City of Providence

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

RESOLUTION OF THE CITY COUNCIL

No. 362

Approved July 24, 2019

WHEREAS, Emergency management and hazard mitigation plans preserve the health, safety and welfare of the citizens of Providence and their property; and

WHEREAS, The 2019 Multi-Hazard Mitigation Plan is an update to the Hazard Mitigation Plan last adopted by the City Council on July 17, 2013; and

WHEREAS, Adoption of this plan is a federal requirement for the City to be eligible for federal mitigation grants either as a result of a disaster or major mitigation planning project; and

WHEREAS, FEMA Region I has completed its review of the 2019 Multi- Hazard Mitigation Plan and approved it subject to approval by the City Council; and

WHEREAS, City Council approval will allow the city to meet its local mitigation planning requirements pursuant to 44 C.F.R. 201.

NOW, THEREFORE, BE IT RESOLVED, That the Providence City Council approves and adopts the 2019 Multi-Hazard Mitigation Plan.

IN CITY COUNCIL

JUL 1 8 2019

READ AND PASSED

PRES.

CLERK

I HEREBY APPROVE.

Mayor

Date: 7/24/19

City of Providence

Strategy for Reducing Risks from Natural, Human-Caused and Technologic Hazards: A Multi-Hazard Mitigation Plan

April 2019

Strategy for Reducing Risks From Natural, Human-Caused and Technologic Hazards in Providence, Rhode Island:

A Multi-Hazard Mitigation Plan

Acknowledgements

Gina Raimondo
Governor

RI Emergency Management Agency

Marc R. Pappas
Director

Authors

Providence Emergency Management Agency
City of Providence Local Hazard Mitigation Committee
Horsley Witten Group, Inc.

Approved by Mayor Jorge O. Elorza

_____

Adopted by the Providence City Council

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Additional Acknowledgements

Mitigation planning has been successfully initiated in Providence with the continuing support and resources provided by the Federal Emergency Management Agency via the Pre-Disaster Mitigation (PDM) grant. The guidance and assistance provided by the Rhode Island State Hazard Mitigation Committee is essential for implementing the strategy presented in this plan. Providence is also grateful for the efforts of the Office of Sustainability, Department of Planning and Development, the Emergency Management Agency, and the Local Hazard Mitigation Committee in preparing this plan. The Providence Emergency Management Agency would also like to thank the community of Providence, especially city staff and those active community members who participated in the planning process.

Elected Officials

- Jorge O. Elorza, Mayor

Providence City Council

- Seth Yurdin, Ward 1
- Helen Anthony, Ward 2
- Nirva LaFortune, Ward 3
- Nicholas J. Narducci Jr., Ward 4
- Jo-Ann Ryan, Majority Leader, Ward 5
- Michael Correia, Council President Pro Tempore, Ward 6
- John Igliozzi, Majority Whip, Ward 7
- James Taylor, Ward 8
- Carmen Castillo, Ward 9
- Luis A. Aponte, Ward 10
- Mary K. Harris, Deputy Majority Leader, Ward 11
- Katherine Kerwin, Ward 12
- Rachel Miller, Ward 13
- David A. Salvatore, Ward 14
- Sabina Matos, Council President, Ward 15

Providence Local Hazard Mitigation Committee

- Melinda Hopkins – Mitigation Planning Supervisor/State Hazard Mitigation Officer, RIEMA
- Kevin Kugel – Director, Providence Emergency Management Agency
- Clara Decerbo – Deputy Director, Providence Emergency Management Agency
- Leah Bamberger – Director, Office of Sustainability
- Jeffrey Lykins – Building Official, Inspection and Standards
- Michael Borg – Director, Department of Public Property
- David Everett – Principal Planner, Department of Planning and Development
- Michael Bates – Acting Chief, Providence Fire Department
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- James Boyd – Coastal Policy Analyst, RI Coastal Resources Management Council
- Janet Freedman – Coastal Geologist, RI Coastal Resources Management Council
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- Dave Aucoin – Safety Compliance Coordinator, Narragansett Bay Commission
- Meg Goulet – Interceptor Maintenance Manager, Narragansett Bay Commission
- Stephen Curtis – Port Facility Manager, Waterson Terminal Services, LLC
- Marisa Albanese – Senior Coordinator/Community Investment & Economic Development NE/National Grid
- Jeffrey Emidy – Project Review Coordinator, RI Historical Preservation and Heritage Commission
- Jared Rishel – Director, Providence & Worcester Railroad
- Phil Stocking – Disaster Program Manager, American Red Cross

- Margaret DeVos – Executive Director, Southside Community Land Trust
- Stephen Morin – Director of Environmental Health and Safety, Brown University
- Chris Harwood – Director of Emergency Management, Johnson & Wales University
- Manuel Cordeiro – Community Member

Consultant Team

- Craig Pereira – Project Manager, Horsley Witten Group, Inc.
- Matt Shultz – Coastal Engineer, Woods Hole Group
- Elise LeDuc – Coastal Scientist, Woods Hole Group
- Dori Boardman – Hazard Mitigation Specialist, Boardman Ecological Services

THE CITY OF PROVIDENCE
STATE OF RHODE ISLAND AND PROVIDENCEPLMTATIONS

RESOLUTION OF THE CITY COUNCIL
No. XXX
EFFECTIVE MMM, DD, YYYY

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NOW, THEREFORE, BE IT RESOLVED, That the Providence City Council approves and adopts the 2019 Multi-Hazard Mitigation Plan.

