCE	CENTRAL POND-TRIB	HASBRO	659	LOW
EAST PROVIDENCE	RUNNINS RIVER-TRIB	GATE OF HEAVEN CEMETERY	660	LOW

Table 13: RI Department of Environmental Management 2020 list of dams in East Providence including hazard category. Source: http://www.dem.ri.gov/programs/benviron/compinsp/pdf/damlist.pdf , accessed February 23, 2022.

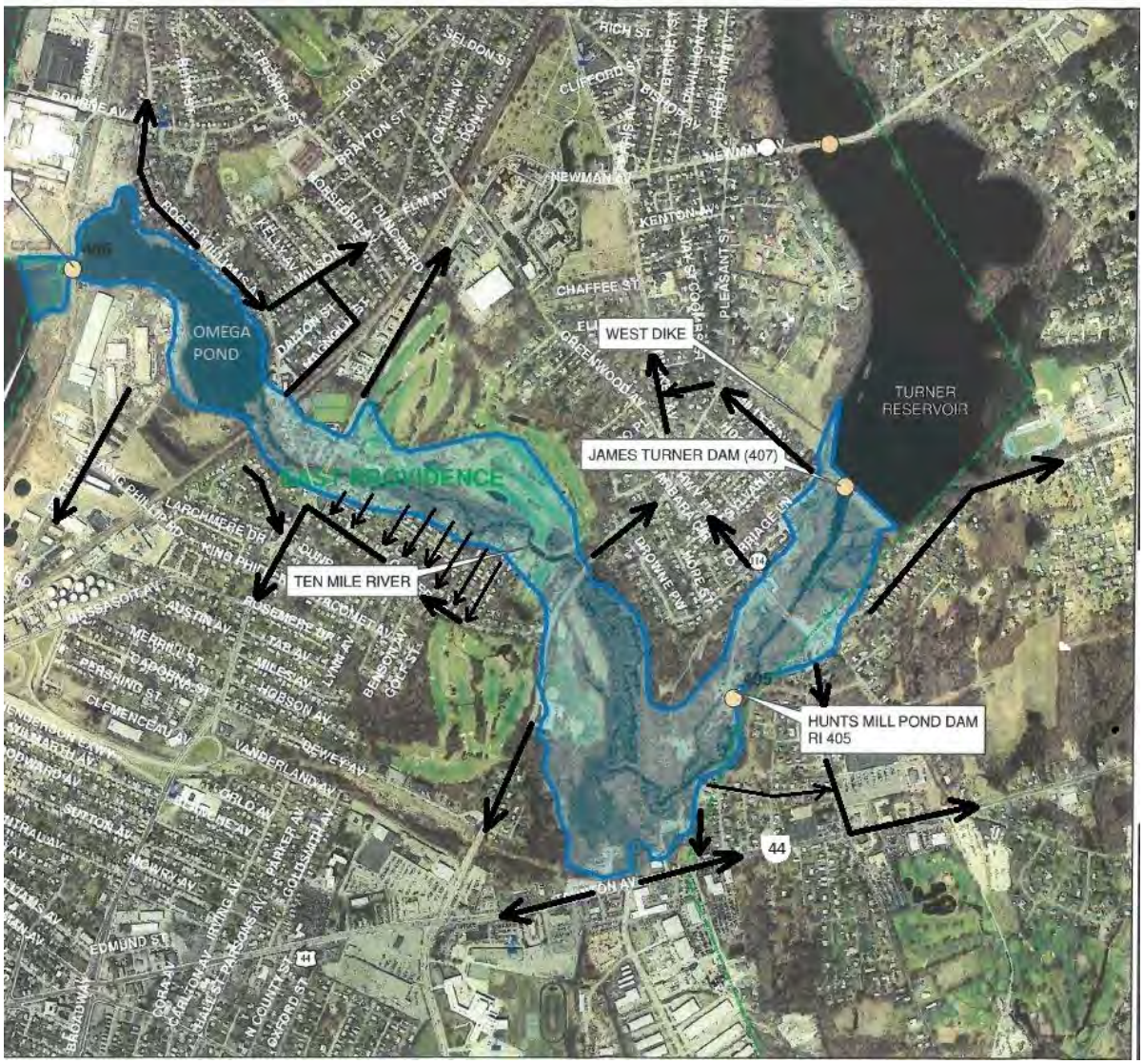
[18] RIDEM, 2020 Annual Report to the Governor on the Activities of the Dam Safety Program, http://www.dem.ri.gov/programs/benviron/compinsp/pdf/damrpt20.pdf . Accessed February 24, 2022.

Extent

Failure of the Bucklin Point Dam would affect the treatment plant itself with obvious secondary effects on the large population served by the plant, along with a significant environmental impact on the Seekonk River and the Providence River/uppermost Narragansett Bay.

Failure of the Turner Reservoir Dam would be a much more substantial disaster, affecting the recreation area at Agawam Playground and numerous homes near the river along Pawtucket Avenue, north of Centre Street, and along Roger Williams Avenue, and would also cause extensive damage to the Agawam Hunt Club Golf Course. Flooding would also likely occur across Route 44 (Taunton Avenue) and affect part of the Commercial Way industrial area. There is an updated Emergency Action Plan (EAP) for the Turner Reservoir Dam that is maintained by the East Providence Emergency Management Agency. This plan includes the inundation and immediate evacuation route map below.

Turner Reservoir Emergency Action Plan - Evacuation Routes



Map 3- DEM-derived Turner Reservoir Dam failure inundation zones and immediate evacuation routes.

The inundation map above was developed and provided by the Rhode Island Department of Environmental Management's Dam Safety Program (Office of Compliance and Inspection). Suggested evacuation routes immediately out of the inundation area (black arrows) were added by East Providence Emergency Management.

Previous Occurrences
There are no known occurrences of dam breaches in East Providence. All structures have held up well historically including during the record-setting March 2010 floods.

Probability of Future Events
The probability of a high-hazard dam break in the City is considered to be low, but the City will continue planning and preparedness activities in the event of an incident, with EAP development including response protocols.

Geologic Related Hazard

12. Earthquakes[19]

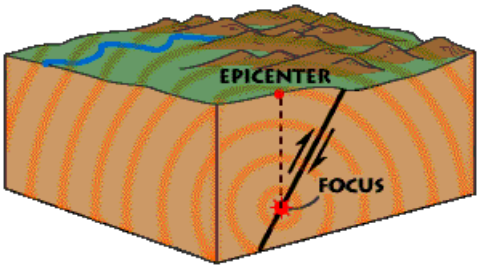


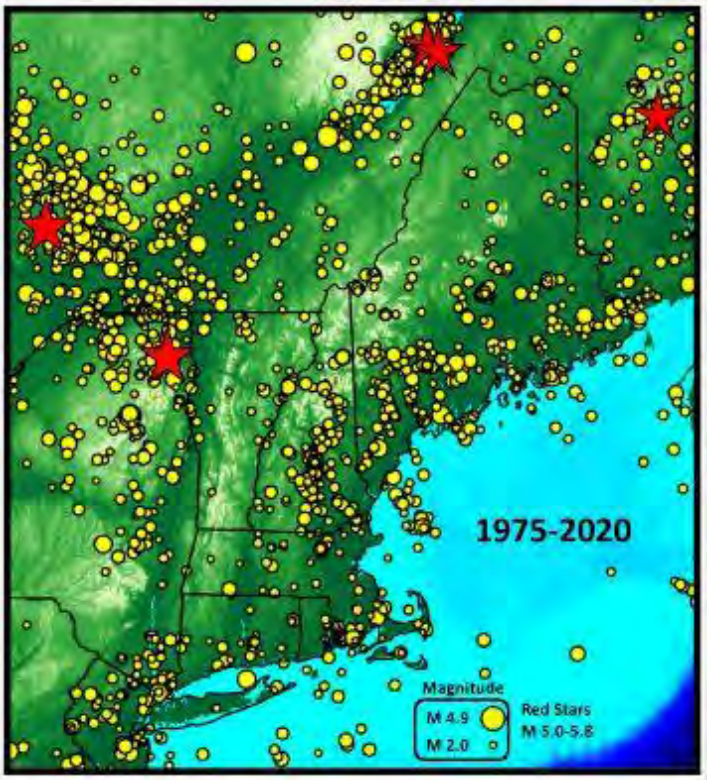
Figure 1. Earthquake epicenter diagram.

An earthquake is a sudden rapid shaking of the earth caused by the shifting of rock beneath the earth's surface. Larger earthquakes usually begin with slight tremors but rapidly take the form of one or more violent shocks, followed by vibrations of gradually diminishing force called aftershocks. The underground point of origin of an earthquake is called its focus; the point on the surface directly above the focus is the epicenter. The magnitude and intensity of an earthquake is measured by the Modified Mercalli Intensity (MMI) scale and the better-known Richter scale (see Table 13 on Page 53).

Location
Rhode Island is located on the North Atlantic tectonic plate and is in a region of relatively low seismicity. Only three or four earthquakes of Richter Scale 4.5 or greater have been centered in Rhode Island, including a 1951 South Kingstown earthquake of magnitude 4.6. and other past earthquakes centered in Narragansett Bay. Because of this low seismic level, there is a perception that the State has little risk of sustaining any earthquake induced damage. However, areas geographically close to Rhode Island have had moderate seismic activity historically. For example, the area off Cape Ann, Massachusetts has had several large earthquake events within the past 300 years. An earthquake of high intensity in that general location has the potential to cause damage to structures in Rhode Island not designed to withstand seismic loadings.

[19] Description and diagram: "Earthquakes Hazards," The Northeast States Emergency Consortium, accessed November 16, 2015, http://nesec.org/earthquakes-hazards/.

The largest earthquake to affect the southeastern New England area in several decades occurred in November of 2020 when a magnitude 3.6 earthquake occurred along the shore of Dartmouth, MA. It was felt as far away as Long Island, the Connecticut Valley of Massachusetts, and southernmost New Hampshire. The quake displaced 9 families in New Bedford due to building structural damage.



Other parts of New England more prone to (mostly minor) earthquakes historically include central and southern Maine, the Merrimack Valley of New Hampshire and northeastern Massachusetts, south coastal Massachusetts, and the central Connecticut shoreline area. Areas just outside of New England that have a greater frequency of earthquakes include the New York/New Jersey border region, northeastern New York through easternmost Ontario and southwestern Quebec (the "Western Quebec Seismic Zone"), the St. Lawrence Valley near and northeast of Quebec City, and New Brunswick province.

Map 4. Weston Observatory Network Seismicity New England area map:
https://www.bc.edu/bc-web/schools/mcas/sites/weston-observatory.html

About a dozen earthquakes affected a small area around Plainfield, CT, just west of the Rhode Island border in January of 2015, with smaller follow-up tremors into February. The largest of those quakes measured a 3.1, enough to shake pictures off of walls in some residences in the southeastern Connecticut area.[20] This area was previously not distinguished for having enhanced seismic activity, which further illustrates that no part of New England including Rhode Island is immune to quakes sufficient to cause at least minor damage.

Extent

Earthquakes can cause buildings and bridges to collapse, disrupt gas, electric, and communications lines on a large scale, and often cause landslides, flash floods, fires, avalanches, and tsunamis. Transportation systems can also be greatly affected as road and railroad tracks can sustain severe damage. Effects can be far-reaching; larger magnitude earthquakes (especially magnitude 5.0 and higher) even in more distant locations like southern Quebec and Ontario, northern New York, and northern New England have caused at least some minor structural damage in Rhode Island. It is

[20] John Penney, "1.5 Magnitude quake confirmed in Plainfield." *Norwich Bulletin*, February 24, 2015. Accessed August 19, 2015, http://www.norwichbulletin.com/article/20150224/NEWS/150229751/1994/NEWS?rssfeed=true.

estimated that earthquakes of the magnitude of the Dartmouth, MA earthquake in November of 2020 have occurred about 9 times since the 1700s[21].

Richter Magnitude Scale	Modified Mercalli Intensity Scale
1.0 to 3.0	I
3.0 to 3.9	II to III
4.0 to 4.9	IV to V
5.0 to 5.9	VI to VII
6.0 to 6.9	VII to IX
7.0 and Higher	VIII or Higher
Defined Modified Mercalli Intensity Scale Rating	
I	Not felt except by a very few under especially favorable conditions
II	Felt only by a few persons at rest, especially on upper floors of buildings
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. Vibrations similar to the passing of a truck.
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 buildings 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
VIII	Damage slight in specially designed structures; considerable damage 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 are distorted. Objects thrown into the air.

Table 14. Richter Magnitude and Modified Mercalli Intensity Scale[22]

A statement can be made regarding likely general impacts of a significant earthquake in close proximity to the City. Damage to underground utility infrastructure would be expected, including water and natural gas lines, likely reaching well into the millions of dollars and requiring years of recovery. This would impact supplies of potable water and increase the structural fire threat and the capability to extinguish those fires. Earthquake-initiated fires are a main cause of destruction of buildings immediately after a major quake. A majority of casualties resulting from an earthquake are caused by falling objects. Older masonry buildings, including some churches, former mill buildings, and many of the City's public buildings, would be particularly vulnerable to non-fire related structural damage from earthquake activity. City roadways would be subject to fracture and some roads could be damaged to the point of closure and the need for repairs in the millions of dollars.

Another probable impact of a significant earthquake is anxiety among residents, especially those in senior high-rises where the effect would be felt more. Public recognition of the earthquake threat is very low in Rhode Island. There are a number of relatively simple tasks that occupants of buildings,

[21] https://www.nbcboston.com/news/local/earthquake-reported-in-massachusetts-on-sunday-morning/2226075/
[22] "Rhode Island State Hazard Mitigation Plan 2014 Update," Rhode Island Emergency Management Agency

both residential and commercial, can undertake to create a safer environment in the case of an earthquake including securing items on shelves, securing tall bookcases to walls, and using care in the storage and display of breakable items, such as glass and china.

Previous Occurrences
The New England Seismic Network (see Figure 4 on Page 52) maintains a chart of all detected recent earthquakes on its website.[23] This chart reveals how remarkably frequent minor earthquakes are in the northeastern U.S., nearby southeastern Canada, and the near-shore waters of the Atlantic. There has been no history of an earthquake epicenter in East Providence.

Probability of Future Events
Earthquake events do occur in Rhode Island, though of less intensity than elsewhere in the region and much less intensity than in other parts of the country, including the West Coast and parts of the Mississippi Valley. 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 somewhere in New England, in a 50-year period. The probability of a damaging earthquake for the City is considered to be medium, but clearly the impact would be major and possibly catastrophic if one occurs.

Additional Hazards

13. Wildfire

Description
Wildfires are fueled by natural groundcover, including trees, brush, and grasses, along with weather conditions. While available “fuels” (defined as “all combustible material”) and dry and/or windy weather provide the conditions that allow wildfires to spread, most wildfires are caused by people through criminal or accidental misuse of fire.

Climatic and meteorological conditions that influence wildfires include the amount of sunshine, the 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, relative humidity below 20%, and combustible material type.

Location
Wildfires are a common hazard in the western part of the country. Wildfires are also a potential issue in the rural/urban interface of the eastern United States as well, including Rhode Island. Higher risk areas in Rhode Island are generally rural areas away from the greater Providence urban core.

There *are* areas throughout the City where brush fires may occur including undeveloped areas adjacent to the East Bay Bike Path and the Ten Mile River Greenway. Access for larger fire apparatus is difficult in these areas; but smaller Department equipment can access all areas as necessary.

[23] The New England Seismic Network. http://aki.bc.edu/cgi-bin/NESN/recent_events.pl.

Property owned by a major fuel distribution interest, bordered by the Wampanoag Trail, Forbes Street, and Pawtucket Avenue in south-central East Providence, encompasses an area of 850 acres. Close to half of this land is developed and utilized for business operations. The remainder of the property is largely wooded, but the risk of a large-scale brush fire threatening any of the buildings or operations is minimized as areas around the buildings dock and storage tanks have been cleared of brush and overgrowth. In the event that a large-scale brush fire does occur, there are numerous hydrants surrounding the property and on-property to provide adequate water for extinguishment, as well as 24/7 onsite security. Brush fires on the property are rare.

Extent

During periods of extended drought, the probability of forest and brush fires increases. The transition period from late winter into spring before the annual spring green-up is considered "brush fire season" in southern New England. This period of higher brush-fire risk occurs on average from mid to late March through April. This risk is somewhat weather-dependent; it is enhanced by unusually dry early spring weather and partially mitigated when overcast and wet weather prevails at this time, or when snow cover lingers well into March. A severe wildfire in East Providence could result in over 400 acres of burned area near the large fuel distribution company.

Previous Occurrences

The NCDC reports no wildfire events for Providence or Bristol Counties in recent years.

Probability of Future Events

The probability of wildfire development in East Providence is considered to be low.

14. Drought

Description

Drought is characterized as a continuous period of time during which rainfall is significantly below the average for a particular area. 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 it is not something that occurs 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.

Four methods are used to define the severity of drought: meteorological, hydrological, agricultural, and socioeconomic. Meteorological drought refers to a reduction in the normal rainfall for a given geographic area. This needs to be area-specific, as the average rainfall can vary greatly in different areas. Hydrological drought is based on the amount of surface and groundwater relative to normal levels. Agricultural drought deals with the amount of moisture in soils available for plants. The last, socioeconomic drought, measures the impact that any or all of the first three have on people and businesses.

There are currently three national commonly referenced drought monitoring resources, including:

- The Palmer Drought Severity Index (PDSI) displays long-term drought, which for many years has been a closely-watched staple indicator in the agricultural commodities industry;
- The Crop Moisture Index (CMI), derived from the Palmer Index, is a shorter-term indicator by country or county sub-district, used almost exclusively for agricultural purposes; and

- The U.S. Drought Monitor, developed in 1999 and using a combination of drought indicators with significant human input, which is tooled for both agricultural and water supply purposes. This is perhaps the most useful indicator of drought conditions for our area.

The U.S. Drought Monitor is highlighted on the U.S. Drought Portal website, http://www.drought.gov/.

Location
Past drought events have affected all of Rhode Island. As drought occurs on a large scale, there are no specific parts of East Providence that are more, or less, drought prone.

Extent
Rainfall in East Providence averages about 47 inches a year, which generally ensures a plentiful water supply for the daily needs of the City's residents and businesses. The annual range of precipitation at T.F. Green Airport, dating back to 1903, includes a minimum or "driest" total of less than 26 inches in 1965 and a maximum or "wettest" total of nearly 68 inches in 1983. The former year was among a stretch of four below-average rainfalls from 1963 through 1967. This time period is generally considered the "drought of record" in the southern New England area. Shorter-term droughts where there has been a concern about water supplies in Rhode Island have occurred about every twenty years over the last century.

The City of East Providence is served by the Providence Water Supply Board (PWSB) and an estimated 95% of City residents are served by City water through the PWSB and the Scituate Reservoir, which has been a very reliable source of quality water over the years. In recent years, the greatest effect of prolonged below-average rainfall for the City of East Providence has been the imposition of partial outdoor watering bans, including odd-even calendar-day bans on activities such as watering lawns and washing vehicles, and this is very infrequent. Other impacts of drought include potential for water supply issues for the very small number of City residents not connected to the City's water supply, and water quality during the warm times of year in the City's freshwater ponds including Central Pond, the Turner Reservoir, and Willet Pond due to algae blooms that are not properly "flushed out" by the flow from upstream.

Lean rainfall in the first half of the growing season can lead to more gypsy moth caterpillar damage, damaging trees and allowing more sunshine to reach the forest floor, which dries out the underbrush and increases the wildfire threat.

Previous Occurrences

Precipitation varies notably from month-to-month in many years, but there have been some periods of several consecutive months with below or well below average precipitation. Among those periods in Rhode Island since 1990 are:

1995- The year started with 7 consecutive drier-than-average months (though January was just slightly dry) and a three-month period from mid-June through mid-September featured less than 4 inches of rain total (about 35% of the average for the time period). A wet fall mitigated serious drought, but the year came in at around 38.5 inches, or around 81% of normal.

1997- With rainfall of under 38 inches, this was the driest year since 1981. Relatively heavy rain in August helped to mitigate what was otherwise an extremely dry summer.

2016- All but three months featured below-average precipitation in Rhode Island. In much of the Northeast, the top level of soil was the driest since the 1990s. Crop yields were down, and water resources were impacted causing water-use restrictions in parts of the region.[28]

2020- Lean and infrequent rainfall across New England starting in late May led to record (30-year) low streamflows at many locations along with usually low groundwater levels by early Autumn[29]. It was also a hot summer with monthly average high temperature records set in parts of the region. Agricultural impacts were greater in northern New England, but there were communities region-wide that had to institute mandatory water restrictions. There were numerous small wildfires in RI due in part to unusually dry vegetation.

Probability of Future Events
The trend over the last 100-plus years has been for a gradual increase in the average annual precipitation in our area. That shift to wetter average conditions implies a lower frequency of drought occurrences, but recent wet and dry periods have illustrated that the variability in rainfall is increasing. Drought intensity and impacts, as a result, may not be mitigated to the extent that we may expect given increased rainfall averages. Based on recent trends, drought conditions with some impact have a medium probability and can be expected during most 10-year periods, perhaps more than once.