Acronyms

AFG	Assistance to Firefighters Grant
ARC RI	American Red Cross of Rhode Island
CBRN	Chemical Biological Radiological Nuclear
CDBG	Community Development Block Grant
CEM	Civil Emergency Messages
CEMP	Comprehensive Emergency Management Plan
CERI	Coastal Environmental Risk Index
CERT	Citizens Emergency Response Team
CFR	Code of Federal Regulations
CFSA	Child and Family Services
CIC	Cambridge Innovation Center
CIP	Capital Improvement Plan
COP	Common Operating Picture
COOP	Continuity of Operations Plan
CPRI	Calculated Priority Risk Index
CRMC	Coastal Resources Management Council
CRMP	Coastal Resources Management Program
CRS	Community Rating System
CSO	Combined Sewer Overflow
CSS	Combined Sewer System
C2ES	Center for Climate and Energy Solutions
CWA	Chemical Warfare Agent
DART	Design and Resilience Team
DBS	Direct Broadcast satellite
DMA	Disaster Mitigation Act
DPW	Department of Public Works
EAP	Emergency Action Plan
EAS	Emergency Alert System
EDA	Economic Development Administration

EMSTARS	Emergency Management State Radio System
EMT	Emergency Medical Technicians
ENS	Environmental Notification System
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
ERSD	End Stage Renal Disorder
ESF	Emergency Support Function
FBI	Federal Bureau of Investigations
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FLUM	Future Land Use Map
FMA	Flood Mitigation Assistance
FPHB	Fox Point Hurricane Barrier
GIS	Geographic Information System
HARI	Hospital Association of Rhode Island
HAZUS	Hazards U.S.
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HUD	Housing and Urban Development
IAP	Incident Action Plan
ICS	Incident Command System
IED	Improved Explosive Device
IPCC	Intergovernmental Panel on Climate Change
ISO	Insurance Services Office
JIC	Joint Information System
LHMC	Local Hazard Mitigation Committee
LID	Low Impact Development
LNG	Liquified Natural Gas
LPG	Liquified Petroleum Gas

MBTA	Massachusetts Bay Transportation Authority
MHW	Mean High Water
MHHW	Mean Higher High Water
MLLW	Mean Low Low Water
MMI	Modified Mercalli Intensity Scale
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer System
NAWAS	National Warning System
NBC	Narragansett Bay Commission
NERC	North American Reliability Corporation
NFIP	National Flood Insurance Program
NOAA	National Oceanic Atmospheric Administration
NRC	Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
OPS	Operations Plan
PAG	Protective Action Guidelines
PDM	Pre-Disaster Mitigation
PEMA	Providence Emergency Management Agency
PII	Personally Identifiable Information
PPCTM	Public Protection Classification
PROVPORT	Port of Providence
PWSB	Providence Water Supply Board
REJC	Racial and Environmental Justice Committee
RDD	Radiological Dispersal Device
RIBA	Rhode Island Broadcasters Association
RIDEM	Rhode Island Department of Environmental Management
RIDOA	Rhode Island Department of Administration
RIDOH	Rhode Island Department of Health
RIDOT	Rhode Island Department of Transportation

RIEMA	Rhode Island Emergency Management Agency
RIPDES	Rhode Island Pollutant Discharge Elimination System
RIPTA	Rhode Island Public Transit Authority
RISG	Rhode Island Sea Grant
SAMP	Special Area Management Plan
SCADA	Supervisory Control and Data Acquisition
SDARS	Satellite Digital Audio Radio Service
SDE	Substantial Damage Estimation
SHMC	State Hazard Mitigation Council
SLOSH	Sea, Lake and Overland Surge from Hurricanes
SLR	Sea Level Rise
SSHWS	Saffir Simpson Hurricane Wind Scale
STAB	Science and Technology Board
SWP	State Warning Point
SWS	State Warning System
TIC	Toxic Industrial Chemical
TIP	Transportation Improvement Program
UCG	Urban Coastal Greenway
UNBRSM	Upper Narragansett Bay Regional Stormwater Management
USACE	United States Army Corp of Engineers
USGS	U.S. Geological Survey
VPN	Virtual Private Network
VOAD	Voluntary Organizations Active in Disasters
WSSMP	Water Supply System Management Plan
WUI	Wildland Urban Interface
WWTF	Wastewater Treatment Facility

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Section 1 Introduction

1.1 What Hazard Mitigation Can Do for the City of Providence

Hazard mitigation is defined by the Federal Emergency Management Agency (FEMA) as "any sustained action taken to reduce or eliminate long-term risk to human life and property from a hazard event." The results of a three-year, congressionally mandated independent study to assess future savings from mitigation activities provides evidence that mitigation activities are highly cost-effective. On average, each dollar spent on hazard mitigation saves the nation an average of $6 in future disaster costs in addition to saving lives and preventing injuries (National Institute of Building Science Multi-Hazard Mitigation Council 2017).

Hazard mitigation planning is the process of determining how to reduce or eliminate the loss of life and property damage resulting from natural, human-caused, and technologic hazards such as floods, earthquakes, hurricanes, biological, chemical, or infrastructure failure. Hazard mitigation means to permanently reduce or alleviate injuries or the loss of life and property resulting from multi-hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects, and other activities.