15. Extreme Heat

Heat waves occasionally affect the Providence area, and have occurred as early as the latter half of May and as late as the middle of September. Heat waves in New England are defined as three consecutive days where the high temperature equals or exceeds 90 degrees F. In general, early-season heat up through the first half of June is accompanied by relatively low humidity and is seldom more than an inconvenience. During an astronomical summer, starting around the Summer Solstice, high temperatures are much more likely to be accompanied by high humidity, which is more problematic for people who are not have proximity to air conditioning.

Location
Heat waves are a regional phenomenon and affect most of Rhode Island evenly. Coastal locations generally have the benefit of lower temperature extremes, but with similar or higher humidity. All of the City is equally subject to extreme heat.

Extent
Lengthy periods of extreme heat and humidity are uncommon in our area, compared to interior parts of the country including the Midwestern and Mississippi Valley states and parts of the Plains states. When Rhode Island does experience these conditions, young children and the elderly are most susceptible, as are outdoor workers. Additional, periods of heat and humidity often cause a degradation in air quality in urban areas, increasing complications for people of all ages with respiratory problems.

[28] https://www.nrcc.cornell.edu/regional/drought/pubs/assessment_2016.pdf
[29] https://pubs.usgs.gov/of/2020/1148/ofr20201148.pdf

Previous Occurrences
Perhaps the hottest stretch of weather over the last 50 years occurred in August of 1988, when high temperatures in the City reached 90 degrees or higher for 13 of the first 15 days of the month. On several of those nights, the lowest temperatures were only in the mid-70s. While this type of extended high heat and humidity period are very unusual, shorter stretches of heat and humidity can be expected in nearly every year in our area.

Recently, July of 2010 featured a four-day heat wave from the 4th through the 7th, including a high temperature of 102 degrees on July 6th. For several days following July 7th, very high humidity continued, effectively prolonging the period of problematic heat. During this time period, the City enabled the East Providence Senior Center and the Weaver Memorial Public Library to serve as "cooling centers" for people who needed to get out of the heat. This has become common practice and is announced on local media outlets, posted in City facilities, and on City Internet resources such as social media. The City will continue these practices during times of excessive heat in the future.

Table 15. Flood Zone and Hurricane Inundation Zone population estimates.

VE Zone	1,270
AE Zone	1,660
Total Flood Zone	2,650
CAT1 Indundation Zone	1,320
CAT2 Indundation Zone	2,410
CAT3 Indundation Zone	3,970
CAT4 Indundation Zone	8,280
City Population (2020)	**47,139**

Note: CAT1, etc, refers to projected inundation zones for Category 1-4 hurricane direct hits.

Probability of Future Events
As heat waves are regionally defined, occurring nearly every year, the probability of future occurrence is high. Very high-impact heat waves that last an extended period of time, accompanied by high humidity, have a medium probability of occurring in the future and can be expected once or twice 10 years.

Section 3.3 Vulnerability - Community Assets

3.3a Population

Depending upon the severity of a natural hazard, all residents of the City of East Providence are vulnerable; especially the elderly, disabled, and children in daycare facilities.

Flood and Storm Surge Studies
Recent storm surge research and improvements in elevation mapping locally and nationally has shown value in guiding decision-making with regard to areas and populations that would be affected by flood related hazards. Table 15 provides estimates of the population that resides on *parcels* within the city's AE and VE zones, the total Special Flood Hazard Area parcel population, and the population within the mapped Hurricane Inundation Zones. These estimates were produced through the use of inundation zone mapping, census data, and parcel data from the City Finance Department's Assessment Division[31]. Note that the Total Flood Zone (SFHA) population is somewhat lower than the sum of AE and VE zones;

[31] Estimates based on average number of persons per residential parcel City-wide and number or residential parcels in each zone.

this is due to certain properties being affected by both types of flood zone and these duplicate properties were counted once for this analysis.

Due to the City's shoreline topography, which features an elevated terrace especially along the Riverside shore, a large majority of actual dwellings within these parcels are above VE-zones.

The City is fortunate to have a large majority of its land area at an elevation higher than the SFHA elevations. Total floodplain acreage in the City is roughly 760 acres, which represents about 8.85% of the City's total land area. That being stated, a much larger portion of the City would be subject to flooding from a severe hurricane storm surge, or if long-term projected levels of sea level rise are realized.

Emergency Sheltering

Currently, there is one American Red Cross designated emergency shelter in the City. According to the American Red Cross, 25% of an area's population would most likely seek shelter from a major natural disaster. For example, if the southern coastline of the City required evacuation, only 25% of the residents living on the coastline would seek the safety of an emergency shelter. The remaining 75% would seek shelter with friends, families, or make other arrangements such as hotel accommodations.

The City will re-evaluate and improve ultimately improve its sheltering capability in the near future. East Providence has recently completed construction of a brand new high school, replacing the former High School Building which was a surveyed and designated Red Cross shelter. We will work with the Red Cross on recertification, or survey and designation of other facilities for emergency sheltering. We will also coordinate with RIEMA and the Red Cross on more complex aspects of sheltering, including provision of services for individuals with functional and medical needs, as well as pet sheltering.

Currently, the City can use the East Providence Senior Center as a smaller emergency shelter or as a spontaneous daily use "Personal Care Center" where residents can charge devices and receive a meal. The Senior Center has been made available for resident storm assistance on four occasions since 2010.

While improving sheltering capability may not meet the strict definition of "hazard mitigation" in the context of this Plan, the City considers strong sheltering capabilities for mitigating post-incident issues for East Providence residents, and in general as a crucial part of emergency planning.

3.3b Economy

Small businesses, such as small retail and service providers, are especially vulnerable to natural disasters considering they are extremely dependent upon the local infrastructure and support from the local population and/or government. Natural disasters not only have the potential to damage communication and transportation systems, but they are also capable of influencing local consumer confidence and spending patterns. Small businesses often have fewer resources at their disposal than the larger commercial and industrial enterprises that possess backup generators, comprehensive insurance policy coverage, and the capital resources required to rebuild or relocate, and can be especially vulnerable to natural disasters. The Planning Department and Emergency Management Agency have developed a strong working relationship with the East Providence Area Chamber of Commerce and we will utilize this relationship and other avenues to increase outreach to the local commercial sector.

Historically, advanced manufacturing, medical, financial services and social services have seen strong growth and the City expects to see continued growth in these employment sectors in the foreseeable

future. As an example, Igus Inc., a local manufacturer of chain cable carrier devices has significant expansion of their facilities in East Providence within the next 1 to 2 years.

There are also several large companies that have a physical presence in East Providence, some of which have national and international significance. Large employers include:

- Santander Bank: Regional corporate office and call center, located at 95 Amaral Street;
- Bank of America: Regional corporate office and call center, located at 3400 Pawtucket Avenue;
- Citizens Bank: Regional corporate office and call center, located at 115 Tripps Lane;
- Aspen Aerogels: Manufacturer of aerogel insulation geared toward large scale energy providers, located at 3 Dexter Road;
- Eaton Aerospace: International manufacturer of components for the aerospace and defense industries, located at 10 New Road;
- Igus: Major industrial cable and chain manufacturer. North American corporate and distribution headquarters, located at 275 Ferris Avenue; and
- Nordson EFD: International manufacturer of fluid dispensing equipment. American headquarters, located at 40 Catamore Boulevard.
- Tockwotton on the Waterfront: Senior living community providing assisted living, memory care, rehab, and long-term care services, located at 500 Waterfront Drive;
- PACE RI: Flagship center and headquarters providing day center eldercare services, located at 10 Tripps Lane;
- Bradley Hospital: a psychiatric hospital, located at 1011 Veterans Memorial Pkwy;
- Brown Medicine: a primary care facility, located at 375 Wampanoag Trail;
- University Orthopedics: a regional orthopedic outpatient center, located at 1 Kettle Point Avenue;
- Coastal Medical: a primary care practice with locations at 900 Warren Avenue, 450 Veterans Memorial Parkway, and 1445 Wampanoag Trail;
- Hasbro, Inc: corporate office, located at 200 Narragansett Park Drive;
  Interplex Engineered Products: manufacturing facility, located at 231 Ferris Ave.

3.3c Built Environment

1. Existing structures

As noted above, the City's total Special Flood Hazard Area acreage is relatively small. The SFHA itself includes about 285 structures, of which 150 are residential homes. Also included are portions of one large apartment building, one long-term care facility, several business and industrial buildings, and a few historic structures. Most of the residential structures are concentrated in three areas; along the Ten Mile River between Pawtucket Avenue and Omega Pond, in the State Street Neighborhood near the Seekonk, MA border, and along Bullocks Cove in Riverside. Each of these areas has at least one NFIP "repetitive loss property" with most of the 15 total properties located in the State Street Neighborhood.

Several residential homes in the floodplain are also found along Narragansett Terrace and both north and south of Sabin Point Park in Riverside. Additionally, there are close to 150 homes in this part of the City where the shoreline frontage of the parcel is obviously in the SFHA, but the homes themselves are at a higher elevation on a bluff above the SFHA. These structures vary in distance from the bluff's edge from just a few feet to as far as 40 or 50 feet.

Flood or Inundation Zone	Est. Total Parcel Valuation($)	# Parcels	Est. Pop.
VE Zone	315,002,854	426	1,270
AE Zone	340,497,091	550	1,660
* Total Flood Zone	518,398,414	876	2,650
^ CAT1 Inundation Zone	383,665,176	445	1,320
^ CAT2 Inundation Zone	501,573,028	794	2,410
^ CAT3 Inundation Zone	659,661,250	1,313	3,970
^ CAT4 Inundation Zone	1,059,265,607	2,734	8,280
Total (entire city)	**$4,133,568,026**	**16,295**	**47,139**

Table 16. Estimates of assessed value of flood and inundation zone parcels. Based on 2015 and 2022 data courtesy of the City of East Providence Assessment Division.

Notes on Table 16:

*Total Flood Zone accounts for duplicates that appear in both AE and VE Zone Databases.

^ CAT1, etc., refers to projected inundation zones for Category 1-4 hurricane direct hits.

Flooding from a major hurricane storm surge would impact a much larger portion of the City. Areas that would be flooded by a major hurricane storm surge include several sections of Riverside including:

- Parts of Narragansett Terrace (also subject to bluff collapse from erosion);
- All areas adjacent to Bullock Cove;
- Areas northeastward from Bullocks Cove through the lower Willett Avenue area and beyond;
- Locations close to the Runnins River including the Wampanoag Trail, Highland Avenue (Rte. 6), and the State Street neighborhood;
- Properties north of Center Street and along Roger Williams Avenue along the Ten Mile River and Omega Pond;
- Lower-elevation portions of the Waterfront Special Development District;
- Oil company infrastructure in along the water in Riverside and near Bold Point; and
- Both wastewater treatment facilities.

While flooding is the most common natural hazard in the City, all structures are prone to certain natural hazards to a degree, as discussed in throughout Section 3.2.

2. City Infrastructure

A vast majority of City-owned structures are situated above the SFHA. There are park facilities and other areas of open space that are in the SFHA and have experienced flooding in recent years. Perhaps the most notable of these is heavily-used Agawam Park located along Pawtucket Avenue (Route 114) by the Ten Mile River, which has at least partially flooded on at least four occasions since June of 1998.

With regard to flooding and City property/rights of way, certain streets are of a higher concern than most city-owned buildings. Of the 160 miles of public streets in the City, roughly 3.8 miles are located in the floodplain, and a considerably greater amount of street mileage would be affected by hurricane

storm surges of increasing height. Storm surge flooding would not only flood streets, but would leave behind substantial debris and could seriously damage the road surface and road base.

3. Critical Facilities

Critical facilities in the City are at risk from natural hazards to varying degrees, with the most likely and possibly the most severe threat being from flooding. East Providence is fortunate in that most critical facilities are located in upland areas away from flood zones. These include City Hall, the Police Station, the four Fire Stations, the Public Works Complex, and all of the City's public schools. Other facilities within East Providence selected for location analysis with respect to natural hazards include dams, bridges and culverts, water storage tanks, wastewater treatment plans, pump stations, gas transmission lines, and overhead high-voltage electrical lines. Note that the City is nearly 100% served by underground sewer, water, and gas lines. See Appendix A, Maps A-1 and A-2, for locations of critical facilities in East Providence.

Facilities included for consideration in this section that are most vulnerable to flooding include the two wastewater treatment facilities (WWTF): the Bucklin Point WWTF operated by the Narragansett Bay Commission off of Campbell Avenue in Rumford and the East Providence WWTF off of Bullocks Point Avenue in Riverside. The latter facility is City-owned, but operated by Suez Water Environmental Services under a 10-year agreement signed in 2021. Related infrastructure prone to flooding includes some of the City's pump stations that feed the City's treatment plant. Five out of 25 such facilities are located in special flood hazard areas. Bridges over streams, culverts, and dams; by nature of their locations and function, are all either within special flood hazard areas or are otherwise prone to flooding and/or streambank erosion. The City's health care facilities, which include Bradley Hospital and a number of long-term care facilities, are out of the flood zone with the exception of Anchor Bay at East Providence off of Wampanoag Trail; a corner of the building and small part of the access road are within an A-Zone.

Hurricane storm surge flooding in a worst case scenario would be much more extensive with the potential to add additional pump stations, up to two more long-term care facilities, one school and, in a most extreme case, the Public Works Complex to the list of facilities that could be flooded. This is in addition to several hundred homes that would be substantially damaged or destroyed in the event of a major hurricane. Flood and hurricane storm surge mapping resources have improved substantially in recent years, as noted in the Capabilities Assessment in Section 4. The City will utilize all of the tools at its disposal to prepare for these hazards and to determine mitigation actions and execute these actions.

4. Historic and Cultural Resources

Properties of historic or cultural significance that are located throughout the City are at risk from a variety of natural disasters, including earthquakes, hurricanes, floods, fire, ice storms, and high winds. Below is a list of cultural and historic properties*[34] identified by the East Providence Planning Department as being at risk from natural disasters:

- Boyden Heights Bandstand (Octagon House), 21 Sunnyside Avenue;
- Bicknell-Armington "Lightning Splitter" House, 3591 Pawtucket Avenue*;

[34] "National Register of Historic Places: Data Downloads", National Park Service, accessed March 2, 2022, https://www.nps.gov/subjects/nationalregister/data-downloads.htm

- Boston and Providence Railroad Bridge, spanning Roger Williams Avenue and Ten Mile River*;
- Bridgham Farm area, 120, 148, 150 and 160 Pleasant Street*;
- Caleb Williams Cottage, Hunts Mill Historic Site off of Pleasant Street;
- Carpenter, Lakeside, and Springvale Cemeteries, near Newman and Pawtucket Avenues*;
- Elm Tree Plat National Register District, south of Willett Avenue near Willett Pond*;
- Looff Carousel at Crescent Park, Bullock's Point Avenue*;
- District #6 Schoolhouse/Riverside Girl Scout House, 347 Willett Avenue*;
- First Baptist Church, 1400 Pawtucket Avenue;
- Humphrey Homestead and Mill, 1290 South Broadway;
- James Dennis House, 3120 Pawtucket Avenue*;
- John Hunt House, Hunts Mill Historic Site;
- Little Neck Cemetery, Read Street*;
- Nathaniel Daggett House, 74 Roger Williams Avenue*;
- Newman Cemetery, intersection of Newman and Pawtucket Avenues*;
- Newman Congregational Church, 100 Newman Avenue*;
- Odd Fellows Hall, 63-67 Warren Avenue*;
- Phanuel Bishop House, 150 Greenwood Avenue;
- Philip Walker House, 432 Massasoit Avenue*;
- Phillipsdale Historic District, mills and mills housing along Roger Williams Avenue*;
- Pomham Rocks Lighthouse, offshore below Whipple and Fuller Avenues;
- Pump House, Hunt's Mill Historic Site;
- Roseland Park Plat National Register District, Florence St, Princeton and Dartmouth Aves.*;
- Richmond Paper Company Mill (Phillipsdale Landing), 310 Bourne Avenue*;
- Rumford Chemical Works and Mill Houses (now Rumford Center mixed-use development), Newman Avenue and North Broadway at Greenwood Avenue*;
- Rumford Historic District, area of Pawtucket Avenue, Greenwood Avenue and Pleasant Street*;
- Saint Mary's Episcopal Church, 83 Warren Avenue*;
- Squantum Association, 947 Veterans Memorial Parkway*;
- Weaver House, 31 Grove Avenue;
- Whitcomb Farm, 36 Willett Avenue*.

Among the more important historic landmarks in the City is the 1895 Charles I.D. Looff Carousel at Crescent Park. This major local attraction is the only structure that remains of a popular amusement park than spanned either side of Bullocks Point Avenue for much of the 20th Century, and included a Shore Dinner Hall fronting on Narragansett Bay. The park closed in the 1970's, but the Carousel has been restored and draws thousands of visitors including Carousel enthusiasts from across the country each year. The Carousel and adjacent Rose Larisa Park are home to a number of civic events including concerts, festivals, cruise nights, movie nights, and fund-raising social events. In addition to its inclusion on the National Register of Historic Places, the Carousel has also been designated as a National Historic Landmark by the National Park Service, one of 45 such properties in the state.[35]

Another outstanding structure of historic significance is the 1871 Pomham Rocks Light, located on a small, rocky island off of the coast of Riverside a short distance north of Sabin Point. An active citizens group has been restoring both the exterior and interior of this classic New England lighthouse.

[35] "Rhode island Historical Preservation and Heritage Commission", State of RI, accessed March 2, 2022, https://preservation.ri.gov/historic-places/national-historic-landmarks .

Most of the properties listed above are privately owned by individuals or by non-government organizations. City-owned properties among the group include the Crescent Park Carousel, the Hunts Mill Historic Site structures, and the Weaver House.

5. Port Infrastructure

There are two major port facilities along the Providence River in East Providence. Capital Terminals operates a regional home heating oil terminal just south of Bold Point Park, or about 0.6 miles southwest of the Washington (I-195) Bridge. From this point, petroleum is transported via underground pipeline about 2 miles to the northeast to a fuel oil tank farm along Dexter Road. Another port facility is a fuel terminal located about 2.5 miles south-southeast of the Washington Bridge. Fuel offloaded at this location is transported by pipeline eastward about 1.5 miles to a tank farm along the Wampanoag Trail (Route 114). This is an important regional gasoline transfer facility for New England.

Considering the vulnerability of the coastlines to earthquakes, hurricanes, and floods and any cargo stored on the sites, the port districts pose a threat to the residents, environment, and the local economy in the event of a major natural disaster.

6. Future development

The City's central waterfront area on the Providence and Seekonk Rivers presents opportunities for major economic development. In much of the 20th century, this portion of the City featured heavy industrial uses including an abundance of fuel industry infrastructure and several tank farms. Much of this infrastructure has been removed and properties are being remediated and restored. The East Providence Waterfront Special Development District Plan was adopted in 2004 to articulate a plan, vision, and strategies to transform over three hundred acres of this underutilized waterfront property. The Plan and associated zoning changed the Waterfront District to allow mixed-use development, with manufacturing encouraged in certain areas and sub-districts for medium and high-density residential uses, restaurants, marinas, and recreational uses oriented towards the water.

The City's waterfront planning efforts encompass consideration of resilience to natural hazards including storm surge flooding and projected levels of sea level rise. To this point, development has occurred on land that had either been previously developed, or was within areas that already contained similar uses. None of the recent development projects have included structural development within the Special Flood Hazard Area.

In 2022, owners of a large former steel mill property located in the Phillipsdale Waterfront Sub-District were in the process permitting a multifamily residential development consisting of apartments, townhouses, and single-family homes. In the Bold Point Harbor Waterfront Sub-District, just south of the Washington Bridge, a concert venue was planned along with a port to support the off-shore wind industry in the region. Development along the waterfront requires the provision of open space for active and passive recreational uses while structural vertical development occurs above the Special Flood Hazard Area.

With respect to new residential development, the city's residential units to this point have balanced off what otherwise would have been a slight loss of the City's population due to other factors. It has been determined that projected increases in population, impervious surfaces, and development density

within projects now proposed or under development will not result in significant environmental issues, nor impact the ability of the City to provide engineering and public safety services.

In recent years, advanced manufacturing and medical, financial, and social services have seen strong growth and the City expects continued growth in these sectors in the foreseeable future.

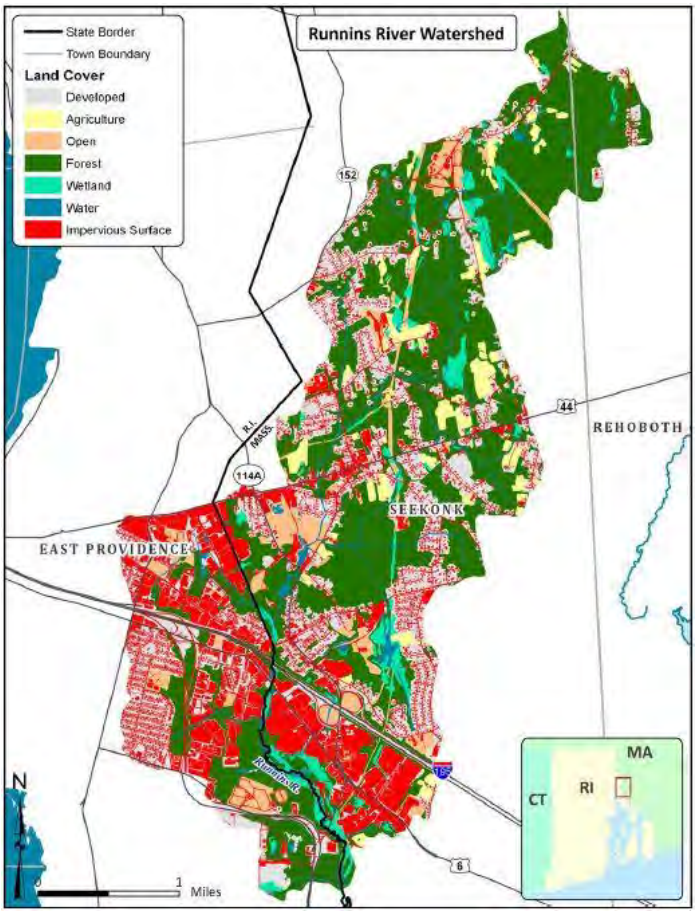
Development elsewhere in the City will continue to proceed with consideration for wetland and floodplain proximity. A general goal for the City's new development is to limit any hazard vulnerability to the new development itself, and to avoid adverse impacts off-site. For example, many proposed development plans are located on parcels developed prior to the City's Zoning Ordinance and therefore the redevelopment of some properties will reduce impervious area and improve storm water management compared to previous uses.

3.3d Natural Environment

1. Water Resources and Watersheds

Hydrologically, East Providence is split among a few drainage basins, including two distinct river basins and the coastal drainage area which is separated into the Providence River and the Seekonk River sub-basins.

The **Runnins River** Basin is relatively small, at about 11 square miles, but is associated with notable flooding issues for the City. The Runnins River flows south-westward from northwestern Rehoboth, MA through central Seekonk and either forms or is very close to the southern half of the City's eastern border. The Land Use Map to the left illustrates the abundance of impervious surface from commercial uses near the river, especially south of Route 44.
The low-lying residential area north of Waterman Avenue near the Seekonk line (the State Street neighborhood) has seen numerous flood incidents in recent years as noted above. The 2010 floods were especially severe with at least three dozen properties affected.



Map 5. Runnins River Drainage Basin Land Use. Source: Barrington-Palmer-Warren Rivers Watershed Plan, Nov. 2012.

This neighborhood would also be subject to at least shallow storm surge flooding from a direct major hurricane hit, as it sits generally from 14 to 18 feet above sea level. The City, in coordination with RIEMA, FEMA, and other partner organizations will continue mitigation measures to assist owners and residents in this neighborhood. As of early 2022, the City was investigating options for the acquisition of some properties in the neighborhood where there is resident interest.

Terrain along the Runnins River remains low downstream (generally southeastward) from the State Street neighborhood through where it becomes tidal close to the Barrington line, but floodplain areas along the southern half of this basin are less developed. Part of this area is discussed further in the Protected Natural Areas section below.

Three projects are in planning stage, underway, or completed to mitigate the effects of severe flooding, reduce the frequency of minor flood events, and improvement stormwater quality in the Runnins River Basin. These projects are:

Invasive Species Remediation- An unnamed Runnins River Tributary, immediately to the north of the State Street neighborhood, has been choked with invasive species in the past. After much planning and permitting work, this tributary has been opened up and native species have been planted along the banks in order to help area return to a more natural state and aid in the improvement of drainage.

High-Water Overflow Pipe- Two high-water overflow culverts within the existing Warren Avenue Culvert structure along the Runnins River have been constructed to aid in channeling water through this structure and away from the neighborhood during high water events.

Lower Runnins River Tributary Stormwater Project- A small tributary to the Runnins River in the Catamore Boulevard area drains a mainly commercial/industrial area that also includes some residential uses. Impervious surface percentage is high. The City is commissioning a study to determine options for improving stormwater quality, and slowing the rate/filtering the stormwater that goes into the tributary and eventually into the Runnins River.

The **Ten Mile River** drains a larger area, mostly in Massachusetts, measuring about 54 square miles. There are residences prone to flooding from major flood events, but the residential neighborhood along the river most vulnerable increases in elevation fairly quickly, limiting the number of homes that are in the regulatory floodplain. Larger flood-prone areas are found toward the Seekonk border where the river makes a sharp bend from a southerly to a northwesterly flow, but this area is less developed. Nonetheless, Ten Mile River flooding affected areas a considerable distance southward away from that bend in the river including the low point on Taunton Avenue (Route 44) and near businesses along the northern portion of Commercial Way. Recent flood studies and 2015 revised flood map panels for the Ten Mile River basin depict these flood-prone areas very well. Protection of the undeveloped land along the river in this area is key to preventing increases in flooding in this portion of East Providence.

Western shoreline areas of the City, along with areas close and east of Bullocks Cove, are subject to coastal flooding including hurricane storm surges, as noted above in the Hazards section (see Map 3). Additionally, much of the Riverside area of the City, especially along and east of Willett Avenue, is subject to seasonal high water and many homes have basements that flood easily. Drainage improvements have been proposed that would require spending in the millions of dollars over a number of years. Infrastructure bonding is seen as a potential tool to achieve funding to execute at least some of this work in the coming years.

2. Protected Natural Areas

The preservation and creation of open space has three important benefits for the City. First, open space is capable of mitigating the severity of floods from hurricanes, severe storms, and snowmelt by acting as a natural buffer to adjacent developed areas. Second, parcels of land that are subject to flooding can be

acquired by the City, maintained as open space, thereby preventing the development of land that is vulnerable to natural hazards. Third, open space may serve as parks, recreational facilities, cemeteries, golf courses, or as conservation areas that can provide natural habitat for plants and animals. Currently, the City maintains approximately 825 acres of open space. This open space includes:

- The 18.4-acre **Bridgham Farm**, owned by the East Providence Land Conservation Trust. Bridgham Farm serves as a passive open space area preserving the unique natural features and historic character of this former farm. There are no structures on the property. It is located close to the Turner Reservoir, which is part of the Ten Mile River system, but is above the floodplain.

- The immediate abutting land surrounding **Turner Reservoir and Central Pond** along the northern portion of the City's eastern border by the City's Water Department that provides a natural buffer between the water bodies and adjacent developed areas. These ponds are part of the Ten Mile River and were formed by the construction of the Turner Reservoir Dam in 1934. Nearly all of the narrow floodplain that surrounds the ponds is within the Water Department property. The land adjacent to the Turner Reservoir includes a hiking trail on the west side within East Providence ad a connector trail on the east side that includes a road/sidewalk segment across the border in Seekonk, MA. The southernmost portion of this east side trail below the Turner Reservoir Dam is an ADA-compliant trail that includes several raised boardwalk segments. This segment of the trail system is the most prone to river flooding.

- **Hunts Mill Historic Site**. This City property consists of 44 acres located off of Pleasant Street in Rumford along a sharp bend in the Ten Mile River. Portions of the site are in the Ten Mile River flood zone and are prone to flooding, though no structures were damaged here during the record March 2010 floods. This attractive property serves as a City park with picnic tables and also includes the historic John Hunt House and Pumping Station, the Hunts Mills Dam and Fish Ladder, a community garden, a dog park, small colonial period gardens, interpretive signs describing the area's history as a company amusement facility, and a mile-long upland hiking trail. The downstream portion of the property, away from the listed amenities, is prone to riverine flooding. The addition of the community garden and dog park has increased the use and popularity of this property.

- **Freedom Green Park** is a one-acre park adjacent to the Ten Mile River, located at the intersection of Centre Street and North Broadway. A portion of this site along the immediate riverbank, which includes an informal kayak launch, is prone to moderate river flooding. Other park amenities are above the floodplain including enhanced landscaping, a walking path, gazebo, and benches. Much of this park could be affected by a major hurricane storm surge.

- The **"Runnins River Critical Area,"** as identified in the Comprehensive Plan, is located in the Runnins River Drainage Basin south of Interstate 195 and to the Barrington line. The area is designated as an "Area of Special Drainage Concern." Along this 2.1 mile stretch of the lower Runnins River is a strip of predominantly open space that serves as a buffer to adjacent residential, retail, and commercial uses. Much of this open land is in the floodplain, and the more southern portion consists heavily of marshland susceptible to shallow coastal flooding and effects from predicted sea level rise, and could be greatly affected by a hurricane storm surge. Sea level rise could lead to the degradation of the coastal marsh in this area, and the loss of flood protection that the marsh provides for the adjacent upland areas east of the Wampanoag Trail.

- **Boyden Heights Conservation Area** is a roughly 11-acre City property overseen by the East Providence Conservation Commission. This diverse area includes a salt-water cove, a tidal wetland, and stream and forested upland areas with a wetland viewing pier and a trail network. The site is a destination for shore birds including Great Blue Herons. The pier has been rehabilitated in a way that will extend its life significantly and make it more resilient when there are severe storms. The pier, located within the floodplain, and a concrete construction pump station well above the floodplain are the only structures on the property. Up to one-fourth of the property could be flooded in a hurricane storm surge and the wetland viewing pier could be damaged or destroyed;

- **Willett Pond**, measuring 4.8 acres near the northern end of Willett Avenue, backs up to a small dam and is within City-owned property. There is a half-mile woodland trail around the pond that is maintained by the Conservation Commission and local residents and offers wildlife viewing. Residential properties border the pond to the west and northeast, with a small retail plaza to the southeast. Structures are several feet above pond level to the east and 15 feet or more higher to the west. Parts of the trail are subject to shallow flooding during times of heavy rain. High water can affect the most distant portion of the trail where it crosses the northern end of the pond and, in rare instances, a part of the trail closer to the retail plaza. There is not a record of street flooding at this location.

- The **Forbes Street Landfill/Southeast Area Drainage** is located south of Forbes Street, west of Wampanoag Trail, and north of Rounds Avenue/Grassy Plain Avenue. This large area consists of approximately 240 acres, approximately 67 acres of the site was previously used as a sanitary landfill by the City from the late 1960s to 1979. An additional five acres or so is used by the City for composting yard waste, which is then used for City landscaping and made available to City residents. The City has successfully closed the landfill and has established a large solar facility at this site. Also on this property, in the southeast corner, is the Grassy Plains Playground. The City has made renewed efforts to improve this long-neglected neighborhood park in coordination with a local community group. These improvements including a new parking area, updated play equipment, resurfaced play areas, and new walking trails. Aside from the manmade landfill ridge, the Southeast Drainage Area has flat topography and many areas have seasonal high water, but the area is not in the SFHA.

- **Rose M. Larisa Memorial Park** consists of approximately 10.6 mostly landscaped acres owned by the City and serves as a recreational park and open space. This scenic property overlooking upper Narragansett Bay includes walking paths, picnic areas, overlooks, an outdoor covered performance stage, and a parking lot. It was part of the former Crescent Park which operated during much of the 20th century. The park is subject to tree damage from strong winds, especially given its location on a bluff along the Bay, and also erosion at the base of the bluff due to wave generating storms. The seawall here collapsed during a storm in 2020 and was being rebuilt during 2022. This is also the site of a shoreline restoration project overseen by the RI Coastal Resources Management Council and the Nature Conservancy. Nearly all of the park is above the floodplain at an elevation of anywhere from 20 to 40 feet above sea level. A hurricane storm surge would cause further erosion of the coastal bluff, loss of the small beach, and damage to the park's overlook.

3. Other Open Space

Additional public open space is associated with parks and playgrounds, which in a few places, are prone to flooding. Bold Point Park, across from Providence's India Point Park, and Sabin Point Park in Riverside,

can flood 5 to 6 feet or more in a storm surge. Sabin Point Park has residential homes immediately to its north and east that are within the SFHA and are at risk from storm surges.

All City parks and recreation areas are prone to tree damage during high wind events. The City works to clear debris as quickly as possible following damage-generating events.

Section 3.4 Risk Analysis and Assessment Matrix

3.4a Repetitive & Severe Repetitive Loss Properties

A repetitive loss property is defined as an NFIP-insured structure that has had at least two paid flood losses of more than $ 1,000 each in any ten-year period, since 1978, while a severe repetitive loss property is defined as a residential property that is covered under an NFIP insurance policy and: (a) that has at least four NFIP claims payments (including building and contents) over $5,000 each, and the cumulative amount of such claims exceeds $20,000; or (b) for which at least two separate claims payments(building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

Within the City of East Providence are 15 “repetitive loss” properties, all residential, including one “severe repetitive loss” (SRL) property. These 15 properties are located within three distinct areas:

1. Runnins River – State Street Neighborhood
The City’s most notable Repetitive Loss Area is located in the east central portion of East Providence, bounded roughly by Waterman Avenue to the southwest, Almeida Avenue to the northwest, and the Seekonk, MA border to the northeast and east (this is known locally as the State Street Neighborhood). This neighborhood contains 12 of the 15 repetitive loss properties in East Providence, including the lone severe repetitive loss property. The principle drainage features in the area are the Runnins River (described in Section 3.3d above) and an unnamed tributary, which flows southeastward just to north of the neighborhood and converges with the Runnins River in Seekonk, MA, at a point just a few yards east of the state line.

The Runnins River floods during long duration heavy rainfall events, or during periods of repeating moderate to heavy rainfalls such as the sequence of storms that occurred in February and March of 2010. There are approximately 75 parcels with structures located in the area, mostly residential. Many of the residential parcels contain raised ranch style, single family dwellings. The number of pre-FIRM versus post-FIRM residential and commercial buildings is roughly split down the middle. There are a half-dozen or so commercial structures that are located predominantly along Waterman Avenue. These commercial parcels are partly landscaped but contain a high percentage of impervious surface. Properties in the area are connected to the City’s sanitary sewer system and have the other usual City utilities including water, natural gas, and electricity.
About 60% of the area is contained within the Special Flood Hazard Area (A-zone), with generally flat topography and a high ground water table. The River itself passes beneath nearby Warren Avenue through a reinforced concrete culvert, with two overflow pipes now also part of the structure. This culvert has historically acted as a choke point during high intensity storms but this has been partly mitigated by the overflow pipes (see section 3.3d above).

Map 6: Repetitive Loss Areas

The majority of damage caused by flooding in this neighborhood has occurred in houses that have (or had) finished lower levels, or had appliances and/or mechanicals within the base flood elevation that were damaged or destroyed by flood water.

2. Ten Mile River

East Providence also experiences very occasional riverine flooding issues along its stretch of the Ten Mile River, in the northern part of the City. The primary area of concern regarding residential properties is near and downstream from the Pawtucket Avenue Bridge (Rte. 114) and downstream to Omega Pond. At the west end of Omega Pond is a dam, immediately beyond which is the tidal Seekonk River. There are numerous residential parcels fronting the river that are at least partly in the SFHA, including two repetitive loss properties. In general, the northernmost properties along each of the streets that head north from Centre Street and dead-end near the river are vulnerable to flooding during excessive rainfall events. Downstream from the Centre Street area is a group of homes along the southern end of Roger Williams Avenue that are also threatened by flooding of the same magnitude.

Flooding of note along the Ten Mile River seldom develops from a single heavy rainfall event. On each occasion where flooding has happened in the last 20 years or more, it has been the result of a series of heavy rain events over a relatively short period of time. Examples include flooding episodes in June of 1998, October of 2005, and March of 2010. The latter, and most significant, of these came in the wake of a series of storms that dropped 17-20
inches of rain across the Ten Mile River
basin in a 6-week time frame. The former two episodes resulted from rainfall of 10 to 15 inches over a period of 3 to 4 weeks.

The USGS has a stream gage at the Pawtucket River Bridge that the City monitors and receives alert-level emails for. The City has documented water levels relative to gage readings during periods of unusually high water as an aid in predicting future flood events (see Section 4.2d – Local Flood Studies for more information on this effort).

3. Cove Street area

A third repetitive loss area is along the narrow tidal portion of Bullocks Cove in Riverside, north of Crescent View Avenue, that includes portions of Cove and Bell Streets. The flood zone in this area, which is an AE zone, clips a number of properties but encompasses only a couple of structures. One of these, located at the eastern end of Cove Street, is the lone repetitive loss property in this neighborhood. The claims from this property, most of which pre-date 1985, appear to have resulted from riverine flooding from upstream as opposed to tidal flooding, though certainly this immediate area would be subject to storm surge flooding from a hurricane. The remainder of structures in this neighborhood appear to be anywhere from 5 to 25 feet above the base flood elevation.

The floodplain areas within each of these repetitive loss areas are largely built out. An application to fill/compensate a wetland and floodplain parcel in the State Street Neighborhood back in 2009 was denied by DEM at the strong recommendation of the City. The remaining open land in this area is a mix of city-and privately-owned undeveloped parcels and unimproved City rights-of-way.

3.4b Identified Risk in the Community

The purpose of the Risk Assessment Matrix, Table 17 below, is to assist in the formation of mitigation actions that are intended to reduce the physical, social, and economic loss that may result from a hazardous event. The Risk Assessment Matrix identifies vulnerable areas and assets of the City that have either sustained damage from a natural disaster in the past or have a reasonable probability of sustaining damage in the future. Natural hazards that were taken into consideration were hurricanes, tornadoes, severe thunderstorms, hail, nor'easters, snowstorms, ice storms, extreme cold, flooding, storm surge, coastal erosion, dam breach, climate change and sea level rise, earthquakes, wildfire, drought, and extreme heat. Once vulnerable areas and assets were identified, the Hazard Mitigation Committee determined the impacts to the residents, property, infrastructure, and economy. The benefits of pre- and post-mitigation efforts were determined by identifying the advantages gained if the impacts of a hazardous event could be prevented. Mitigation benefits include the protection of life, property, infrastructure, economy, and preservation of historically significant structures. One or more mitigation strategies, as described in Section 5.2, is assigned to each of the at-risk areas or facilities within the matrix.

Vulnerable Areas	Locations	Owner-ship	Natural Hazard	Impacts	Mitigation Benefits	Historic/ Potential	Strategies (Sec. 5.2)
Public Facilities	• City Hall • Fire Stations • Libraries • Police Station • Public Works • Senior Center • Water Tower/ Related Facilities • Schools	Public	• Earthquakes • Hurricanes • Flooding • Wildfire • Snowstorms • Severe Thunderstorms	• Loss of life; • Disruption of city relief efforts; • Loss of public communication; • Loss of City computer networks and servers; • School disruption.	• Protection of life; • Maintain City services during times of emergency • Maintain public communication; • Maintain public education; • Maintain vital utility provision	Historic and potential	3, 6, 7, 9, 13
Residential Mid- and High-Rise Structures	• City View • Harbor View • Rumford Towers • Willet Avenue • Parkway Twrs. • Kent Farm Village • Goldsmith Manor • Winslow Gardens • Riverside House • Taunton Plaza	Public/ Private	• Earthquakes • Hurricanes • Flooding • Wildfire • Severe Thunderstorms	• Loss of life; • Substantial loss of housing units (senior, market and low-income).	• Protection of life and property; and • Maintain housing units (senior, market and low-income).	Potential	3, 7, 9
Other Residential Structures	City-wide	Private	• Flooding • Wildfire • Hurricanes • Severe Thunderstorms • Earthquakes • Storm Surge • Coastal Erosion • Dam Breach • Sea Level Rise	• Loss of life; • Property and utility damage; • Sewage overflow; • Lost housing units.	• Protection of life and property; • Maintain housing; and • Maintain tax revenue.	Historic	1, 2, 5, 7, 8, 9, 10, 11, 12, 13, 14

Vulnerable Areas	Locations	Owner-ship	Natural Hazard	Impacts	Mitigation Benefits	Historic/ Potential	Strategies (Sec. 5.2)
Historic Properties	• Looff Carousel • Pomham Rock Lighthouse • Others City-wide	Public/ Private	• Hurricanes • Earthquakes • Flooding • Severe Thunderstorms	• Loss/damage of property; • Loss of utility; and • Lost local heritage and historical icons.	• Protection of property; and • Maintain City landmarks and iconic structures.	Potential	10
Commercial Properties	• City-wide • In particular close to or in floodplain	Private	• Earthquakes • Hurricanes • Flooding • Wildfire • Severe Thunderstorms • Storm Surge • Sea Level Rise	• Loss of life; • Disruption/loss of industrial services; and • Loss/disruption of employment.	• Protection of life; • Maintain industries and services provided; and • Secure workforce.	Historic	4, 7
City Water Supply Pipelines	• Beneath nearly all City streets	Public	• Earthquakes • Flooding • Dam Breach	• Loss of water service; and • Decreased water quality	• Maintain water supply and quality.	Potential	7
Sewage Treatment Facilities, Sanitary Sewer Lines, and Pump Stations	• Narragansett Bay Commission Bucklin Point WWTF • City of East Providence WWTF • Wastewater Pump Stations	Public	• Earthquakes • Flooding • Sea Level rise • Hurricanes • Storm Surge • Dam Breach • Power Outages	• Loss/damage to utilities; • Loss of services to residents, businesses, and industries; • Public financial cost to repair/rebuild; and • Discharge of pollutants into marine environment.	• Maintain/ protect utilities; • Maintain services to residents, businesses, and industries; • Prevent/ decrease cost incurred to repair/rebuild; and • Protect marine environment.	Potential	1, 2, 7, 12
Dams	• Turner Reservoir • Hunts Mills • Omega Pond • Willett Pond	Public/ Private	• Earthquakes • Flooding • Dam Breach	• Loss of life; • Major property damage; • Loss/damage to utilities; and • Loss of natural recreational facilities.	• Protection of life and property; • Maintain utilities; • Protection of natural recreation facilities; and • Protection of all downstream facilities.	Potential	8, 13
Local Bridges and Culverts	City Wide	Public	• Flooding • Sea Level Rise • Earthquakes • Hurricanes • Storm Surge • Dam Breach	• Disruption of transportation; • Disruption of emergency routes; • Loss of utility lines.	• Maintain both routine and emergency transportation routes; • Protection of utility lines.	Historic	1, 2, 12
Care Facilities	• Bradley Hospital • Long-term care facilities City-wide	Private	• Hurricanes • Flooding • Sea Level Rise • Earthquakes • Severe Thunderstorms	• Power and transportation disruption • Disruption of patient care	• Minimize chance of patient evacuation • Provide for continuing high-quality care	Potential	5, 9

Vulnerable Areas	Locations	Owner-ship	Natural Hazard	Impacts	Mitigation Benefits	Historic/ Potential	Strategies (Sec. 5.2)
Streets	City Wide	Public	• Earthquakes • Hurricanes • Flooding • Sea Level Rise • Snowstorms • Ice Storms • Storm Surge • Coastal Erosion • Dam Breach	• Loss of life; • Road damage or closures • Disruption of transportation; • Disruption of emergency routes.	• Protection of life; • Maintain transportation network; • Maintain emergency routes; • Mitigate impact to emergency services.	Historic	1, 2, 12
Indoor and Outdoor Recreation Facilities	City wide with special emphasis to facilities located in or adjacent to coastal areas and rivers.	Public and Private	• Flooding • Hurricanes • Storm Surge • Sea Level Rise • Snowstorms • Ice Storms • Wildfire • Dam Breach	• Loss/damage to recreational facilities; and • Financial cost to repair/rebuild.	• Maintain recreational facilities as important quality of life amenity; • Prevent/ decrease cost incurred to repair/rebuild.	Potential	1, 8, 11
Trees	Citywide	Public and Private	• Flooding • Hurricanes • Snowstorms • Ice Storms • Severe Thunderstorms • Wildfire • Drought	• Loss of utility services to residents, businesses, and industries; • Cost and time to replace utility lines • Bulk loss of valuable natural resource	• Maintain/ protect utilities; • Mitgate loss of transportation due to fallen trees and wires; • Protect valuable visual and natural function resource.	Potential	11
Wetlands, Undeveloped Floodplains, Conservation Areas	Scattered City and private properties City-wide	Public and Private	• Flooding • Hurricanes • Storm Surge • Sea Level Rise • Severe Thunderstorms • Dam Breach	• Loss of passive recreational area • Loss of habitat • Loss of floodplain natural functions including flood mitigation immediately inland	• Protection of habitat • Retain functions of floodplains and wetlands • Retain sensitive open space in natural state	Potential	2, 8, 11

Table 17. Risk Assessment Matrix

Note: All areas vulnerable to damage from severe thunderstorms are also vulnerable to tornado and hail damage.