This plan update was prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 (Public Law 106-390) and the implementing regulations set forth by the Interim Final Rule published in the *Federal Register* on February 26, 2002 (44 CFR §201.6) and finalized on October 31, 2007 (hereafter, these requirements and regulations will be referred to collectively as the Disaster Mitigation Act). While the act emphasized the need for mitigation plans and more coordinated mitigation planning and implementation efforts, the regulations established the requirements that local hazard mitigation plans must meet for a local jurisdiction to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288). Because the City of Providence is subject to many kinds of hazards, access to these programs is vital. This plan updates the City's 2013 Multi-Hazard Mitigation Plan.

The Providence Emergency Management Agency (PEMA), in collaboration with the Mayor's office, provided the lead in soliciting the participation of City departments, state agencies, universities, non-profits, and other stakeholders to form the Providence Local Hazard Mitigation Committee (LHMC) and undertaking a comprehensive planning process to update the 2013 plan. The City of Providence, with the assistance of the Horsley Witten Group, Inc. (HW), developed this update to the Multi-Hazard Mitigation Plan with funds provided through a Hazard Mitigation Assistance Grant from the Rhode Island Emergency Management Agency (RIEMA). Public input on community assets, vulnerabilities, preferred mitigation strategies, and the plan was also solicited throughout the evolution of the project. As a result, this plan represents the work of community members, elected and appointed officials, and other interested stakeholders

in the City of Providence. This plan demonstrates the City's commitment to reducing risks from hazards and serves as a tool to help decision makers direct and coordinate mitigation activities and resources, including local land use policies.

1.2 Goals

It is the goal of this plan to preserve and enhance the quality of life, property, and resources for the community members of Providence by:

a) Identifying areas at risk from natural and human-caused hazards, and
b) Implementing priority hazard mitigation actions in order to protect the City's built environment, people, historic, cultural, economic, and natural resources.

An important benefit of hazard mitigation is that money spent today on preventive measures can significantly reduce the cost of post-disaster cleanup tomorrow. Pre-disaster planning can reduce the cost of disasters because it helps to safeguard areas. By planning ahead Providence will minimize the economic and social disruption that can result from floods, blizzards, or hurricanes (destruction of property, loss or interruption of jobs, and the loss of businesses).

1.3 Planning Process

A hazard mitigation plan should be considered a dynamic document that keeps pace with a community as it grows and changes. The Disaster Mitigation Act of 2000 (DMA) places high priority on the continuation of the planning process after the initial submittal, requiring communities to seek and receive re-approval from the FEMA in order to remain eligible for assistance. The evaluation, revision and update process are also a means to create an institutional awareness and involvement in hazard mitigation as part of daily activities.

This 2019 update allowed for academia, non-profits, representatives of state agencies, utility providers, and other interested stakeholders to be involved and bring their ideas to the table for incorporation into this update. Both Brown University and Johnson & Wales University were represented on the LHMC, in addition to the Southside Community Land Trust, Hospital Association of Rhode Island (HARI), National Grid, and Narragansett Bay Commission (NBC). Also included were institution-specific annexes for Higher Education and Healthcare/Hospital Clusters in order to frame the most current information from these facilities as they pertain to hazard mitigation planning in Providence. A complete set of materials that documents coordination efforts for both are included in Appendix B and C.

Members of the Providence LHMC include:

- Melinda Hopkins – Mitigation Planning Supervisor/State Hazard Mitigation Officer, RIEMA
- Kevin Kugel – Director, Providence Emergency Management Agency

- Clara Decerbo – Deputy Director, Providence Emergency Management Agency
- Leah Bamberger – Director, Office of Sustainability
- Jeffrey Lykins – Building Official, Inspection and Standards
- Michael Borg – Director, Department of Public Property
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- Matt Shultz – Coastal Engineer, Woods Hole Group
- Elise LeDuc – Coastal Scientist, Woods Hole Group
- Dori Boardman – Hazard Mitigation Specialist, Boardman Ecological Services

The Horsley Witten Group, Inc. conducted a series of meetings from April 6, 2018 through March 2019. Meeting compositions varied throughout the project and included project team meetings with PEMA and City officials, meetings of the LHMC, and public workshops. All meetings were held in an open public forum and in accordance with R.I.G.L. 42-46-2(a) in complying with the requirements of the Federal Disaster Mitigation Act of 2000. A Spanish translator was provided at each of the three Public Workshops.

A kickoff meeting was conducted on April 6, 2018 (PEMA representatives, City officials, and the project consultant) to review the project scope and revised schedule, discuss project coordination (data collection, municipal coordination and public outreach), review communications protocols (project website, press release, social media, language interpreters, Higher Education and Healthcare/Hospital Cluster annexes, and coordinate the agenda and logistics for the first public workshop. A complete set of meeting materials is included in Appendix D.

A project webpage was designed and hosted on PEMA's website to announce the project, inform and engage the community before, during, and after plan development, and to serve as a repository of project documents, presentations, and summaries. A PDF of the project webpage layout is included in Appendix D.

The first LHMC meeting was conducted on May 25, 2018 to review the scope and schedule, updated layout for the update, data collection and municipal coordination, public outreach, and agenda/logistics for the first public workshop. Much of the meeting was a review of the 2013 plan mitigation actions to inform the development of the 2013 Plan Report Card (actions completed/not addressed/to be carried forward/to be removed). A complete set of meeting materials is included in Appendix D.

The second LHMC meeting was conducted on July 13, 2018 to update the outreach/public engagement process, review the 2013 Plan Report Card, review the updated draft Risk Assessment/Hazard Index, identify a Technical Review Committee, and update the process for outreach to the Higher Education and Healthcare/Hospital Cluster. A complete set of meeting materials is included in Appendix D.

The first public workshop was held on July 25, 2018 at PEMA. Announcements (English and Spanish) were posted on the project webpage, emailed to Providence municipal Boards, Commissions, and interested community members, and posted on the Secretary of State's website (copies included in Appendix D). The presentation included an overview of the project, a review of the 2013 Risk Assessment Matrix Report Card, and preliminary revisions to the update. A question/answer period followed the presentation, then a mapping exercise where participants were provided the opportunity to mark-up citywide maps with specific issues at identified locations. An online survey map, utilizing ArcGIS' Survey 123 digital platform) was initiated and demonstrated at the workshop. It allowed users to geographically provide input regarding hazards (local knowledge). Also, at the workshop, an online community survey was also available (English and Spanish versions) with hard copies and laptops setup up for participants to complete. The survey remained active after the workshop and available to the larger community through PEMA's website. A complete set of meeting materials is included in Appendix D.

Mitigation actions from the 2013 plan were reviewed and an assessment of progress made in implementing each action has been completed (Table 1.1). Progress was tracked using the following definitions:

- **Completed** –action was discrete and completed during the period from 2013 to 2018. These actions are not included in the 2019 Mitigation Strategy.
- **Not Completed, Carry Forward (revised)** –action is to be continued in the plan update.
- **Not Completed, Remove** – action was removed from consideration due to lack of resources or not contributing to the 2019 Mitigation Strategy.
- **Ongoing, Move to Capability Assessment** – action with progress made in implementation and/or represents an on-going continuing activity in the implementation of the plan. Activities that are considered ongoing have been moved to Section 3 Capability Assessment.

The 2013 Plan included 10 actions (Actions #1 and #2 were removed from the 2013 Update, however, the numbering remained consistent). As of July 2018, two of these actions were fully completed, five were not completed and carried forward (and revised), one was not completed and removed, and two were ongoing and moved to the Capability Assessment section of the update. A description for each (including a status report) follows.

Table 1-1
2013 Plan Report Card (2019 Update), Providence, Rhode Island

Mitigation Measure	*Location*	*Ownership*	*Natural Hazard*	*Primary Problem/Effect*	*Mitigation Objective*	*Risk H-Historical P- Potential*	*2019 Status*
Apply for the Community Rating System (2013 Plan Mitigation Action #3)	FEMA Flood Zones	Public and Private	Flooding	Public and Private property damage	Reduced cost for homeowner/business insurance policies	H and P	Not completed, carry forward revised
Public Outreach on complying with A Zone and V Zone Floodplain Standards (2013 Plan Mitigation Action #4)	FEMA Flood Zones	Public and Private	Flooding	Public and Private property damage	Reduced damages/costs for property owners; retrofit of structures to current standards; public education/safety	H and P	Compliance completed, carry forward public outreach program
Conduct study of potential flood mitigation projects (2013 Plan Mitigation Action #5)	Woonasquatucket River, Waterplace Park to hurricane barrier, and Port of Providence	Public and Private	Flooding, Earthquake	Public and Private property damage	Reduced damages/costs for property owners; public safety	H and P	Not completed, remove
Retrofit ProvPort Facility to protect against flood/earthquake damage (2013 Plan Mitigation Action #6)	ProvPort Facility	Private	Flooding, Earthquake	Private property damage; environmental contamination	Reduced damages/costs for property owners; Minimize environmental; public safety	H and P	Completed.

Table 1-1
2013 Plan Report Card (2019 Update), Providence, Rhode Island

Mitigation Measure	*Location*	*Ownership*	*Natural Hazard*	*Primary Problem/Effect*	*Mitigation Objective*	*Risk H-Historical P- Potential*	*2019 Status*
Repair/replace structurally-deficient bridges (2013 Plan Mitigation Action #7)	Citywide	Public	Flooding, Earthquake	Compromised emergency access/evacuation; damages to infrastructure	Expedited emergency access/evacuation; public safety; maintenance of infrastructure	H and P	On-going, move to Capability Assessment
Conduct study to ensure proper protection of vital public records (2013 Plan Mitigation Action #8)	City Hall and other public properties	Public	All hazards	Loss of vital public records	Protection/preservatio n of vital public records	H and P	Study completed, carry forward implementation
Initiate tree-trimming/debris management plan (2013 Plan Mitigation Action #9)	Citywide	Public and Private	All hazards	Damage to public/private property and infrastructure	Reduced damages/costs to public/private property; Expedited clean-up	H and P	Completed, move to Capability Assessment
Retrofit older buildings to current codes (2013 Plan Mitigation Action #10)	City-wide	Public and Private	All Hazards	Damage to public/private property; compromised public safety	Reduced damages/costs to public/private property; public safety	H and P	Not completed, carry forward