SECTION 4 – CAPABILITY ASSESSMENT

Section 4.1 - Purpose

The Capability Assessment reviews existing plans, studies, programs and policies in the City and the state that focus on or include a component of hazard mitigation. Additionally, this section will highlight local accomplishments and shortcomings, and will briefly discuss goals and areas for improvement in the City's overall hazard mitigation strategy.

Section 4.2 - Local Government Capabilities

4.2a Local Government
From its re-designation as a City in 1958, East Providence operated under a Council-Manager form of government until 2018 when a Mayor-Council form of government was established by Charter Amendment. Tthe Mayor and the Council are elected to serve for a period of 4 years. The Mayor is the primary managerial leader of the City.

The City Council serves as the legislative and governing branch of the City, and consists of five elected officials; one from each of four City wards and one "at-large" councilor representing the whole city. The Council meets regularly twice a month, except once monthly in July and August.

Several City Departments perform services and activities that can include a component of hazard mitigation, preparedness, response, and recovery. Mitigation activity is overseen by several Departments of Divisions including the East Providence Emergency Management (part of the Fire Department), the Engineering and Building Divisions of the City's DPW, and the Department of Planning and Economic Development.

4.2b Local Emergency Management Agency
The East Providence Emergency Management Agency (EMA), a division of the East Providence Fire Department since 2019, assumes primary responsibility for emergency planning along with response and recovery efforts. In recent years, East Providence EMA has pursued and received preparedness and mitigation grants, collaborated with other City Departments and the East Providence School Department, and worked closely with Federal, State, and other agencies including FEMA, RIEMA, the Rhode Island Department of Health, the Rhode Island Fusion Center, and the Rhode Island Chapter of the American Red Cross. East Providence EMA also maintains active membership in the Rhode Island Association of Emergency Managers (RIAEM) and the Rhode Island Flood Mitigation Association.

In addition, East Providence EMA has served as the City's CRS Coordinating Office, and is responsible for maintaining the City's Hazard Mitigation Plan.

City Public Works officials including the Engineering and Building Division heads work with Emergency Management on floodplain coordination, with enforcement responsibilities under the purview of the Building Division.

City EMA and Engineering offices maintain copies of the current and past Flood Insurance Rate Maps (FIRMs), Flood Insurance Studies and Letters of Map Amendment. Both divisions coordinate on the City process for map revisions, including floodplain ordinance revisions when necessitated. The City

maintains a log of floodplain-related inquiries, noting location, flood zone and base flood elevation, and information given to the inquirer. The number of these inquiries varies from year-to-year, in part dependent on actual incidents or threats of flooding.

Section 4.2c Emergency Sheltering
The former East Providence High School was a designated American Red Cross emergency shelter in the City. Two others are identified in the 2015 State of Rhode Island Shelter and Coordination Plan. The new High School will need to be surveyed in cooperation with City officials and the School Department to be certified as a new emergency shelter.

The East Providence Senior Center has been made available as a short-term shelter on multiple occasions. Installation of a generator and hurricane-resistant windows has improved its capacity for sheltering residents in the event of an emergency. Riverside Middle School has also been identified as a potential emergency storm shelter location.

Name	Location	Capacity
East Providence High School	1998 Pawtucket Avenue East Providence, RI 02914	?
East Providence Senior Center	610 Waterman Avenue East Providence, RI 02914	100
Riverside Middle School	179 Forbes Street East Providence, RI 02814	500

Table 18: East Providence Emergency Shelters

According to the American Red Cross, 25% of an area's population would most likely seek shelter from a major natural disaster. For example, if the southern coastline of the City required evacuation, statistically only 25% of those residents would seek the safety of an emergency shelter. The remaining 75% would seek shelter with friends or families, or make other arrangements such as hotel accommodations. In a recent survey, a number of residents indicated that they are aware of the City's storm shelters, increasing the importance of ensuring that they are available in the event of a major natural hazard event.

The City will continue work to increase our sheltering capacity and to communicate the availability of shelters and suggested evacuation routes during this 2022 Hazard Mitigation Plan cycle.

Section 4.3 - Local Planning Integration and Regulatory Resources

4.3a Integration with Plans and Local Regulations

East Providence Comprehensive Plan
The East Providence Comprehensive Plan serves as the policy framework for decisions concerning land use, development, design, planning and economic programs, and public investment priorities. The Planning Department was managing a complete update of the Plan in 2021 and 2022. Natural hazards including climate change and sea level rise were being incorporated into the Comprehensive Plan update to a larger extent that previously, given increases in frequency of major storm events and the prospect for significant sea level rise in the upcoming decades. An increased emphasis on hazards and hazard mitigation as a Comprehensive Plan policy further supports hazard mitigation initiatives as a component of local government activity.

East Providence Waterfront Special District Development Plan
This plan, originally adopted in 2003, guides the development of roughly 300 acres along the central portion of the City's western shoreline along the Seekonk and Providence Rivers, and still remains in full effect. Historically, much of the waterfront land use in these areas was industrial in nature. While some industrial and port uses continue, many of these uses have ceased allowing for rezoning to less "intensive" uses including mixed-use, residential, and recreational. The Plan calls for preservation of natural habitat areas and environmental protection as part of development proposals along the waterfront. The Waterfront Commission consults with East Providence EMA regarding natural hazards, particularly with respect to the district's Special Flood Hazard Areas (which include both A-zones and V-zones) and any need for flood mitigation with regard to development in the Waterfront District.

East Providence Emergency Operations Plan (EOP)
East Providence Emergency Management has developed a new Emergency Operations Plan based on twenty emergency support functions. The Plan includes responsible parties for each function, roles, scope of work, policy information, and contact information. It is designed to be easily updatable as priorities, existing conditions, and personnel change.

Revised Ordinances of the City of East Providence
The City's Zoning Ordinance (Chapter 19 of the Revised Ordinances) contains the most pertinent City regulations regarding natural hazards, including FEMA-compliant floodplain regulations (Division 12-Special Flood Hazard Areas, Sections 19-306 through 19-315) and stormwater runoff / erosion control with respect to Development Plan Review (Section 19-455).[37] The Zoning Ordinance is revised as needed, and the floodplain was revised as recently as the summer of 2015 in advance of the most recent revised FIRM adoption. Reference to the City's building code is found in Chapter 4, Buildings and Building Regulations, Section 4.1(a), which states that "The city hereby adopts the State Building Code, as amended, as the building code of the city."

East Providence Land Development and Subdivision Review Regulations
Included among the regulations regarding development projects is the assurance that floodplains and wetlands be accounted for, and that impacts of development be minimized. Land development regulations state that "Drainage systems shall be designed so that there will be no increase in the rate of runoff from the post-development site as compared to the pre-developed site based on an assumption of pre-development site condition of vacant land."[38] Hazard mitigation is incorporated into the subdivision and development plan review process for all residential and commercial developments. FEMA floodplain maps are consulted as part of the review of development proposals. All proposals, whether they are in or out of the City's special flood hazard areas, are carefully evaluated with an eye to drainage, impervious surface, and vegetative landscaping; and for the potential to affect floodplains or other areas that are prone to flooding.

[37] "Revised Ordinances of the City of East Providence", accessed February 28, 2022, https://library.municode.com/ri/east_providence/codes/code_of_ordinances?nodeId=REVISED_ORD_EAST_PROVIDENCE_RHODE_ISLAND

[38] East Providence Land Development and Subdivision Review Regulations, Sec. 13-9(b.)(6), http://www.eastprovidence.com/filestorage/9177/9461/9463/9925/9927/Subdivision_Regulations_Jan_9_2012.pdf.

City of East Providence Capital Budget/Five-Year Capital Improvement Program
The City's annual Capital Improvement Budget and five-year Capital Improvement Plan is prepared utilizing a list of potential projects and purchases as requested by all City Departments with such needs. The amount of funding needed to execute all submitted projects always far exceeds the available capital budget, but City funding for capital improvements has increased significantly in recent years and many projects have been executed. Capital funding requests that relate directly to hazard mitigation have been principally oriented toward flood mitigation and include culvert upgrades or replacements, and neighborhood- or larger-scale drainage improvements to reduce frequent nuisance street flooding. These are costly projects that often require a multi-year investment. Future infrastructure bonding is a possibility to fund such projects. Prioritizing mitigation projects including those addressing sea level rise as part of a Capital Improvement Program indicates their importance as part of overall infrastructure budgeting policy and further, it supports future alternative funding efforts.

East Providence Harbor Management Plan - Storm Preparedness and Hazard Mitigation Plan for the East Providence Shorelines and Coastal Waters
This Plan is included as an appendix to the East Providence Harbor Management Plan and was developed in 2012 by the Planning Department, in coordination with the Harbor Commission and East Providence EMA. An update to this plan will be necessary in the future given future waterfront development including an alternative energy storage port. For now, it includes detailed descriptions of the immediate coastal and nearshore environment and marine/boating amenities, a risk assessment table for shoreline and coastal water features, preparedness strategies and operational action timelines, and mitigation and preparedness action items. The plan recommends flood mitigation actions to commercial interests along the water including:

- Placing essential equipment and functions above the floodplain level;
- Installing dewatering pumps;
- Installing master shut-off valves for utility services where flooding may threaten those services;
- Reinforcing existing walls to carry hydrostatic and hydrodynamic loads; and
- Install safety glass in windows.

State and Local Dam Safety Plans
The State Dam Safety Program identifies high-hazard dams across the State. These are dams which, if failure were to occur, could result in significant loss of life and property. The City owns three dams along the Ten Mile River; the most upstream of these, the James V. Turner Reservoir Dam, is classified as a high-hazard dam. A Dam Emergency Action Plan (EAP) for the Turner Reservoir Dam was approved by RIDEM in 2017. The Plan has been updated to account for changes in personnel, with DEM Inspection Reports added as appendices.

The East Providence Emergency Management Agency has a copy of the EAP for the Hebronville Pond Dam in Attleboro, MA., another high hazard dam along the Ten Mile River about 5.9 miles upstream from the Turner Reservoir Dam. That plan, most recently updated in 2013, includes notification protocols in the event of failure of this structure. The plan's study area includes riverbanks from the dam itself southward to the Turner Reservoir Dam. It is expected that the impact of failure at Hebronville would be less for East Providence than that of Turner Reservoir Dam's failure, making the Turner Reservoir EAP representative of a worse-case scenario for such an incident.

An impoundment within the property of the Narragansett Bay Commission's Bucklin Point Wastewater Treatment Plant off of Campbell Avenue in Rumford, which also supports one of the property's

roadways, is also classified as a high hazard dam. Failure of that structure would impact that facility and the constituency that it serves for wastewater treatment. The Narragansett Bay Commission is responsible for emergency action planning regarding that structure.

4.3b Local Flood Studies

Ten Mile River Gage

A USGS river gage (Station # USGS 01109403)[39] has been gathering and transmitting data since 1986 along the Ten Mile River at Pawtucket Avenue (Route 114) near Centre Street. The City has an extensive photo archive from high-water events including the record-setting March 2010 floods. Photos are correlated with river levels and the amount of rainfall that was received during and prior to that major flood event, and similar data is now collected for other flood events and close calls. This provides East Providence with guidance as to how high the water may rise and which properties and infrastructure it may affect along the Ten Mile River, up the peak level on March 30, 2010. EMA and the Engineering Department have also performed an ongoing study to use the Ten Mile River gage as an informal, yet reasonable indicator of the potential for flooding along the Runnins River in the State Street neighborhood.

It is acknowledged that the Runnins River drainage basin is a separate and smaller basin than the Ten Mile River basin and that this correlation will never be perfect, but the two basins are adjacent to each other, and we have found the Ten Mile Gage has shown skill as an indicator for flood potential along the Runnins River in the State Street Neighborhood. We have determined that when the Ten Mile gage measures over 6 feet, areas with seasonal water in the State Street neighborhood will be partly inundated, with water in some swales and approaching a few houses. A gage level over 6.6’ or higher has been associated with a more serious threat to the lowest homes in the neighborhood and serves as an “action level”. Our empirical research has found that we can get achieve a reasonable estimate of the rise in the river level at the gage in feet by multiplying forecast basin rainfall in inches by 0.9. Actual results vary based on the season and on antecedent conditions, which continue to be studied.

Figure 2 on the next page displays a sample of the rainfall/streamgage correlation chart prepared as part of this study. Basin-averaged rainfall in inches is indicated in red, and the streamgage rise in feet from each storm is indicated in blue.

[39] “USGS 01109403 Ten Mile R., Pawtucket Ave. at East Providence, RI, Ten Mile River Gage at Pawtucket Avenue”, USGS National Water Information System: https://waterdata.usgs.gov/monitoring-location/01109403

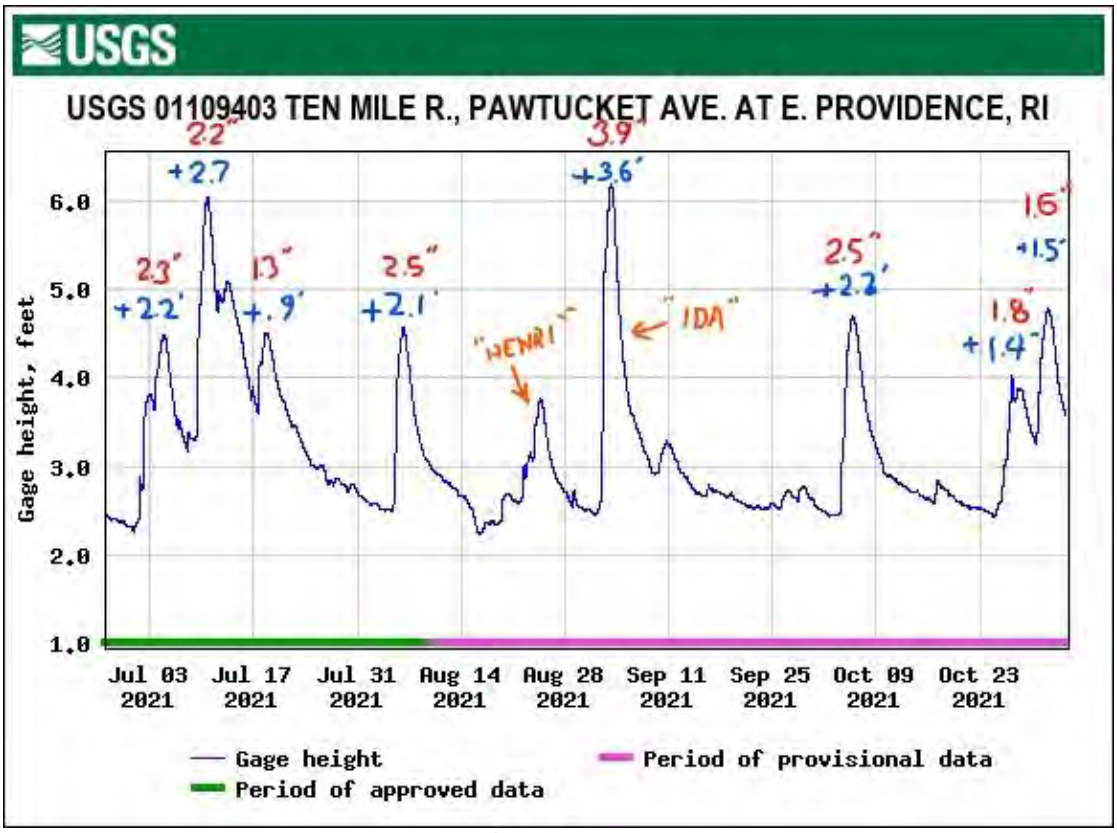


Figure 2: Sample from East Providence EMA/Engineering river gage flood and precipitation study. Rainfall is indicated in red, gage rise in blue.

Fox Point Tide Gage

The NWS Advanced Hydrologic Prediction Service (and locally, the Northeast River Forecast Center in Taunton) maintains tide gages in the Rhode Island area including "Narragansett Bay at Fox Point" (FOXR1),[40] located along the Port of Providence directly across the river from East Providence. The Fox Point gage and others can be linked via the website of the Marine Observation Page of the NWS Forecast Office in Taunton at www.weather.gov/box.

The City has photos from Hurricane Sandy which document high water levels and post-storm debris lines. City Public Safety staff visited numerous coastal areas during the highest storm tide on the evening of October 29, 2012 to view the height of the tidal surge. This photo documentation compared with tide gage readings at these times will aid in coastal flooding forecasts during future surge events, as this is a NOAA forecast point for tide levels. We will also monitor the Conimicut Point tide gage off of Warwick, which is about 2 miles south-southwest of the southernmost point in East Providence.

Section 4.4 - National Flood Insurance Program and Community Rating System

The City of East Providence, along with the other 38 municipalities in Rhode Island, participates in the NFIP, which enables City residents to purchase Federally-backed flood insurance. Additionally, the City is enrolled in FEMA's Community Rating System (CRS), whereby City property owners can receive flood

[40] NOAA Narragansett Bay at Fox Point Tidal Gage, National Weather Service Advanced Hydrologic Prediction Service, accessed October 15, 2015, http://water.weather.gov/ahps2/index.php?wfo=box.

insurance discounts as a result of the City meeting more than the minimum NFIP requirements to help property owners prevent or reduce flood losses. CRS participation by East Providence is administered by local Emergency Management and the Dept. of Public Works (DPW) Building and Engineering Divisions. DPW performs maintenance of drainageways and infrastructure, and helps to identifying flood areas and study areas, along with City Public Safety officials as incidents, needs, or opportunities present. As of 2022, the City was a "Class 8" community, enabling a 10% discount for resident and commercial flood zone policies. This saves residents across the City a total of around $15,000. East Providence EMA will consider increasing this participation so as to achieve a "Class 7" ranking resulting in 15% policy discounts, based on City interest and personnel availability.

East Providence will maintain compliance with NFIP regulations by continuing to require permits for proposed construction and development in the City, and by ensuring that proposed building sites are as safe as possible from flooding. City floodplain coordination staff reviews development plans, with particular emphasis where wetland and floodplain areas are in proximity to the site. Private engineering firms are occasionally consulted when additional input is needed regarding drainage, groundwater, and nearby surface water. For development projects, site elevation contours and proposed building elevations are required, along with a determination of FEMAs flood zones and, if applicable, on-site or nearby base flood elevations and wetland locations.

NFIP	VE Zone	AE Zone	Non-SFHA	City Total
NFIP Policies in Force	4	122	145	271
# of Repetitive Loss Properties	0	15	0	15
Historic # of NFIP Claims	0	73	43	116
Total NFIP Premium				$295,270

Table 19. National Flood Insurance Program Information for East Providence.
Courtesy of RIEMA.

Section 4.5 - Mapping Resources

East Providence EMA, with assistance from the City's Geographic information system (GIS) Coordinator, performs mapping for planning purposes including floodplain and inundation mapping using available RIGIS and City mapping layers. East Providence EMA and the City's Engineering Division both maintain copies of the City's FIRMs and FEMA Flood Studies. Other mapping resources utilized include RIEMA's "Rhode Island Floodplain Mapping Tool," Rhode Island CRMC's "STORMTOOLS," and NOAA's Coastal Flood Exposure Mapper.

Section 4.6 - Other Accomplishments

The City of East Providence has realized numerous accomplishments during the cycle of the 2017 Hazard Mitigation Plan update. These include increasing our enrollment in FEMA's Community Rating System to Class 8, administering the FEMA disaster declaration process for several storms and the COVID-19 pandemic, conducting local riverine and tidal flood studies, obtaining mitigation and preparedness

grants, and determining and implementing practicable mitigation activities in the flood-prone State Street Neighborhood.

For a review of progress and accomplishments regarding action items from the 2017 Hazard Mitigation Plan Update, please see the chart in Section 5.3 below.

Section 4.7 - Capability Needs

Emergency management and hazard mitigation functions in East Providence have advanced considerably over the last decade. Nonetheless, there is a need for increased capability in some areas including:

Continued Emergency Planning: An Emergency Support-Function based Emergency Operations Plan has been recently completed by East Providence EMA. This will need to be maintained and updated as personnel and priorities change. City EMA has also done continuity of government/continuity of operations planning in recent years. The City will consider expanding this effort via RIEMA's COOP Planning contract with a third party vendor.

Increased Capacity for Emergency Storm Sheltering. Progress was made during the 2010's regarding storm sheltering. The replacement of East Providence High school with a brand new facility has temporarily reduced the City's Red Cross-certified sheltering capacity. East Providence will work with RIEMA, the Red Cross, and other agencies as appropriate to increase our capacity again, be it with use of the new high school or other City facilities. We will also work with appropriate agencies regarding complex sheltering issues including accommodations for individuals with functional or medical needs, along with pet sheltering. Emergency shelter capacity planning will be a priority consideration during this Hazard Mitigation Plan cycle.

Expanded Public Outreach. Personnel changes and shifts in emergency management responsibilities during the 2017 Hazard Mitigation Plan cycle resulted in increased EMA capacity and a robust operation, which has served the City very well and will continue to do so. These changes resulted in a temporary loss of institutional knowledge of the hazard mitigation planning process, followed by a heavy focus by EMA and others on the COVID crisis. The City's COVID administrative work was expected to continue for much of 2022, even though COVID operations were decreasing late in 2022's first quarter. During the upcoming hazard mitigation cycle, EMA will establish a program ensuring additional involvement from the public along with City officials and commercial interests with regard to hazard mitigation priorities and opportunities.

SECTION 5 – MITIGATION STRATEGY

City of East Providence staff, with constituent input and aid from RIEMA and FEMA, have developed mitigation strategies for previous planning cycles in 2004 and again in 2010, prior to the current hazard mitigation Planning process. The most recent FEMA-approved Hazard Mitigation Plan (approved May of 2011), included 30 action items designed to address mitigation of future natural hazards. These are listed in the chart below along with their expected benefit at the time, and a statement regarding the progress and status of each item.

Section 5.1 – 2017 Action Plan Status Report

2017 East Providence Hazard Mitigation Plan Action Item Status Report

Action Item	Progress	2022 Status	Rationale
1. Upgrade alternate power capability at municipal facilities including City Hall, other City Buildings	Full service generators have been installed at City Hall, the City Public Works Complex, and at the East Providence Senior Center during this 5-year cycle. This action item is essentially complete.	The City will investigate funding options to provide alternative power for wastewater pumping stations, optimally powered by green energy.	Maintain operations at key City facilities in the event of power outages.
2. Upgrade the City's participation in FEMA's Community Rating System.	At the ASPFM National Conference in 2017, the City of East Providence worked closely with ISO personnel to upgrade our CRS class. On October 1, 2017, the City was upgraded from Class 9 to Class 8. This item is complete as intended.	The City will consider working toward a Class 7 rating in the future depending on staffing and other workload considerations.	Increase flood-plain awareness across the community and ensure flood insurance discounts for our policy holders.
3. Upgrade and strengthen infrastructure at school facilities.	Most public schools had new doors and windows installed to strengthen the building in the event of major weather hazards such as a hurricane, and also to increase security. Construction of a new high school was completed in time for the 2021-22 academic year. This state-of-the-art facility school is up-to-date regarding infrastructure requirements.	Complete	Reduce vulnerability of City schools to impacts from natural and man-made hazards.
4. Update Emergency Action Plans for local high hazard dams and coordinate with upstream communities.	A new dam emergency action plan was completed for the James V. Turner Reaervoir Dam in 2017. The Plan is updated regularly for contact information and any other changes. This task is now performed annually the City's Emergency Management Agency. The City maintains copies of the most recently updated upstream dam plans from the City of Attleboro, MA.	Complete. Plan maintenance will continue.	Inform response activities in the event of a dam emergency; developed list of potentially impacted properties.

5. Implement education program for residents regarding the purpose and use of mapped evacuation routes and coordinate with neighboring towns.	Needs to be coordinated further with the RI Emergency Management Agency and likely with the Rhode Island Department of Transportation, as evacuation routes largely follow State roadways. Education is needed regarding major routes most likely to be affected by hazards during an evacuation operation.	This action will be continued as part of the 2022 Hazard Mitigation Plan cycle.	Inform public regarding evacuation routes in event of a major coastal flooding incident such as a nearby landfalling hurricane.
6. Prepare post-disaster Continuity of Operations Plan for City government.	The East Providence Emergency Management Agency worked with all City Departments to compile lists of essential functions and their priority, orders of succession and delegation of authority, alternate facilities, databases, communications, devolution, and contact information. EMA has assembled this information into a Continuity of Operations Plan for City government. As part of this process, the City provided Alternate Work Arrangements to keep employees safe during the COVID outbreak. This work model will be useful in the event of other types of disasters, natural or otherwise.	RIEMA has contracted with a vendor to assist in producing standardized Continuity of Operations Plans in municipalities statewide. East Providence will participate in the initial meetings and training regarding this effort.	Inform the continuation of government during an emergency that results loss of facilities and/or loss of key employees.
7. Increase shelter capacity and capability with infrastructure upgrades.	Installation of a full-service generator at the East Providence Senior Center Generator has greatly increased the capability of the Center for use as a shelter. The City recently upgraded the Center with hurricane-rated windows which will further enable the building's use as a shelter. Staff have also noted substantial energy savings with the new windows.	The City's new high school has not been surveyed as a potential shelter yet. City EMA will work with the School Department, the Red Cross, and RIEMA to determine the potential for use of this facility for emergency sheltering.	Provide temporary sheltering in the event of a major disaster that results in unlivable conditions for some residents.
8. Upgrade water lines.	The City has performed cleaning and lining of many miles of water mains in the central City area. Multiple projects are in progress to provide back-up for the City main water supply from the Providence Water Supply Board. The City Department of Public Works will continue this effort dependent on the availability of funding.	Ongoing	Ensure reliable supply of clean city-provided water.
9. Reduce poor drainage flooding at flood-prone locations city-wide.	In late 2020, the City replaced a deteriorating culvert along one of the two main north-south thoroughfares to prevent road damage and mitigate erosion and flooding along a steep seasonal stream bank at this location. Drain lines and catch basins throughout the City are maintained on a regular scheduled by the Department of Public Works.	Ongoing. The City will perform additional flood and stormwater mitigation projects as funding allows.	Reduce or eliminate mainly nuisance routine street flooding, reduce stormwater drainage, and improve stormwater quality.

10. Implement physical mitigation activities in repetitive loss areas.	The City completed installation of two "relief pipes" within the structure containing the Warren Avenue Culvert adjacent to a repetitive loss neighborhood. Efforts continue with regard removal of invasive species which impede the natural drainage in areas around the flood-prone State Street neighborhood.	Invasive species removal continues near the Runnins River. The City is investigating property acquisition options in repetitive loss areas.	Protect life and property in flood-prone areas, potentially relocate some housing.
11. Acquire or secure conservation easements on flood-zone and other environmentally sensitive properties.	The Nature Conservancy purchased the development rights to the Agawam Hunt Club's 18-hole golf course in April of 2018. This acquisition protects over 100 acres of land from the addition of impervious surface and preserve wetland and floodplain functions in the lower elevations of the property, particularly along the property's long frontage on the Ten Mile River.	A former 18-hole golf course is up for development; City staff and the City's Waterfront Commission are working with the developer on preserving as much land as possible, including all of the land on this property that is within the SFHA.	Preserve open space to the extent possible, support natural floodplain functions, avoid non-compliant development.
12. Develop a recovery and reconstruction ordinance for post-disaster rebuilding.	Not completed.	This activity may be pursued in the future as part of emergency planning depending on staffing and City leadership priority.	Expedite recovery in the event of a major disaster.
12. Perform emergency/ disaster planning for the City's historic properties.	The City works closely with its Historic District Commission and local groups with regard to preserving the City's historic properties.	Disaster planning has not been a specific focus to this point, but will be considered in the future.	Expedite recovery in the event of a major disaster.
14. Research and implement a backflow valve retrofit program.	A backflow valve is now a plumbing code requirement. A sanitary backwater valve is required for all new construction. The City also requires the installation of a backwater valve on all house lateral repairs. There is not a retrofit program at this time.	This objective is essentially complete.	Reduce or eliminate the risk of sewage backflow into homes/ basements.
15. Conduct outreach regarding tree trimming.	Emergency Management and the Public Works Department continue to with National Grid on providing information to residents regarding tree trimming, and Grid has a program to trim problematic trees in neighborhoods a rotating basis, and on an emergency basis when necessary.	Work with new electrical provider PPL on continuing this National Grid program.	Reduce tree/wire conflicts to lessen incidents of downed wires.

16. Research coastal erosion mitigation options.	The Rhode Island Coastal Resources Management Council and the Nature Conservancy has been constructing a "living shoreline" with native beach vegetation, supported by structural improvements, alongside the coastal bluff Rose Larisa Park in Riverside. A damaged seawall is also being rebuilt at this site.	Plans are being developed to expand the living shoreline installation several hundred feet southward from Rose Larisa Park toward the adjacent residential neighborhood.	Mitigate coastal erosion from storms and gradual sea level rise; protect life and property along shoreline areas and restore natural floodplain functions.
17. Increase resident participation in City-wide hazard mitigation priority identification.	Hazard mitigation outreach has resulted in limited public participation to this point. COVID has added to the challenge with a lack of in-person meeting capability at most times over the last two years.	EMA and planning staff will pursue methods of increasing public input in this area.	Determine mitigation options for floodplone properties.
18. Increase outreach to commercial interests.	EMA is available offered to speak before local business groups regarding natural hazards and will pursue this opportunity. City-based lenders and realtors have been made aware of our Community Rating System participation.	Additional opportunities for business outreach will be pursued.	Assist commercial interests, mitigate natural hazard risks, aid in economic properity.
19. Increase hazard and hazard-mitigation communication in hard copy form and via the use of technology.	EMA has successfully provided public information regarding severe weather, power outages and power restoration following storms via social media platforms. The Mayor's social media and emergency mass- calling outreach is very successful in reaching large numbers of City residents. FEMA information in the City Library system has been updated with the assistance of the City's Library Director, and the 2017 Hazard Mitigation Plan is part of the Library collection.	Continue use of communications media for preparedness and mitigation efforts in addition to use for immediate incidents.	Increase awareness of preparedness, risks, and hazard mitigation.
20. Develop and distribute City specific earthquake damage mitigation information.	Natural and manmade hazard priorities have resulted in efforts geared toward other initiatives.	This effort will be pursued as time allows during the new Hazard Mitigation plan cycle.	Preparedness and mitigation education in the event of an earthquake.

Table 20. 2010-2016 Action Item Progress and Status Report

Section 5.2 - 2016-2021 Action Plan and Mitigation Strategies

Action items (identified as "strategies" below) for this Hazard Mitigation Plan update were developed via review of implementation success of action items from prior East Providence Hazard Mitigation Plans, research of achievements in other local communities, constituent public outreach and input, and City staff public outreach and input. All strategies include:

- A brief description;
- A relative priority assignment based current conditions and general City priorities;

- The mitigation action type;[41]
- Strategy implementation lead agency and supporting agencies and/or resources;
- Description of expected mitigation benefits;
- Time frame as follows and will be put in to action following FEMA's approval of the plan:
    - Short-term = 0 to 2 years
    - Medium term = 2 to 5 years
    - Long-term = 5 years or more
- Approximate cost and funding options as applicable.
- Status of these action plan strategies as of early 2022 (beginning of planning cycle).

For purposes of this Plan update, the Committee has elected to highlight the highest priority hazards as determined by the group and for which mitigation goals could realistically be met, by considering actions aligned to the following mitigation categories:

- Emergency Services
- Natural Resource Protection
- Planning and Prevention
- Property Protection
- Public Education and Awareness
- Structural Projects

Development of mitigation strategies and, in particular, their prioritization, was assisted using FEMA-suggested criteria as found in FEMA's 2013 Local Mitigation Planning Handbook.[42] This criteria includes:

- Life Safety: How effectively will the action protect lives and prevent injuries?
- Property Protection: how significant will the action be at eliminating or reducing damage to structures and infrastructure?
- Technical: Is the action technically feasible? Is it a long-term solution?
- Political: Does the public support the proposed action and is there the political will to support it?
- Legal: Is there local legal authority to implement the action?
- Environmental: What are the potential environmental impacts of the action? Will it comply with environmental regulations?
- Social: Will the proposed action adversely affect a segment of the population?
- Administrative: Is operational and administrative capability adequate to implement the action and maintain it?
- Local Champion: Is there a strong advocate for the action or project among local departments and agencies who will support implementation?
- Other community objectives: Does that action advance other community objectives and display consistency with local goals and with the Comprehensive Plan and other planning mechanisms?

[41] FEMA. Local Mitigation Planning Handbook." 2013. Page 6-4. https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-planning-handbook_03-2013.pdf. Accessed most recently March 7, 2022.
[42] FEMA. "Local Mitigation Planning Handbook." 2013. Pages 6-7 and 6-8. https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-planning-handbook_03-2013.pdf Accessed most recently March 7, 2022.

Hazard Mitigation Mission, Goals, and Specific Strategies

Mission: East Providence is prepared for natural hazards and has the resources to mitigate, prepare for, respond to, and recover from a disaster.

Goal 1: Reduce the vulnerability of our residences, businesses and government to natural disasters.

Strategies:

1. **Implement mitigation activities in repetitive loss areas and other locations vulnerable to flooding.**

   Includes areas vulnerable to coastal flooding and storm surge and river/stream flooding. Investigate managed retreat including property acquisition options in repetitive flood areas. Provide City resources and pursue outside funding options to support these activities.

   Priority: High
   Action Type: Structure and Infrastructure Projects, Natural Systems Protection.
   Project Lead: East Providence DPW.
   Supporting Resources: East Providence EMA and Department of Planning and Economic Development, East Providence Capital Improvement Program, RI Municipal Resilience Program, FEMA Hazard Mitigation Grant Program, USDA-Natural Resources Conservation Service.
   Benefit: Reduce vulnerability of residents and public safety to flood hazards, potentially restore floodplains areas to provide natural floodplain functions.
   Time frame: Medium to long term
   Cost: $100,000's to start.
   Funding options: City Capital Budget, Hazard Mitigation Grant opportunities, other Federal resources.
   2022 status: With grant assistance, the City has recently performed channel maintenance and improved a culvert adjacent to the City's primary repetitive loss area. The City is currently investigating options for property acquisition and has reached out to residents to gage interest in such a program. This action item is modified from the 2017 Hazard Mitigation Plan.

2. **Perform stormwater improvements in areas prone to frequent urban stormwater flooding.**

   Improve stormwater drainage infrastructure in frequent nuisance flood areas, reduce volume and improve stormwater quality into streams and small tributaries. Engineering projects have been identified to reduce routine flood incidents, including culvert upgrades and upsizing or construction of drainage swales.

   Priority: Medium
   Action Type: Structure and Infrastructure Projects, Natural Systems Protection.
   Project Lead: East Providence DPW Engineering Division
   Supporting Resources: Rhode Island Department of Environmental Management, Rhode Island Infrastructure Bank
   Benefit: Reduce the frequency of nuisance urban flooding in chronic flood areas, improve stormwater quality through projects that provide natural filtering.
   Time Frame: Long-term.
   Cost Estimate: $10,000's to start.
   Funding Options: City Capital Budget, Rhode Island Infrastructure Bank, grants available through RIDEM. This a mostly new action item.

2022 Status: The City is currently doing a study on options to reduce stormwater drainage and stormwater quality in the Catamore Blvd. area near the Runnins River.

3. Reduce vulnerability of municipal infrastructure to natural hazards.

Ensure that municipal buildings and other infrastructure continue to provide service and function as designed in the event of an interruption of electrical power or storm structural damage, improve resilience of wastewater infrastructure to rising sea levels.

Priority: Medium
Action Type: Structure and Infrastructure Projects
Project Lead: East Providence DPW
Supporting Resources: SUEZ North America (manager of the City's wastewater treatment plant), FEMA Hazard Mitigation Grant Program
Benefit: Ensure continuity of government operations and full service to the public, ensure continued operations of the City's wastewater infrastructure.
Time Frame: Long-term.
Cost Estimate: $100,000's to start.
Funding Options: City Capital Budget, Hazard Mitigation Grant opportunities.
2022 Status: Full-service generators has been installed at City Hall, the DPW Complex, and the East Providence Senior Center. There are 24 wastewater pumping stations or which five are in Special Flood Hazard Areas. This action item is modified from the 2017 Hazard Mitigation Plan.

4. Increase outreach to commercial interests.

Provide hazard information to commercial interests via established information networks including the East Providence Chamber of Commerce, East Providence Economic Development Commission, realtor groups, and other business organizations.

Priority: High
Action Type: Public Education and Awareness, Planning and Prevention
Project Lead: East Providence EMA.
Supporting Resources: East Providence Department of Planning and Economic Development, East Providence Area Chamber of Commerce and other local business organizations.
Benefit: Increase awareness of hazards and of resource availability.
Time Frame: Short-to-medium term.
Cost/Funding Options: Staff time.
2022 Status: Outreach regarding hazards and hazard mitigation has been minimal in recent years and decreased further during the pandemic. Opportunities to work with the business community should increase in the coming years. This action item is modified from the 2017 Hazard Mitigation Plan.

5. Increase emergency sheltering capability and knowledge of sheltering options and evacuation routes.

In a survey, only 13% or respondents could identify the location of their nearest emergency shelter. Include provision for functional needs individuals and pets in sheltering plans. Included provisions for functional needs individuals and pets. Work with long-term care facilities and East Providence Housing Authority to develop protocol for sheltering in place. Evacuation route signs are posted along some roadways in East Providence but many are not aware of how best to use that information, and some roadways may become unusable in a flood emergency. Evacuation route identification was identified as a concern in a Comprehensive Plan public meeting.

Priority: High
Action Type: Local Plans and Regulations, Education and Awareness Programs.
Project Lead: East Providence EMA.
Supporting Resources: American Red Cross, East Providence Fire and Police Departments, East Providence Housing Authority, Rhode Island Department of Health, RIEMA's Rhode island Sheltering and Coordination Plan, long-term care facilities.
Benefit: Improved service to all residents including those with additional needs in the event of an emergency that requires sheltering.
Time Frame: Medium to long Term.
Cost/Funding Options: Staff time
2022 Status: The Senior Center is the first option for emergency sheltering in the City, but this facility many not be large enough in the case of a major incident such as a direct hurricane hit. The new East Providence High School may be another option. This item is modified from the 2017 Hazard Mitigation Plan.

6. Expand post-disaster Continuity of Operations/Continuity of Government Plans.

Work has been accomplished to develop clear chains of command within City government in the event of a major emergency. This information will need to be updated with any personnel changes. Staff awareness of continuity procedures should be ensured on occasion.
Priority: Medium
Action Type: Local Plans and Regulations
Project Lead: East Providence EMA
Supporting Resources: City Management, all City Department and Division heads, RIEMA.
Benefit: Continued operation and service to the Public in the event of a major incident or emergency.
Time Frame: Short to medium term.
Cost/Funding Options: Staff time, potential monetary costs in the $10,000's longer term depending on participation in RIEMA Continuity of Operations initiative.
2022 Status: The City has completed a Continuity of Operations Plan including staff functions and contact information. RIEMA has offered communities the opportunity to develop detailed continuity plans and expand their existing plans. The City will work with RIEMA on this initiative. This is a modified action item from the 2017 Hazard Mitigation Plan.