Table 1-1
2013 Plan Report Card (2019 Update), Providence, Rhode Island

Mitigation Measure	*Location*	*Ownership*	*Natural Hazard*	*Primary Problem/Effect*	*Mitigation Objective*	*Risk H-Historical P- Potential*	*2019 Status*
Evaluate flood mitigation options at the Atwells Ave. Fire Station (2013 Plan Mitigation Action #11)	Atwells Avenue Fire Department Site	Public	Flooding	Damage to public property; compromised emergency response/public safety	Reduced damages/costs to public property; public safety	H and P	Not completed, carry forward revised
Update the NBC Emergency Operations Plan (2013 Plan Mitigation Action #12)	Narragansett Bay Commission Sewage Treatment Plant	Public	All Hazards	Economic/social hardship; Loss of life/property	Expedited coordination with the City; public safety	H and P	Completed

Mitigation Action #3
The City's Department of Planning and Development has initiated efforts to enroll in the National Flood Insurance Program's (NFIP) Community Rating System (CRS) two separate times since the 2013 plan. PEMA and the Department of Planning and Development initiated efforts in coordination with Inspection and Standards. Both times, because of the lack of additional staff dedicated to these efforts and the low-cost benefit to enroll (based on the limited number of flood insurance policies that would be affected), it was not a priority of the City to complete. It was determined by the LHMC to carry forward the action into the 2019 update, however, revising it to reflect a 'periodic review on the feasibility to join' the CRS, particularly considering future climate change and SLR projections.

Mitigation Action #4
The Inspection and Standards Department continues to enforce compliance regarding flood hazard regulations. However, the public education campaign was not completed. The LHMC determined to carry forward the action into the 2019 update, revising it to reflect the educational outreach/campaign needs to be implemented.

Mitigation Action #5 and #6
No major development has occurred in the port area (the focus of this action) that would trigger changes in buildings under the NFIP regulations. Several recent studies, plans, or reports with recommendations for improved resilience within the port area have been completed since the 2013 plan and have mitigation actions specific to the port incorporated into this 2019 update. The LHMC determined that Action #5 would be removed as not contributing specifically to the 2019 update, and Action #6 was considered complete, as per the regulations oversight by Waterson Terminal Services.

Mitigation Action #7
There has been some progress on this action with improvements completed through the Rhode Island Department of Transportation's (RIDOT) RhodeWorks initiative and Transportation Improvement Program (TIP). Section 3.3 provides a list of scheduled improvements for bridges in Providence in accordance with the TIP schedule. The LHMC determined this action should be incorporated into the Capability Section.

Mitigation Action #8
Although the City has completed the feasibility study to relocate vital records and digitized existing documents, a new location has not been determined. Therefore, the LHMC determined to carry forward the implementation piece into the 2019 update.

Mitigation Action #9
The Providence City Forester coordinates with National Grid's Forester to trim, maintain, and replace trees throughout the city, according to their identified management schedules. The LHMC determined this action should be incorporated into the Capability Section.

Mitigation Action #10
The retrofit of older buildings to current codes has experienced very limited advancement due to the slow degree of economic recovery. The Department of Inspection and Standards will continue to enforce compliance with regulations. The LHMC determined this action was not completed and should be carried forward into the 2019 update.

Mitigation Action #11
No progress has been made on this action, with lack of funding as the primary barrier. The LHMC determined this action was not completed and should be carried forward into the 2019 update.

Mitigation Action #12
The Narragansett Bay Commission has updated its Emergency Operations Plan (EOP) since the 2013 plan and continues to coordinate with the City on a periodic basis. The LHMC determined this action was completed.

Online Survey Map
Utilizing ArcGIS' Survey 123 digital platform, an online map survey was created. This application provides a map of the City of Providence and allows users to geographically place comments throughout the city. The benefit of this application is the local knowledge provided by residents, specific to their home, business, or neighborhood. Six responses in total were received centered around sea level rise/flooding and extreme temperatures (extreme heat/heat island effect).

Online Community Survey
An online community survey was kicked off at the first public workshop (English and Spanish versions) via hard copy and laptops for electronic access. The surveys were also made available (hard copy) at the second public workshop on November 16, 2018. The survey was open beginning July 25, 2018 and closed on March 1, 2019 and included a total of thirteen responses (English only, no Spanish survey were completed). A brief summary of responses collected is included below. The full survey summary is included in Appendix D.

- Most residents/businesses have experienced flood, winter, wind, and extreme temperature-related hazard events in the past 20 years.
- Approximately two-thirds (69%/9 respondents) of residents and business owners feel they are adequately (or higher) prepared to deal with a natural hazard event, with most getting their information from local news/social media (69%/9 respondents), and/or personal experience with one or more natural hazards/disasters (62%/8 respondents).
- Almost all respondents are 'Very Concerned' with wind-related hazards (62%), followed by winter and wind-related hazards (both at 92%/12 respondents).

- 46% (6 respondents) of respondents are not sure if their property is in/near a FEMA-designated floodplain
- 77%/10 respondents are interested in making their home, business, or neighborhood more resilient, with over half (54%/7 respondents) willing to spend their own money to do so.
- The top three choices to reduce damage/destruction of natural hazards in Providence include:
    - Retrofit public infrastructure, such as elevating roadways and improving drainage systems (77%/10 respondents)
    - Work to improve utility resilience: electric, communications, or water/wastewater facilities (62%/8 respondents)
    - Retrofit/strengthen essential public facilities such as police, fire/emergency, schools (46%/6 respondents) and assist vulnerable property owners with securing funding to make their properties more resilient (46%/6 respondents)

The second meeting (coordination call) between the PEMA/City/Project Team was conducted on August 9, 2019 to review the project schedule, Risk Assessment Rubric, and Higher Education and Healthcare Hospital Clusters/annexes. A memorandum of the coordination call is included in Appendix D.