7. Ensure continued quality water supply and a redundant system for water provision for City residents and businesses.

Water service is provided to nearly 100% of City residents. Underground infrastructure is many decades old in most cases. Action is needed to mitigate long term degradation of the system.
Priority: High
Action Type: Structure and Infrastructure Projects
Project Lead: DPW Engineering and Water Divisions
Supporting Resources: Other Department of Public Works Divisions and local contractors.
Benefit: Pro-active avoidance of water main breaks. Strengthen existing water infrastructure for increased resilience. Have an alternate water supply available in the case of a failure to receive water service from the Providence Water Supply Board.
Time Frame: Short to medium term.

Cost/Funding Options: $Millions. Funding available through the RI Infrastructure Bank. Additional funding options include City Water Enterprise Fund, City Capital Budget, and a City Bond initiative.

2022 Status: Water main cleaning and lining is in the project priority list through the RI Infrastructure Bank. This activity is expected to continue over the next three years. Design is in progress for an interconnection with the Pawtucket Water Supply Board to meet the Rhode Island Water Board's guidelines and recommendations to have a second source of water. The City will also coordinate with the Bristol Country Water Authority on this initiative. This is a mostly new action item.

8. **Perform maintenance projects at the James V. Turner Reservoir Dam as recommended by the RI Department of Environmental Management.**

Occasional state inspections through RIDEM's Dam Safety Program have led to some recommendations for dam maintenance that will help to ensure long-term structural resilience. No short-term threats to public safety have been discovered, but preventive maintenance is recommended.

Priority: Medium

Action Type: Structure and Infrastructure Projects

Project Lead: DPW Engineering Division

Supporting Resources: RIDEM, RI Infrastructure Bank

Benefit: Avoid the future need for more immediate and more costly future maintenance**.**

Time Frame: Medium term.

Cost/Funding Options: $Hundreds of thousands. Funding may available through the RI Infrastructure Bank. Additional funding options include City Capital Budget. More investigation is needed on potential funding.

2022 Status: The City maintains a Dam Emergency Action Plan for this state-designated High-Hazard dam. A 2018 RIDEM inspection found mostly minor issues including minimal concrete deterioration and some areas with vegetation where it didn't belong. The City doing preliminary research on maintenance options for the structure. This is a new action item.

Goal 2: Increase local capacity regarding hazard mitigation and incident and disaster preparedness, response, and recovery

Strategies:

9. **Preserve open space to the extent possible in special flood hazard areas and other environmentally sensitive areas.**

Certain undeveloped properties, or portions of properties, in the SFHA or containing wetlands, may be best suited to remain in or return to a natural state. Acquire, secure conservation easements on, or otherwise retain these areas so that their value for natural floodplain functions and wildlife habitat is preserved.

Priority: High

Action Type: Natural Systems Protection

Project Lead: East Providence Department of Planning and Economic Development

Supporting Resources: Waterfront Special Development District Commission, Conservation Commission, RIDEM, National Fish and Wildlife Program, RI Infrastructure Bank Municipal Resilience Program.

Benefit: Protection of natural resources, reduction in imperious surface, mitigation of additional flooding due to intensified land use, avoid development in areas of high flood risk, natural treatment of stormwater runoff.

Time Frame: Short through long term
Cost/Funding Options: Potential DEM funding, City Capital Budget, fee-simple acquisition, RI Infrastructure Bank, various Federal funding opportunities.
2016 Status: City does not actively seek land acquisition or conservation easements but considers inquiries on a case-by-case basis. Subdivision and development plan review includes consideration of flood potential and of sensitive environments on-site and nearby. This action item is expanded from the 2017 Hazard Mitigation Plan.

10. Develop a recovery and reconstruction ordinance for post-disaster rebuilding.
In the wake of a major hazard incident, such as a hurricane, an emergency reconstruction ordinance that is specific to East Providence could expedite responsible rebuilding in affected areas.
Priority: Low to Medium.
Action Type: Local Plans and Regulations.
Project Leads: City's Planning Department and DPW Building Division
Supporting Resources: East Providence EMA, Planning Board, City Council, City Administration, RI Dept. of Administration.
Benefit: Aid in streamlining the permitting process and expediting the return of the community to pre-incident conditions.
Time Frame: Long-term
Cost: Staff time.
Funding Options: n/a
2022 Status: Research will be performed regarding similar communities' experiences with this type of initiative. This is a continued action item from the 2017 Hazard Mitigation Plan.

11. Perform emergency/disaster planning for the City's historic properties.
Provide disaster planning resources including templates for disaster planning for parties responsible for City-owned or affiliated historic properties and structures including the historic Crescent Park Looff Carousel.
Priority: Medium
Action Type: Structure and Infrastructure Projects
Project Lead: East Providence Planning Department
Supporting Resources: Historic District Commission, East Providence EMA, Rhode Island Office of Library and Information Services, RIEMA Emergency Support Function 17- Historic Culture and Preservation.
Benefit: Prepare for and potential mitigate damage to historic structures from natural hazards.
Time Frame: Medium-term.
Cost/Funding Options: Staff and volunteer time
2022 Status: Coordination needed with resources as above. This is a continued action item from the 2017 Hazard Mitigation Plan.

12. Establish a comprehensive tree program.
Overhead utilities lines, transportation, and property are all at risk from damage by falling, overgrown, or poorly-located trees. National Grid, as the City's electrical provider in recent years, has an existing tree trimming program. Continue work with Grid and or/future providers, and participate in statewide urban forest initiatives, to provide City residents with resources regarding maintenance of trees on private property that are adjacent to power

lines, may affect the overhead utility connection to their property, or may otherwise cause property damage.

Priority: Medium

Action Type: Education and Awareness Programs

Project Lead: East Providence EMA

Supporting Resources: National Grid or current electric utility provider, DPW Parks Division, RIDEM Urban and Community Forestry Program.

Benefit: Protection of overhead utilities, limit property damage especially during storm events.

Time Frame: Medium-term.

Cost/Funding Options: Staff time.

2016 Status: Working with National Grid to determine rotating schedule of tree trimming activities and other line maintenance. Outreach to residents regarding trees on private property will be developed. This action is modified and expanded from the 2017 Hazard Mitigation Plan.

13. Develop coastal erosion mitigation options.

Shoreline erosion resulting from high-than-normal tide events and from storm wave action is causing gradual incremental property loss in portions of Riverside and there is concern for structural damage in the long term based on expected climate events, and in the shorter-term in the event of a hurricane storm surge. Some individual property owners have undertaken their own shoreline protection measures and there is resident interest in a comprehensive strategy for erosion mitigation.

Priority: Medium

Action Type: Property Protection, Structural Projects.

Project Lead: East Providence EMA, Planning Department, DPW Engineering Division.

Supporting Resources: Coastal Resources Management Council, The Nature Conservancy.

Benefit: Protection of property during major storm and high tide events.

Time Frame: Long-term

Cost/Funding Options: $100,000's to start, $Millions long-term. Funding options to be determined.

2022 Status: The City has worked with the Nature Conservancy and the RI Coastal Resources Management Council on a "Living Shoreline" project to reduce coastal erosion adjacent to Rose Larisa Park and is also performing structural improvements including rebuilding a seawall at this locations. It is hoped that the living shoreline project can be expanded below the coastal bluff to the north and south. This is a continued action item from the 2017 Hazard Mitigation Plan.

14. Maintain/coordinate Emergency Action Plans for local high hazard dams and coordinate with upstream communities.

Ensure that local emergency action plans are up to date with regard to areas of impact, emergency notification protocol, and local contact information.

Priority: High

Action Type: Natural Systems Protection, Structure and Infrastructure Projects

Project Lead: East Providence EMA

Supporting Resources: Police Dept., Fire Dept., DPW Water Division, RIEMA, and Narragansett Bay Commission.

Benefit: Higher level of preparedness and increased ability to move people from harm's way in the unlikely event of a dam emergency.

Time Frame: Medium-term. Complete early 2018
Cost/Funding Options: Staff time
2022 Status: The Turner Reservoir Dam Emergency Action Plan is currently being updated for contact information. More detailed hazard mapping is desirable. Coordination is still needed with Narragansett Bay Commission (NBC) re: EAP for a structure at their WWTF facility in Rumford. The NBC should produce this plan, but it is the City's responsibility to ensure that it is completed. This is a continued action item from the 2017 Hazard Mitigation Plan.

Goal 3: Maintain FEMA National Flood Insurance Compliance to compliance to ensure the availability of Federally-backed flood insurance for City residences and businesses, and further to ensure City eligibility to apply for preparedness and mitigation grants through FEMA.

Strategies:

15. Engage constituents in City-wide climate change and hazard mitigation priority identification.
Develop a public outreach strategy to inform the constituency of the impacts of natural hazards and climate change through various methods of engagement, develop a clearinghouse of resources available to residents to increase awareness and resiliency. Coordinate with social service agencies to engage our more vulnerable residents.
Priority: High
Action Type: Public Education and Awareness
Project Lead: East Providence EMA
Supporting Resources: Office of the Mayor (public outreach assistance), Health Equity Zone, East Bay Community Action Program, East Providence Senior Center, Rhode Island Municipal Resilience Program, RIEMA and FEMA Resources.
Benefit: Increased constituent awareness of natural hazards and government resources.
Time Frame: Long-term
Cost/Funding Options: Staff time
2022 Status: The City is participating in the Municipal Resilience Program which had aided in identifying hazards and areas of concern, and held Hazard Mitigation and Comprehensive Plan meetings and distributed related surveys. This action item is modified from the 2017 Hazard Mitigation Plan.

16. Maintain the City's participation in FEMA's Community Rating System as at least a Class 8 Community.
Continue maintenance of our participation in this program and investigate a possible upgrade to Class 7. Increase staff certified in floodplain management.
Priority: High
Action Type: Local Plans and Regulations, Education and Awareness Programs.
Project Lead: East Providence EMA
Supporting Resources: East Providence DPW Engineering Division, RIEMA CRS User Group as available, or other RIEMA Resources, FEMA CRS Resources including CRS Coordinator's Manual, Insurance Services Office (ISO).
Benefit: 10% Federal flood insurance discounts for floodplain residents, increased public outreach and floodplain awareness.
Time frame: Short-term for CRS 5-year recertification, long-term for maintenance.
Cost: Staff time.

Funding options: City support for necessary time and resources to complete requirements.
2022 Status: The City's 5-year CRS recertification is due in December of 2023. Substantial staff time will be needed in the months preceding this deadline to complete this project. Annual certifications are less intensive. The City currently does not have a Certified Floodplain Manager on staff and should support one or more staffers to work toward this certification. This action item is modified from the 2017 Hazard Mitigation Plan.

17. Perform annual maintenance and a five-year update on the City's Hazard Mitigation Plan. Engage constituents annually to the extent possible in accordance with FEMA guidance including the Local Hazard Mitigation Planning Handbook and Plan Review Guide.
Priority: High
Action Type: Local Plans and Regulations, Education and Awareness Programs
Project Lead: East Providence EMA
Supporting Resources: Office of the Mayor (public outreach assistance and publicity, FEMA guides, East Providence Chamber of Commerce, RIEMA.
Benefit: Keep up with local concerns regarding natural hazards, citizen and government priorities, and opportunities for funding and implementing projects.
Time Frame: Short and Medium Term.
Cost/Funding Options: Staff time, BRIC or HMA grant assistance.
2022 Status: With pandemic activity on the decrease as of the first quarter of 2022, other priorities including mitigation planning are receiving more attention and we expect this to continue moving forward. This is a mostly new action item.

SECTION 6 – PLAN ADOPTION, IMPLEMENTATION, AND EVALUATION

Section 6.1 - Plan Adoption

The adoption of this Hazard Mitigation Plan update follows procedures per guidance from FEMA. Upon completion of the Draft Hazard Mitigation Plan update, it is forwarded to RIEMA for review and comment. Upon return to the City, the recommended adjustments are made the Draft Plan is re-submitted to RIEMA, who will forward the revised draft to FEMA Region I for review and any additional recommendations for revision or correction. Finally, upon FEMA approval, the Plan is forwarded to the East Providence Planning Board, with request for a recommendation to the Council to adopt the Plan as the official Hazard Mitigation Plan for the City of East Providence.

The completion of the formal FEMA approval and City adoption process aids in improving our status as a CRS jurisdiction, and assists the City in applying for available mitigation grant funding. Documentation of this process, including a timeline of plan submissions, revisions, and City Planning Board and Council activity, will be found in Appendix G along with evidence of FEMA plan approval and City Council plan adoption.

Section 6.2 - Plan Implementation and Evaluation

In accordance with common practice and to remain realistic with plan implementation expectations, relative time frames have been assigned to the mitigation strategies in Section 5 of this Plan update. These were assigned with consideration of the existing state of the City late in 2015. Immediate needs were prioritized for earlier implementation, with longer-term planning initiatives assigned a time frame further into the future. The concurrent development of this Plan update and the City's Comprehensive Plan update allowed for optimal integration of these planning mechanisms and strong coordination with other planners during this process.

Over time, priorities will shift based on factors including successful completion of projects, new natural hazard incidents and/or disasters, changes in City leadership, adjustments in the economy, changes in development, and more. East Providence Emergency Management will work with the Planning Department, City Management and Incident Command Staff, and others to track and update our mitigation strategies and overall action plan. As noted in Section 2, this Plan update will be made available to the public on hard copy in the Planning Department and at the City's libraries, and online via the City of East Providence's EMA webpage; available at http://www.eastprovidence.com/ema. Constituents are always invited to submit comments by e-mail or phone. Implementation progress on the action plan will be reported to City officials and to RIEMA annually. The City's EMA webpage also features information on upcoming meetings and plan updates, and is updated frequently for general Emergency Management information including agency activities, preparedness resources, and forecasts for impact weather events.

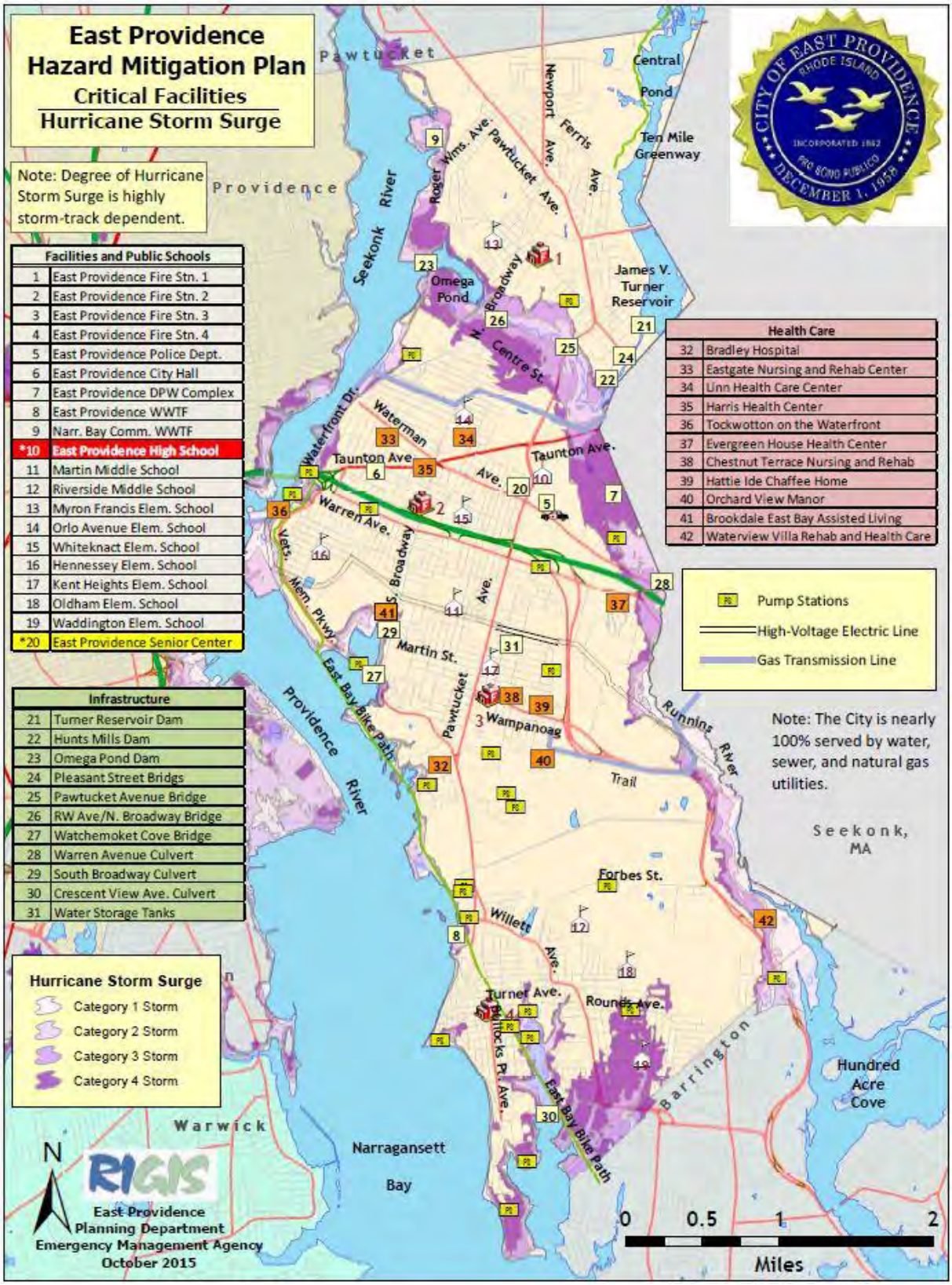
APPENDIX A. Critical Facilities and Storm Surge Mapping

Facilities and Public Schools	
1	East Providence Fire Stn. 1
2	East Providence Fire Stn. 2
3	East Providence Fire Stn. 3
4	East Providence Fire Stn. 4
5	East Providence Police Dept.
6	East Providence City Hall
7	East Providence DPW Complex
8	East Providence WWTF
9	Narr. Bay Comm. WWTF
*10	East Providence High School
11	Martin Middle School
12	Riverside Middle School
13	Myron Francis Elem. School
14	Orlo Avenue Elem. School
15	Whiteknact Elem. School
16	Hennessey Elem. School
17	Kent Heights Elem. School
18	Oldham Elem. School
19	Waddington Elem. School
*20	East Providence Senior Center

Infrastructure	
21	Turner Reservoir Dam
22	Hunts Mills Dam
23	Omega Pond Dam
24	Pleasant Street Bridgs
25	Pawtucket Avenue Bridge
26	RW Ave/N. Broadway Bridge
27	Watchemoket Cove Bridge
28	Warren Avenue Culvert
29	South Broadway Culvert
30	Crescent View Ave. Culvert
31	Water Storage Tanks

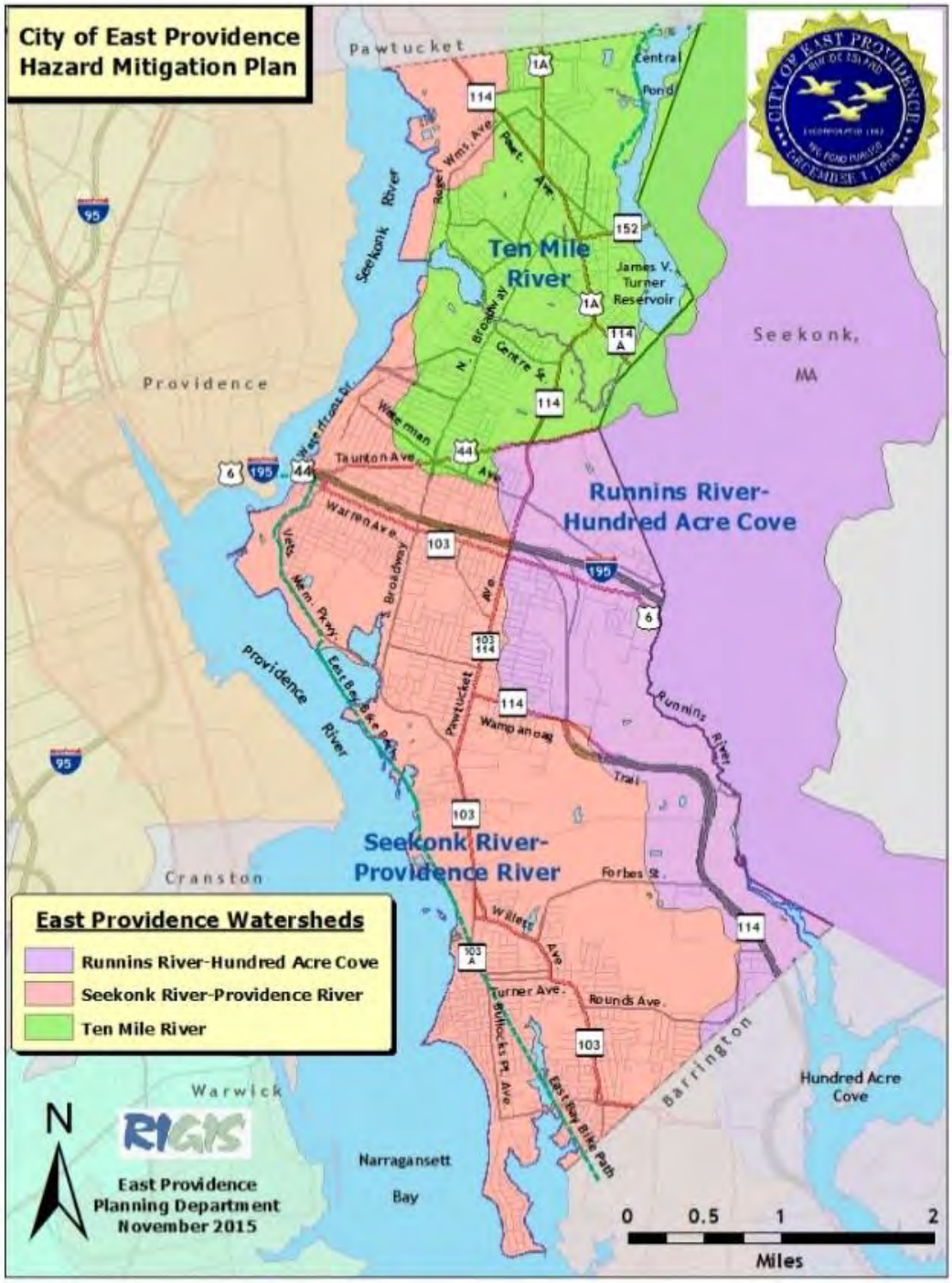
Health Care	
32	Bradley Hospital
33	Eastgate Nursing and Rehab Center
34	Linn Health Care Center
35	Harris Health Center
36	Tockwotton on the Waterfront
37	Evergreen House Health Center
38	Chestnut Terrace Nursing and Rehab
39	Hattie Ide Chaffee Home
40	Orchard View Manor
41	Brookdale East Bay Assisted Living
42	Waterview Villa Rehab and Health Care