The third meeting (coordination call) between the PEMA/City/RIEMA/Project Team was conducted on September 14, 2018 to review the vulnerability scenarios to be conducted. The vulnerability scenarios agreed upon are included in Appendix D.

The third LHMC meeting was conducted on October 26, 2018 to review the revised/updated Risk Assessment Rubric, present the findings of the vulnerability analyses, update the Higher Education and Healthcare/Hospital Cluster annexes, and discuss logistics for the second public workshop. A complete set of meeting materials is included in Appendix D.

The second public workshop was held on November 16, 2018 at the Mayor Joseph A. Doorley Municipal Building. Announcements (English and Spanish) were posted on the project webpage, emailed to Providence municipal Boards, Commissions and interested community members, and posted on the Secretary of State's website (copies included in Appendix D). The presentation included an overview of the Risk Assessment Rubric, various vulnerability analyses and the economic impacts to critical infrastructure, and the City's shelter capacity roll-up. The online survey map (ArcGIS Survey 123 digital platform) was demonstrated and hard copies of the online community survey were available for participants to complete. A complete set of meeting materials is included in Appendix D.

A series of municipal/stakeholder interviews (in-person, telephone and email correspondence) were conducted in January/February 2019 to inform the update's Capability Assessment and solicit for potential mitigation actions for consideration.

Meeting memorandums of the municipal/stakeholder interviews are included in Appendix D.

Interviews:

- Antonio Morabito – Director, Department of Public Works
- Dave Aucoin/Meg Goulet – Safety Compliance Coordinator/Interceptor Maintenance Manager, NBC
- Elaine Richards – Deputy Commissioner, Department of Public Safety
- Erick Riker/Bobbie Colleta – Major Account Manager/Rhode Island & Connecticut Manager, Verizon Wireless
- Hugh Clements – Chief, Providence Police Department
- Jim Silveria – Director, Department of Information Technology
- Peter LePage – Director of Engineering, Providence Water
- Stephen Curtis - Port Facility Manager, Waterson Terminal Services, LLC
- Clara Decerbo – Deputy Director, Providence Emergency Management Agency
- Leah Bamberger – Director, Office of Sustainability
- Dave Everett – Principal Planner, Department of Planning and Development

The fourth meeting between the PEMA/City/RIEMA/Project Team was conducted on February 19, 2019 to review the list of potential mitigation actions for consideration in advance of the next LHMC meeting. A complete list of mitigation actions for consideration is included in Appendix D.

The fourth LHMC meeting was conducted on March 1, 2019 to review the revised/updated Risk Assessment Rubric and Vulnerability Analyses maps and prioritize the mitigation actions for consideration (cost benefit review). The Providence LHMC completed the cost benefit review to prioritize/rank the action items, assigned time frames and responsible parties, and agreed on the proposed methodology/schedule for plan maintenance and update (based on FEMA requirements). A complete set of meeting materials is included in Appendix D.

The third public workshop was held on March 20, 2019 at PEMA. Announcements (English and Spanish) were posted on the project webpage, emailed to Providence municipal Boards, Commissions and interested community members, and posted on the Secretary of State's website (copies included in Appendix D). The presentation included an overview of the mitigation actions for consideration. A complete set of meeting materials is included in Appendix D.

The fifth LHMC meeting was conducted on March 29, 2019 at PEMA to review the summary of the third public workshop and draft mitigation plan update. A complete set of meeting materials is included in Appendix D.

With this information, the Horsley Witten Group, Inc. prepared the draft City of Providence Multi-Hazards Mitigation Plan update which was available for public

comment from March 10, 2019 through March 29, 2019 (online, on the City's website). The draft was then submitted to RIEMA for review/consideration.

This update was also forwarded to the neighboring City of East Providence (Diane Feather – Planning Director), City of Pawtucket (Sue Mara – Director of Planning), City of North Providence (Dave Westcott – Director of Planning), Town of Johnston (David Wilwerding – Director of Planning), and City of Cranston (Jason Pezzullo – Director of Planning), with no comments returned. It is the intention of the Providence LHMC that the Multi-Hazards Mitigation Plan be an available and pertinent source of information to a wide variety of individuals and interests. The update also has a specific and pragmatic function. By identifying and prioritizing local mitigation needs, the plan has already served, and will continue to serve, as a basis for amendments to local policies and regulations. A complete set of correspondences is included in Appendix D.

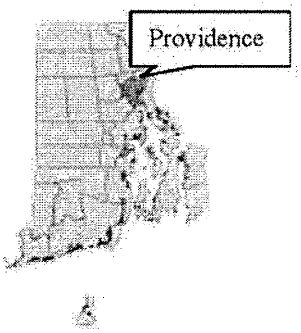
As the City of Providence Multi-Hazards Mitigation Plan is implemented, additional regulations and steering documents may be subject to compliance. Likewise, the routines of some government departments and related agencies may be adjusted to reflect the aspirations of the plan. On relevant matters, the plan update can serve as a budgetary and administrative guide to decision-making entities, such as the Mayor and City Council.