Map A-1. East Providence Critical Facilities with Flood Zones

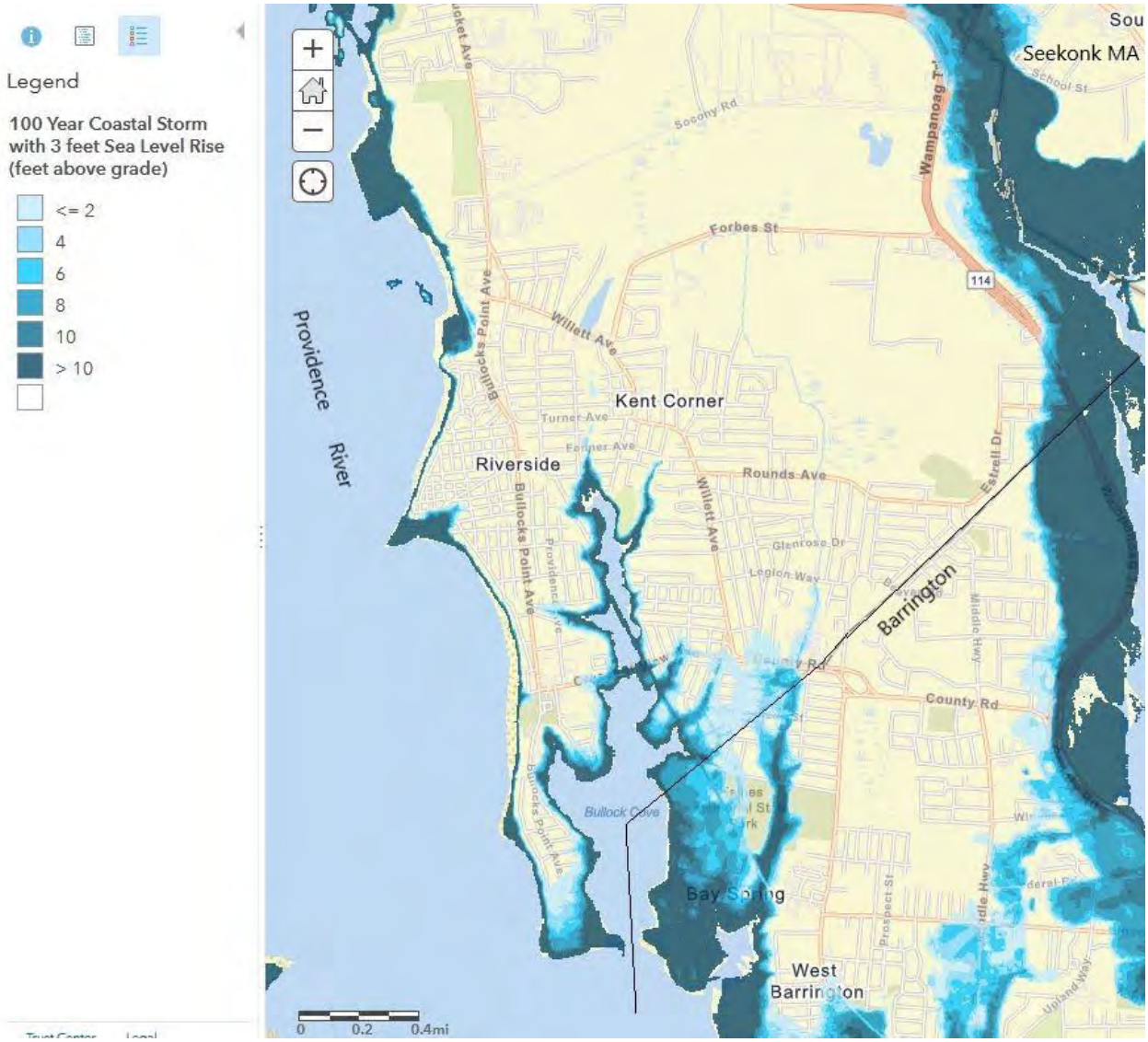


Map A-2. East Providence Critical Facilities with Hurricane Inundation Zones

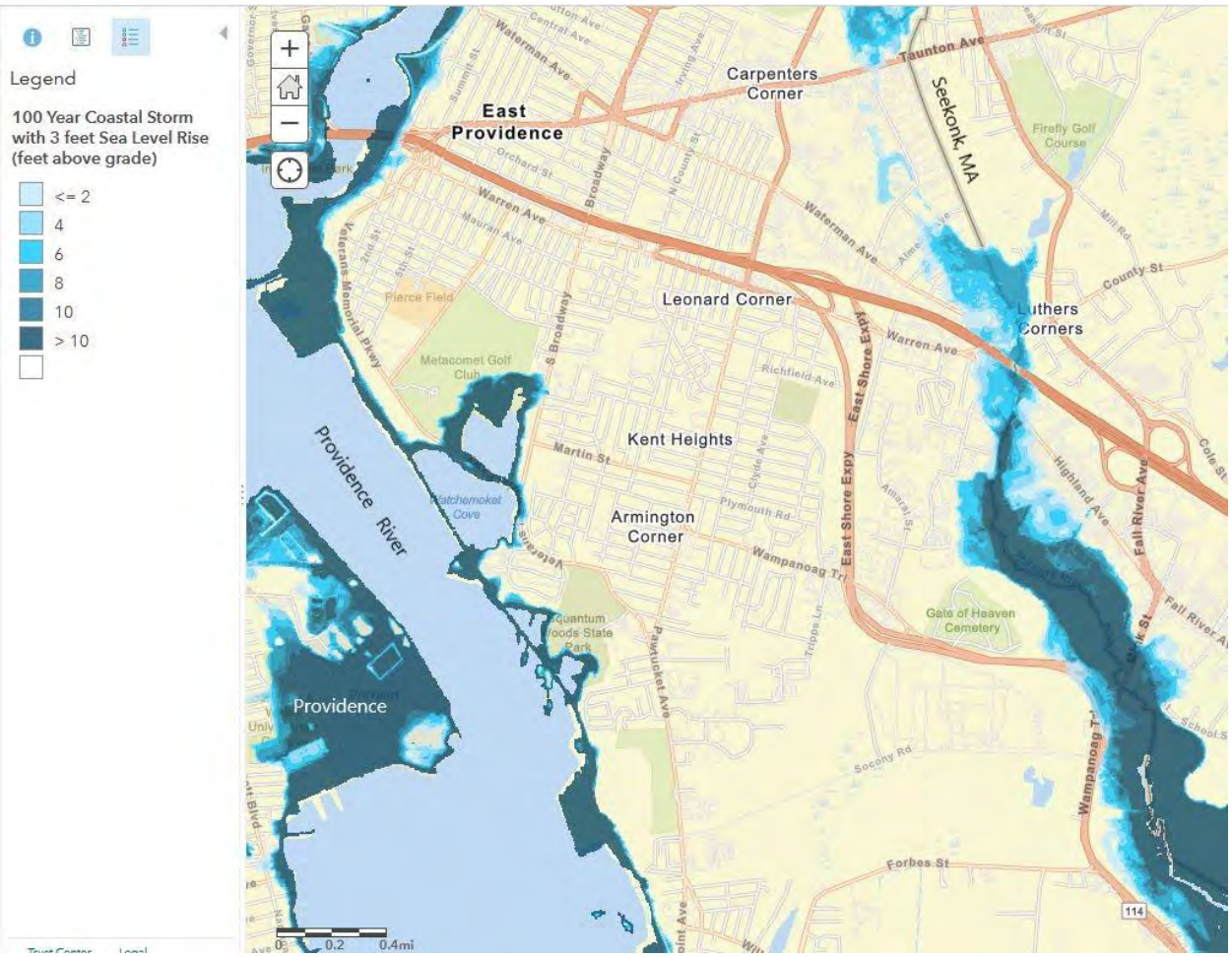
APPENDIX B. Drainage Basins and Coastal Hazards Mapping



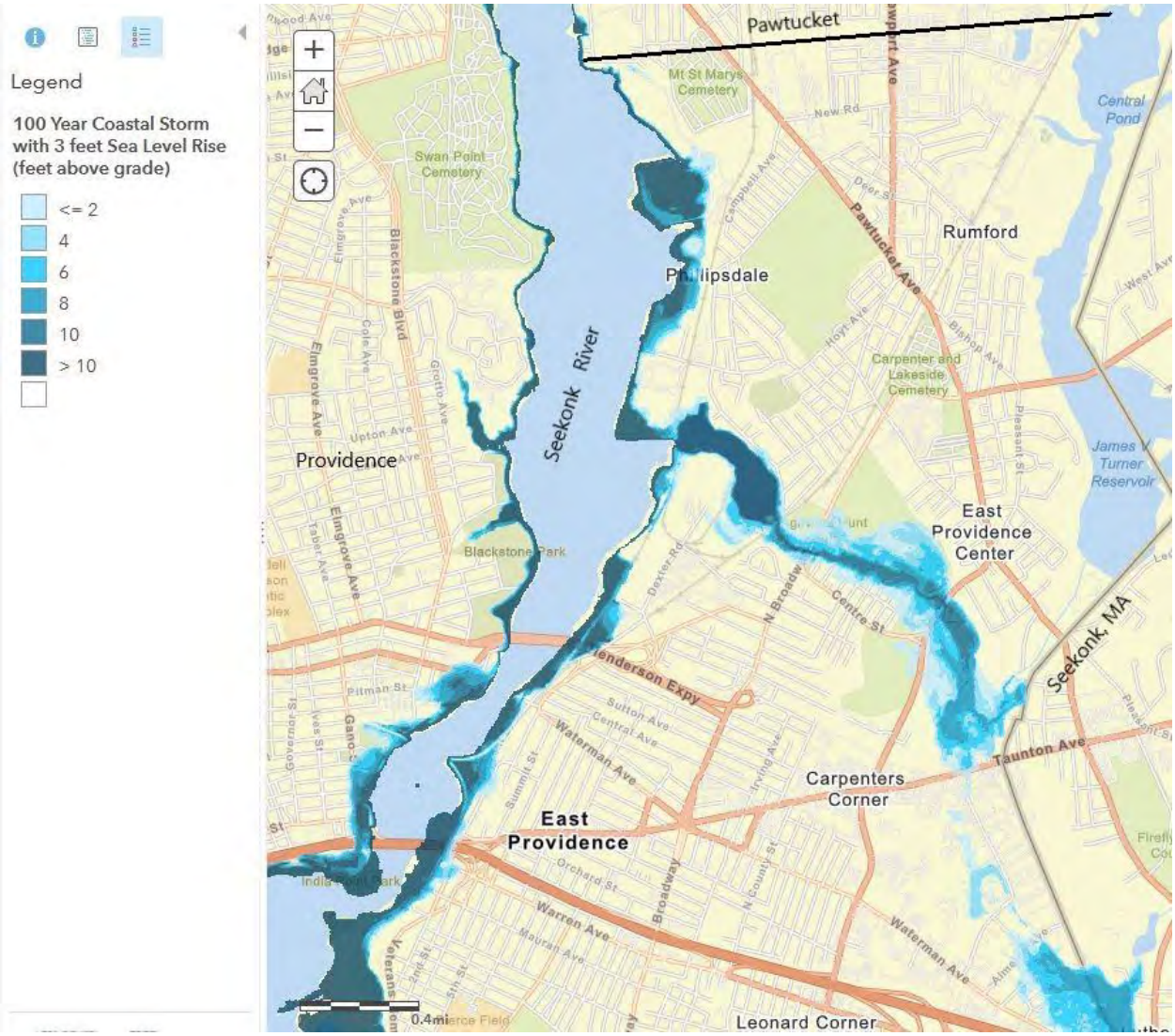
Map B-1: East Providence Drainage basins



Map B-2: Southern East Providence 100-year storm plus 3-foot sea level rise. Map from RI Storm Tools, http://www.beachsamp.org/stormtools/



Map B-3: Central East Providence 100-year storm plus 3-foot sea level rise. Map from RI Storm Tools, http://www.beachsamp.org/stormtools/



Map B-4: Northern East Providence 100-year storm plus 3-foot sea level rise. Map from RI Storm Tools, http://www.beachsamp.org/stormtools/

APPENDIX C. Technical and Financial Assistance Resources

State Resources

Rhode Island Departments of Climate Change and Environmental Management can provide technical assistance and resources to communities seeking to implement their hazard mitigation plans.

Rhode Island Emergency Management Agency: The Rhode Island State Hazard Mitigation Office (SHMO) and State Mitigation Planner(s) can provide guidance regarding grants, technical assistance, available publications, and training opportunities.

RI Mapping Portal: GIS data available to download

Rhode Island Department of Environmental Management:

Rhode Island DEM has produced and maintains the Rhode Island Stormwater Design and Installation Standards Manual. A central component of the manual is encouragement of the use of low impact development (LID) techniques as the primary strategy to control and reduce stormwater impacts. DEM's Stormwater Guidance website, http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/t4guide/desman.htm, contains the latest version of the stormwater manual along with LID guidance documents, soil erosion and sediment control guidance, and permitting guidance.

DEM's Division of Planning and Development is responsible for functions ranging from land acquisition programs, open space and recreation grant funding, and much more. Information on these programs is available on-line at http://www.dem.ri.gov/programs/bpoladm/plandev/index.htm.

For general information on DEM programs, call (401) 222-6800 or visit http://www.dem.ri.gov/.

Rhode Island Coastal Resources Management Council:

CMRC is the regulatory management agency for the state's coastal zone. STORMTOOLS has been developed as part of the agency's Shoreline Change Special Area Management Plan. This program displays coastal flood zones statewide, the depth of flooding at a given locations from the 100-year flood, and maps out projected levels of sea level rise. A link to this product and a tutorial for its use is available at http://www.beachsamp.org/resources/stormtools/.

RI Coastal Resources Management Council
Stedman Government Center
4808 Tower Hill Road
Wakefield, RI 2879
Phone: (401) 222-2476
http://www.crmc.ri.gov

RI Department of Administration
Division of Planning
One Capitol Hill, Third Floor
Providence, Rhode Island 02908
Phone: (401) 222-6478
http://www.planning.ri.gov

RI Department of Environmental Management
235 Promenade Street
Providence, RI 02908-5767
401-222-4700
http://www.dem.ri.gov/

RIDEM: Division of Parks and Recreation
1100 Tower Hill Road
North Kingstown, RI 02852
Phone: (401) 667-6200
http://www.riparks.com/

RI Department of Transportation
Two Capitol Hill
Providence, RI 02903
Phone: (401) 222-2450
http://www.dot.ri.gov/

RI Public Utilities Commission
89 Jefferson Blvd.
Warwick, RI 02888
Phone: (401) 941-4500
http://www.ripuc.ri.gov

RI Department of Health
3 Capitol Hill
Providence, RI 02918
401-222-5960
https://health.ri.gov

RI Builders Association
450 Veterans Memorial Parkway
East Providence, RI 02914
Phone: (401) 438-7400
https://ribuilders.org/

RI State Building Code Commission
560 Jefferson Blvd, Suite 100
Warwick, RI 02886
Phone: (401) 921-1590
http://www.ribcc.ri.gov/

RI Department of Business Regulations
1511 Pontiac Avenue
Cranston, RI 02920
Phone: (401) 462-9500
http://www.dbr.ri.gov

RI Emergency Management Agency
645 New London Avenue
Cranston, RI 02920
Phone: (401) 946-9996
http://www.riema.ri.gov/

RI National Flood Insurance Program
c/o RIEMA, 645 New London Avenue
Cranston, RI 02920
http://www.riema.ri.gov/
Phone: (401) 946-9996

RI State Fire Marshal's Office
550 Jefferson Blvd.
Warwick, RI 02886
(401) 889-5555
http://www.fire-marshal.ri.gov/

Federal Resources

FEMA

- FEMA Climate Change: Provides resources that address climate change.
- FEMA Library: FEMA publications can be downloaded from the library website. These resources may be especially useful in public information and outreach programs. Topics include building and construction techniques, NFIP policies, and integrating historic preservation and cultural resource protection with mitigation.
- FEMA RiskMAP: Technical assistance is available through RiskMAP to assist communities in identifying, selecting, and implementing activities to support mitigation planning and risk

reduction. Attend RiskMAP discovery meetings that may be scheduled in the state, especially any in neighboring communities with shared watersheds boundaries.

National Flood Insurance Program
All of Rhode Island's 39 municipalities participate in the NFIP. Flood insurance is made available to residents in exchange for community compliance with minimum floodplain management regulations. Communities participating in the NFIP must:

- Adopt the latest Flood Insurance Rate Maps;
- Require that all new construction or substantial improvement to existing structures in the flood hazard area be elevated or (if nonresidential) flood proofed to the identified flood level on the maps; and
- Require design techniques to minimize flood damage for structures being built in high hazard areas.
-

Coverage for land subsidence, sewer backup and water seepage is also available subject to the conditions outlined in the NFIP standard policy. Since homeowners' insurance does not cover flooding, a community's participation in the NFIP is vital to protecting property in the floodplain as well as being essential to ensure that federally backed mortgages and loans can be used to finance flood prone property.

If a community participating in NFIP's CRS program performs activities that include maintaining records for floodplain development, publicizing the flood hazard, improving data and floodplain management planning, then the flood insurance premiums paid by policyholders in the community will be reduced by 5 to 45 percent, depending on the number of mitigation activities performed from an approved list. Developing and maintaining this Hazard Mitigation Plan is among the activities that gain credit under the CRS.

For further information contact the State of Rhode Island Floodplain Manager at RIEMA, (401) 946-9996.

Other Federal

- **NOAA – National Weather Service and Northeast River Forecast Center (NERFC):** The National Weather Service (NWS) Forecast Office that serves most of southern New England, located in Norton, MA provides forecasts, warnings and local climate information. The NWS has provided customized meteorological support to RIEMA during times of hazardous RIEMA shares with municipalities via conference call. The Northeast River Forecast Center provides general hydrologic forecasts for the northeast region which extends into New York and Pennsylvania, and provides specific forecasts for some regional river gages. The City's Deputy EMA Director also provides meteorological support as conditions warrant and as requested by City staff.
  For further information contact National Weather Service at (508) 622-3300.
- **NOAA – National Centers for Environmental Information:** This agency is the premier source for climate data and information. Their website provides public access to the nation's climate and historical weather data and information including climate reports, drought information, and climate datasets for thousands of locations.
- EPA Resilience and Adaptation in New England (RAINE): A collection of vulnerability, resilience and adaptation reports, plans, and webpages at the state, regional, and community levels. Communities can use the RAINE database to learn from nearby communities about building resiliency and adapting to climate change.

- EPA Soak Up the Rain: Soak Up the Rain is a public outreach campaign focused on stormwater quality and flooding. The website contains helpful resources for public outreach and easy implementation projects for individuals and communities.
- NOAA C-CAP Land Cover Atlas: This interactive mapping tool allows communities to see their land uses, how they have changed over time, and what impact those changes may be having on resilience.
- NOAA Sea Grant: Sea Grant's mission is to provide integrated research, communication, education, extension and legal programs to coastal communities that lead to the responsible use of the nation's ocean, coastal and Great Lakes resources through informed personal, policy and management decisions. Examples of the resources available help communities plan, adapt, and recovery are the Community Resilience Map of Projects and the National Sea Grant Resilience Toolkit
- NOAA Sea Level Rise Viewer and Union for Concerned Scientists Inundation Mapper: These interactive mapping tools help coastal communities understand how their hazard risks may be changing. The "Preparing for Impacts" section of the inundation mapper addresses policy responses to protect communities.
- NOAA U.S. Climate Resilience Toolkit: This resource provides scientific tools, information, and expertise to help manage climate-related risks and improve resilience to extreme events. The "Steps to Resilience" tool may be especially helpful in mitigation planning and implementation.
- **U.S. Army Corps of Engineers (USACE):** The Army Corps New England District manages major Corps engineering projects in the region and performs functions including:
  - Environmental restoration and stewardship;
  - Flood risk management;
  - Natural resource and recreation management;
  - Streambank and shoreline protection;
  - Navigation improvements and maintenance;
  - Disaster assistance;
  - Regulatory/Permitting program; and
  - Engineering and construction management support to other agencies.