For Providence, like most cities/towns, costly mitigation projects are an impracticable luxury in the absence of external funding. Thus, the preparation of this update is closely tied to the pursuit of financial assistance. The Hazard Mitigation Grant Program, or 'The 404 Program,' of the FEMA is the primary vehicle. Based on state priorities and available funds, the Rhode Island State Hazard Mitigation Committee (SHMC) will conduct preliminary eligibility review of projects submitted by Providence for funding and will serve as a grant manager for projects ultimately approved by FEMA. Projects commonly receiving funds include:

- Acquisition and relocation or repetitively damaged structures,
- Retrofitting of vulnerable structures,
- Construction of minor flood controls, and
- Development of an official hazard mitigation plan.

State authorities will incorporate information compiled in this document into the State Hazard Mitigation Plan to strengthen the statewide knowledge and idea-base for mitigation planning. A well-prepared and locally-adopted plan can demonstrate understanding and commitment, two important variables when vying for limited, high-demand resources.

1.4 Environmental Setting



Providence, the capital of Rhode Island, is in Providence County in the northeastern part of the state and is bordered by the communities of Pawtucket, North Providence, Johnston, and Cranston. Providence is located at the head of Narragansett Bay along three rivers, Woonasquatucket, Seekonk and Providence rivers.

Industrial and residential floodplain development has occurred extensively throughout Providence. South of Glenbridge Avenue to the Providence River, the Woonasquatucket River floodplain is heavily developed with a mixture of industrial and residential development. North of Glenbridge Avenue, development along the river is generally confined to residential housing. The Moshassuck River floodplain is heavily developed with industries and residences from below the North Burial Ground to the confluence with the Woonasquatucket River. The areas surrounding the West River floodplain and the Upper Canada Pond Brook are generally in residential land use. The portion of the floodplain in Providence affected by the Pocasset River consists generally of industrial development. The coastline along the Providence River is heavily developed with industrial facilities, as is the lower portion of the Seekonk River. The head of the Woonasquatucket River is in North Smithfield and flows into Providence from the west through the Town of Johnston. Along its course, it passes through many reservoirs and old mill ponds.

The Moshassuck River rises in Lincoln and continues south into Providence where it joins with the Woonasquatucket River to form the Providence River. Adjacent to the North Burial Ground and Interstate 95, the Moshassuck River enters a 0.5 mile-long culvert which terminates just north of the confluence of the West River. The West River enters the City from the northwest and is also characterized by several old mill ponds with heavy industrial development. Upper Canada Pond Brook enters Providence in the north from its headwaters in North Providence. The portion of this stream within Providence is dominated by Upper Canada Pond. The Pocasset River flows from Johnston through the southwestern corner of Providence at the Johnston-Cranston corporate limits.

Providence Harbor and the Providence River form the northern end of Narragansett Bay, ending at the Fox Point Hurricane Barrier. The Seekonk River branches from the Providence River and is tidally affected throughout its length in Providence.

1.5 Brief History

Providence's History[1]

The Providence area was first settled in 1636 by Roger Williams and was one of the original thirteen colonies. Having been expelled from the Massachusetts Bay Colony for

[1] Taken from Providence Tomorrow: The Comprehensive Plan, page 18.

his religious views, Williams sought to resettle elsewhere and secure a title to the land from the local Narragansett natives around this time. Here he gave the city its present name, in honor of 'God's merciful Providence' which he believed had aided him in finding the location. Williams cultivated Providence as a refuge for persecuted religious dissenters, as he himself had been exiled from Massachusetts.

Shortly after being settled, much of Providence was burned in King Philip's War, which lasted from 1675 to 1676. Providence's growth was slow during the next quarter-century. The first census of the colony, taken in 1708, recorded 1,446 residents. However, the second census, taken in 1730, the colony's population had almost tripled to 3,916 people. The Providence territory would become smaller as more and more of the land would become part of different towns, including Scituate and Johnston. The city's slow growth was also due to the rocky, hilly, and heavily wooded land which made farming difficult, as well as the tradition of dissent and independent-mindedness (Rhode Island was the first of the thirteen colonies to declare independence from Great Britain). Residents often fought over land titles, politics, and religion.

Providence is ideally located along the eastern seaboard of the United States. The City developed near a natural harbor, establishing a populated area along one of the earliest key trade routes. Today this network includes the major northeastern cities: Boston, Providence, New York, Philadelphia, Baltimore, and Washington, D.C. This northeast corridor runs 600 miles long and 30 miles wide, and Providence is well situated within it. The city's location facilitated its development as a transportation center, offering access to both water and overland routes.

Providence developed in a unique way compared to most older cities. Its settlers seemed to have no need for a common square or meetinghouse, and the town grew in a linear fashion, along the east side of the Providence River. The downtown area, typically the core of early development in a community, did not develop for a century after Providence's colonization. Known then as Weybosset Neck, the downtown area to the west of the river was dominated by steep hills, marshy lowlands, and muddy creeks. Not until 1771 was any kind of permanent link created between the east side and downtown.

Demand for a specialized commercial district in Providence increased around the turn of the nineteenth century, as 'downtown' started to develop west of the Providence River. Shipping and manufacturing became the key industries around the downtown area, as residential development continued along its fringes. By the end of the 1820s, what we know today as downtown was a thriving area. During this time the jewelry industry grew most significantly of the manufacturing trades, later establishing Providence as the jewelry capital of the region.