  The Corps's Update Report for Rhode Island is an excellent source of information on the progress of Corps projects including mitigation activities in the state. This newsletter is available on-line at http://www.nae.usace.army.mil/Media/StateUpdateReports.aspx.

Not for Profit

- Kresge Foundation Online Library: Reports and documents on increasing urban resilience, among other topics.
- Naturally Resilient Communities: A collaboration of organizations put together this guide to nature-based solutions and case studies so that communities can learn which nature-based solutions can work for them.
- Rockefeller Foundation Resilient Cities: Helping cities, organizations, and communities better prepare for, respond to, and transform from disruption.
- **American Red Cross (ARC):**
- The American Red Cross Chapter of Rhode Island public education materials and conducts training programs and seminars. The agency provides shelter assistance to communities across the state on a regional basis and works with RIEMA in this capacity. The Red Cross also has supply emergency clean-up kits in flood disasters.

Funding Sources:

- Grants.gov: Lists of grant opportunities from federal agencies (HUD, DOT/FHWA, EPA, etc.) to support rural development, sustainable communities and smart growth, climate change and adaptation, historic preservation, risk analyses, wildfire mitigation, conservation, Federal Highways pilot projects, etc.
- FEMA Hazard Mitigation Assistance (HMA): FEMA's Hazard Mitigation Assistance provides funding for projects under the Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), and Flood Mitigation Assistance (FMA). States, federally recognized tribes, local governments, and some not for profit organizations are eligible applicants.
- GrantWatch: The website posts current foundation, local, state, and federal grants on one website, making it easy to consider a variety of sources for grants, guidance, and partnerships. Grants listed include The Partnership for Resilient Communities, the Institute for Sustainable Communities, the Rockefeller Foundation Resilience, The Nature Conservancy, The Kresge Climate-Resilient Initiative, the Threshold Foundation's Thriving Resilient Communities funding, the RAND Corporation, and ICLEI Local Governments for Sustainability.
- Rhode Island Department of Environmental Management: Funding for a variety of types of projects that will increase the resilience of local communities, including Local Open Space Grants.
- Rhode Island Emergency Management Agency: The State of Rhode Island administers FEMA HMA grants. Communities are encouraged to work with the State to maximize use of every 406 Hazard Mitigation opportunity when available during federally declared disasters.
- USDA Natural Resource Conservation Service (NRCS) and Rural Development Grants: NRCS provides conservation technical assistance, financial assistance, and conservation innovation grants. USDA Rural Development operates over fifty financial assistance programs for a variety of rural applications.

APPENDIX D. Public Outreach

December 21, 2021 East Providence City Council meeting- Hazard Mitigation Plan presentation including request for public and Council input

Page 10 The Post December 16, 2021

Next council meeting features Hazard Mitigation Plan update

Planning Department will present latest amendments being considered

To The Post

The Planning Department, as part of the regularly scheduled City Council meeting for the evening of December 21 in City Hall, will present its updated Hazard Mitigation Plan.

The purpose of the session is to inform the council, residents and business owners of revisions being made to the plan in time for 2022. The Hazard Mitigation Plan details natural hazards that are a threat to the city and outlines actions that the city can take to minimize the impact of these hazards to its constituents including loss of life and property. This is achieved by identifying risks and vulnerabilities that are common here.

"Having a Hazard Mitigation Plan in place is imperative in order to mitigate disaster damage and reconstruction," Mayor Bob DaSilva said. "In addition, having a FEMA-approved (Federal Emergency Management Agency) Hazard Mitigation Plan is required in order for East Providence to be eligible for various FEMA grants, participation in the National Flood Insurance Program, and a federal program which achieves discounts on federal flood insurance for policy holders."

As part of the planning process, the city is soliciting public input regarding the reduction of its vulnerability to natural hazards. These include flooding, severe thunderstorms, major winter storms, hurricanes, excessive heat, coastal erosion, sea level rise, and more. Please join us to learn more and to provide your input on hazard mitigation planning goals and risk-reduction ideas for East Providence.

"We encourage our residents to join us to learn more and to provide input on hazard mitigation planning goals and risk-reduction ideas for East Providence," DaSilva added.

The current Hazard Mitigation Plan, last updated in 2017, is available for review and inspection in the Department of Planning, Room 309, City Hall, 145 Taunton Ave., Monday-Friday 8 a.m. to 4 p.m. It is also posted on the city's website https://eastprovidenceri.gov/departments/emergency-management.

December 21, 2021 East Providence City Council meeting- Hazard Mitigation Plan presentation-

Public Comment sign

Public Comment Sign Up Sheet – East Providence City Council

Meeting Date: December 21, 2021

Linda Leite?

NAME	ADDRESS	DOCKET ITEM
Candy Seel	1340 So. Broadway	Resilence and Hazard Mitigation
Heather Andrade	145 Wampanoag Trail	Resilience and Hazard Mitigation
Jenn Tierney	54 Mary Ave	" " "

December 21, 2021 East Providence City Council meeting- Hazard Mitigation Plan presentation- Section of meeting minutes including Hazard Mitigation Plan presentation

VIII. PROCLAMATIONS & PRESENTATIONS

1. Presentation on the City of East Providence's plan to update the hazard mitigation plan in 2022 – City of East Providence Planning Department

- ***William Fazioli, Dominic Leonardo and Wayne Barnes present the hazard mitigation plan.***
- ***Candy Seel speaks to the hazard mitigation plan***
- ***Heather Andrade speaks to the hazard mitigation plan***
- ***Jenn Tierney speaks to the hazard mitigation plan***
- ***Linda Leite speaks to the hazard mitigation plan***

Summary: Comments from three of the speakers centered on preservation of large open space parcels as natural areas, and a fourth speaker commented with regard to the City's tree canopy and a need for more tree maintenance and tree planting to help absorb CO2 and mitigate temperature increases.

Hazard Mitigation Survey

This survey was available from late January through the mid-February 2022. The following pages include survey questions and responses.

Q1 In the past 5 years, which of the following hazards have impacted you or someone in your household where you currently live? (Select all that apply.)

Answered: 54 Skipped: 0

ANSWER CHOICES	RESPONSES	
Flooding	20.37%	11
Severe winter weather (extreme cold, heavy snow)	40.74%	22
High winds	61.11%	33
Extreme heat / Drought	5.56%	3
Damage from severe thunderstorms	12.96%	7
Earthquake damage	0.00%	0
Hurricane/Nor'Easter	31.48%	17
None	14.81%	8
Other (please specify)	11.11%	6
Total Respondents: 54		

Q2 The City of East Providence's Hazard Mitigation Plan is evaluating the following natural hazards as concerns of the City. Please rank these hazards according to your perception of which present the most risk to your business.

Answered: 54 Skipped: 0

	NO RISK	LOW RISK	MODERATE RISK	MOST RISK	TOTAL
Flooding	7.41% 4	20.37% 11	48.15% 26	24.07% 13	54
Severe winter weather (extreme cold, heavy)	1.85% 1	18.52% 10	62.96% 34	16.67% 9	54
High winds	0.00% 0	1.85% 1	51.85% 28	46.30% 25	54
Extreme Heat / Drought	18.52% 10	46.30% 25	31.48% 17	3.70% 2	54
Damage from severe thunderstorms	3.70% 2	31.48% 17	38.89% 21	25.93% 14	54
Earthquake Damage	38.89% 21	59.26% 32	1.85% 1	0.00% 0	54
Hurricane / Nor'Easter	0.00% 0	7.41% 4	40.74% 22	51.85% 28	54

Q3 Which of the following steps (if any) has your household taken to prepare for a hazard event or disaster? (Select all that apply.)

Answered: 54 Skipped: 0

ANSWER CHOICES	RESPONSES	
A fire escape plan	42.59%	23
Designate an outside meeting place	18.52%	10
Identified utility and water shutoffs	64.81%	35
Have disaster supplies on hand (I.e. food, water, batteries, flashlight)	77.78%	42
Installed smoke/carbon dioxide detectors on each level	98.15%	53
Have a medical supply kit	61.11%	33
Identified the nearest emergency shelter	14.81%	8
Purchased or installed a generator	27.78%	15
Other (please specify)	1.85%	1
Total Respondents: 54		

Q4 How prepared is your household to deal with a major natural hazard event (for instance, hurricane, major winter storm, flood, lengthy power outage)?

Answered: 54 Skipped: 0

ANSWER CHOICES	RESPONSES	
Very prepared	16.67%	9
Somewhat prepared	66.67%	36
Not very well prepared	14.81%	8
Not sure	1.85%	1
TOTAL		54

Hazard Mitigation Survey

Q5 What are the most effective ways for you to receive information about disaster preparedness and impending hazards? (select all that apply)

Answered: 54 Skipped: 0

ANSWER CHOICES	RESPONSES	
City website	25.93%	14
Social media	48.15%	26
E-mail	59.26%	32
Citywide 'Code Red' phone/text/email alerts	87.04%	47
Local newspaper	12.96%	7
TV	46.30%	25
Radio	18.52%	10
Community meetings/information sessions	7.41%	4
Other (please specify)	0.00%	0
Total Respondents: 54		

Q6 Do you have any special/functional needs within your household that would require a specialized response during a disaster? For example: people who use oxygen, respirator, ventilator, dialysis, or pacemaker; use a wheelchair, scooter, walker or cane; are visually impaired, blind, hard of hearing, or deaf; have a speech, cognitive, developmental or behavioral health disability; or other condition that may require extra help during a time of emergency.

Answered: 54 Skipped: 0

ANSWER CHOICES	RESPONSES	
Yes	16.67%	9
No	83.33%	45
Not Sure	0.00%	0
TOTAL		54

Hazard Mitigation Survey

Q7 If yes, are you registered with the Rhode Island Special Needs Registry, which lets police, fire, and other first responders better prepare for and respond to your needs during a hurricane, storm, or other emergency?

Answered: 54 Skipped: 0

ANSWER CHOICES	RESPONSES	
Yes	7.41%	4
No	20.37%	11
I am not aware of this program	0.00%	0
Not applicable	72.22%	39
TOTAL		54

Q8 To your knowledge, is your property located in a designated floodplain?

Answered: 54 Skipped: 0

ANSWER CHOICES	RESPONSES	
Yes	14.81%	8
No	62.96%	34
I don't know	11.11%	6
I don't know, but would like to know	11.11%	6
TOTAL		54

Q9 Do you have flood insurance?

Answered: 54 Skipped: 0

ANSWER CHOICES	RESPONSES	
Yes	20.37%	11
No	79.63%	43
TOTAL		54

Hazard Mitigation Survey

Q10 In your opinion, how important are the following actions that local government can take to reduce the impact to our residents from natural hazards?

Answered: 54 Skipped: 0

	NOT IMPORTANT	SOMEWHAT IMPORTANT	VERY IMPORTANT	TOTAL	WEIGHTED AVERAGE
Strengthen public facilities like Police, Fire, City Hall, and schools to ensure that government operations continue	18.52% 10	37.04% 20	44.44% 24	54	2.26
Improve drainage systems	3.70% 2	29.63% 16	66.67% 36	54	2.63
Invest in coastal erosion control measures	1.85% 1	22.22% 12	75.93% 41	54	2.74
Provide better information on hazards, risks, and specific high-hazard areas	7.41% 4	50.00% 27	42.59% 23	54	2.35
Work to improve utility (electric, gas and water) resiliency	0.00% 0	16.67% 9	83.33% 45	54	2.83
Buy out the most floodprone properties	55.56% 30	33.33% 18	11.11% 6	54	1.56
Conduct regular tree management and maintenance	0.00% 0	29.63% 16	70.37% 38	54	2.70

Q11 What is your connection to East Providence? (check all that apply)

Answered: 54 Skipped: 0

ANSWER CHOICES	RESPONSES	
I rent in East Providence	5.56%	3
I own a home in East Providence	94.44%	51
I work in East Providence	11.11%	6
I own a business in East Providence	5.56%	3
Other (please specify)	0.00%	0
Total Respondents: 54		

Q12 Are there any additional comments or questions you would like to share?

Answered: 20 Skipped: 34

Summary of open-ended responses: There were numerous comments favoring the increased use of solar energy to power residential and commercial uses, both new and already in place, as well as solar panel covered parking spaces. Some residents commented that they would like to see a City-sponsored composting program, as well as more education on recycling. Other respondents reiterated a push to ensure that the City protects open and green space in the City from any development.

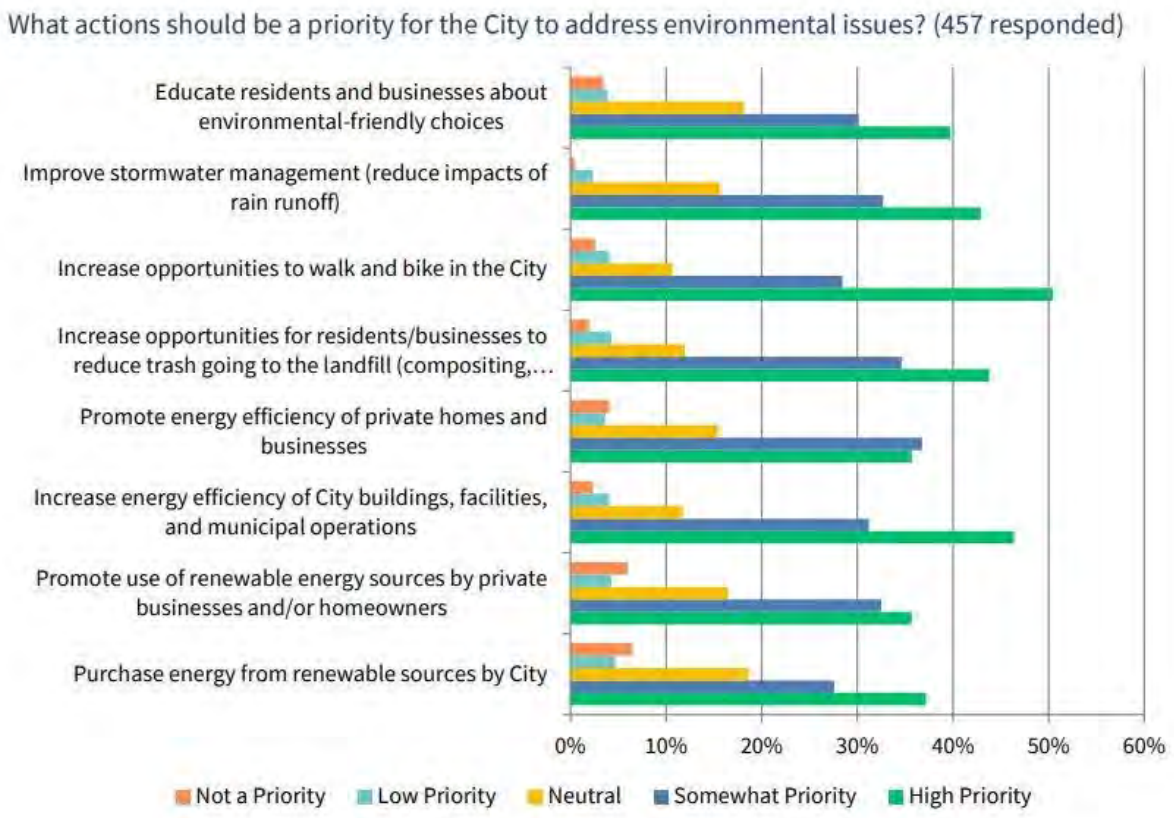
Coastal erosion is a major concern for those residents who are on or close to waterfront property.

A concern of multiple stakeholders is the increasing frequency of power outages during the types of large storms that are expected here at least yearly. The City will work with the state's new electrical power provider, PPL (DBA Rhode Island Energy) to address this issue.

One other issue mentioned repeatedly was tree canopy maintenance with respect to the potential for structural damage and for power line damage. The City inventoried its street trees in 2021, mapping 6,376 trees and performing a quick condition assessment on each. Many trees in question turn out to be on private property. The City can advise residents with respect to these trees, but ultimately they responsibility of the respective property owners.

Comprehensive Plan Survey Question

This question from an East Providence Comprehensive Plan Survey focused mostly on renewable energy, but also yielded a strong response regarding stormwater run-off.



APPENDIX E. Local Mitigation Plan Review Tool

LOCAL MITIGATION PLAN REVIEW TOOL

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA's evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of the each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool*.

Jurisdiction: City of East Providence, RI	**Title of Plan: 2022 Local Hazard Mitigation Plan – A Multi Hazard Mitigation Strategy**	**Date of Plan Update Revision: June 27, 2022**
Local Point of Contact: **Wayne Barnes**	**Address:** **145 Taunton Avenue** **East Providence, RI 02914**	
Title: **EMA Executive Project Manager**		
Agency: **East Providence Fire Department and Emergency Management Agency**		
Phone Number: **(401) 435-7500, Ext. 21012**	**E-Mail:** wbarnes@eastprovidenceri.gov	

State Reviewer:	**Title:**	**Date:**

FEMA Reviewer:	**Title:**	**Date:**
Date Received in FEMA Region ***(insert #)***		
Plan Not Approved		
Plan Approvable Pending Adoption		
Plan Approved		

REGULATION CHECKLIST

INSTRUCTIONS: The Regulation Checklist must be completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been 'Met' or 'Not Met.' The 'Required Revisions' summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is 'Not Met.' Sub-elements should be referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each Element and sub-element are described in detail in this *Plan Review Guide* in Section 4, Regulation Checklist.

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan** (section and/or page number)	**Met**	**Not Met**
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Acknowledgments, p.3 Sec. 2.1 - 2.3, pp. 17-20 Sec. 6.1, p. 96 App. D, pp. 105-112		
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Sec. 2.3, pp. 19-20 Sec. 2.4a and c, pp. 20-21		
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Sec 2.2b, pp. 18-19 App. D, pp. 105-112		
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Sec. 2.2, pp. 17-19 Sec. 4.3a and b, pp. 76-80		
A5. Is there discussion of how the community(s) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Sec. 2.4c, p. 21 Sec. 6.2, p. 96		
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Sec. 5.2, Strategy 17, p. 94-95 Sec. 6, p. 96		

ELEMENT A: REQUIRED REVISIONS

ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Sec. 3.2, pp. 23-58		
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	Sec. 3.2, pp. 23-58		
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	Sec. 3.2, pp. 23-58		
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Sec. 3.4, pp. 69-74 Sec. 4.4, pp. 80-81		
ELEMENT B: REQUIRED REVISIONS			
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	Sec. 4-2a and b, pp. 75-76		
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Sec. 1.3, p. 15 Sec. 4.4, pp. 80-81 Sec. 5.2, Strategy 16, p. 94		
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Sec. 3.4b, pp. 72-74 Sec. 5.2, pp. 82-91		
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Sec. 3.3c.6, pp. 61-62 Sec. 5.2, pp. 82-91		
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Sec 5.2, pp. 86-95		
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Sec. 4.3, pp. 76-80		

ELEMENT C: REQUIRED REVISIONS

ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Sec. 2.4b, p. 21		
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Sec. 5.1, p. 83-96		
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Sec. 6, p. 96		
ELEMENT D: REQUIRED REVISIONS			

ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	(forthcoming in Appendix F following RIEMA review and required revisions)		
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	N/A, not a multi-jurisdictional plan.		
ELEMENT E: REQUIRED REVISIONS			

ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			
F1.			
F2.			
ELEMENT F: REQUIRED REVISIONS			

APPENDIX F. Plan Adoption Documentation

(2017 Plan documentation below. The 2022 approved plan will have similar adoption documentation)

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STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

CITY OF EAST PROVIDENCE

RESOLUTION NO. 11

RESOLUTION ADOPTING THE 2017 CITY OF EAST PROVIDENCE, RHODE ISLAND LOCAL HAZARD MITIGATION PLAN

WHEREAS, the City of East Providence recognizes the threat that natural hazards pose to people and property within our City; and

WHEREAS, the City of East Providence, in accordance with the Disaster Mitigation Act of 2000, has prepared a multi-hazard mitigation plan hereby known as the City of East Providence, Rhode Island Local Hazard Mitigation Plan as required by the Federal Emergency Management Agency (FEMA); and

WHEREAS, the 2017 Local Hazard Mitigation Plan identifies mitigation goals and actions to reduce long-term risk to people and property in East Providence from the impacts of future natural hazards and disasters; and

WHEREAS, the Local Hazard Mitigation Plan shall include documentation that the plan has been formally adopted by the City Council indicating approval of the plan.

NOW, THEREFORE, BE IT RESOLVED that the City Council hereby adopts the 2017 City of East Providence, Rhode Island Local Hazard Mitigation Plan.

Adopted by the City Council: March 7, 2017

Attest:

City Clerk of East Providence, Rhode Island

Requested by: Deputy EMA Director

A certified true copy 3/23/17 Date

Attest:

City Clerk of East Providence, Rhode Island