Providence's growth and transformation from a small shipping town to the major economic center of the most highly industrialized state in the nation was rapid and dramatic. Providence grew in population from 15,000 people to more than 175,000 at the turn of the twentieth century. Forty years later the city enjoyed its highest population

ever (253,504), as industries and businesses continued to migrate to Providence's active harbor and commercial areas. The next forty years, however, from 1940 to 1980, saw a significant decrease in population, as the 'suburbanization' phenomenon negatively impacted most of the older cities throughout New England. Urban renewal schemes and the construction of Routes 6 and 10 and Interstates 95 and 195 in the 1950s and 1960s destroyed a significant part of the City's urban fabric and isolated neighborhoods from each other and from downtown.

Providence reached its lowest population count of the century in 1980, with 156,804 people. In the early 1980s, however, this trend began to reverse, and the City has since enjoyed a much-touted renaissance. According to the 2010 census the city had 178,042 residents making it the third largest New England city behind Boston and Worcester.

Providence Today[2]

The City of Providence is characterized by a number of outstanding features: its topography and open spaces; its waterways and shoreline; its unique scale in terms of buildings and population; the many respected private and public learning and health institutions; its history and historically significant architecture; and its proximity to a variety of economic, recreational, and cultural areas, including the cities of Boston and New York, the ocean, and the mountains in northern New England, all adding to the significance of Providence as the capital city of the State of Rhode Island. Providence's population is ethnically and culturally diverse and varied, which creates a unique cultural and educational environment. The city is also home to numerous top hospitals, colleges, and universities, a key part of its economy. The city is alive with new development designed to complement existing scale, and along with the ongoing preservation and renovation activities, is helping to continue the tradition that is Providence. According to the 2017 census estimates, the city had 180,393 residents.[3]

1.6 History of Disaster Declarations

Since 1953, FEMA Region 1 (the New England states) has endured more than 150 federal emergency and disaster declarations. The following information gives an overview of the most significant past Federal Emergency and Disaster Declarations for Rhode Island (and Providence County, including the City of Providence):

Hurricane Carol	August 1954
Hurricane Edna	September 1954
Hurricane Diane and Flood	August 1955
Blizzard 1978	February 1978
Hurricane Gloria	October 1985
Hurricane Bob	August 1991
January Blizzard	January 1996
Snowstorm	December 2003

[2] Ibid, page 19.
[3] U.S. Census Quick facts, https://www.census.gov/quickfacts/providencecityrhodeisland.

Snowstorm	February 2005
Hurricane Katrina	August 2005
Severe Storm/Floods	December 2008
Severe Storms/Flooding	March 2010
Tropical Storm Irene	August 2011
Hurricane Sandy	October 2012
Severe Winter Storm/Snowstorm	February 2013
Severe Winter Storm	January 2015

1.7 Recent Disaster Declarations

The communities of Providence County (including Providence) have experienced significant losses during several recent storms that have warranted FEMA to declare these storms as disasters. The following are descriptions of each of the recent storms (since the 2013 Plan) that have been declared as disasters by FEMA and which have affected the City of Providence.

1.7.1 Severe Winter Storm/Snowstorm – February 2013 (FEMA-4107)

A major disaster declaration (DR - 4107) was declared on March 22, 2013 due to a severe winter storm and snowstorm in Bristol, Kent, Newport, Providence, and Washington counties. The total public assistance cost estimate in Rhode Island was $7,057,671.

Reports indicated that this storm stretched from New Jersey to Maine and into Canada. More than two feet of snow fell in Rhode Island from Friday night to Saturday morning. National Grid estimated more than 180,000 customers lost power. By Saturday night, 129,000 customers in Rhode Island remained without power.

1.7.2 Severe Winter Storm/Snowstorm – January 2015 (FEMA-4212)

An historic winter storm brought heavy snow to southern New England with blizzard conditions to much of Rhode Island and eastern Massachusetts, beginning during the day on Monday, January 26, 2015 and lasting into the early morning hours of Tuesday, January 27th. The highest snowfall totals, averaging two to three feet, extended from extreme northeast Connecticut and northwest Rhode Island into much of central and northeast Massachusetts, including greater Boston. Much of southeast Massachusetts and the rest of Rhode Island received one to two feet of snow. Totals dropped off dramatically west of the Connecticut River Valley where totals of four to eight inches were observed.

The storm was well-forecast, with Blizzard Watches and Winter Storm Watches issued two days before the snow began. Low pressure tracked northeast from the Carolinas and strengthened rapidly as it slowly passed southeast of Nantucket on Monday evening, January 26th. All the precipitation fell as snow with this storm. At its peak, snowfall rates of two to three inches per hour were common. In Rhode Island, blizzard

conditions were officially reported in Westerly (five hours), Newport (four hours), and at T.F. Green State Airport in Warwick (three hours).

Daily snowfall records were set for January 27th in Boston (22.1 inches, previous record 8.8 inches in 2011), Worcester (31.9 inches, previous record 11.0 inches in 2011), and Providence (16.0 inches, previous record 6.7 inches in 2011). In Providence, the total of 19.1 inches was the fourth highest on record (dating back to 1904), while in Boston the total of 24.6 inches was the sixth highest on record (dating back to 1872).

The Blizzard of January 2015 produced very strong winds late Monday into Tuesday near the Massachusetts and Rhode Island coasts where gusts of 50 to 65 miles per hour (mph) were common.

The Governor of Rhode Island declared a statewide travel ban beginning at midnight on January 27th and continuing through 8 pm. The few cars/drivers who did not obey the travel ban became stuck. A Rhode Island Department of Transportation RIDOT) vehicle flipped over during the storm as well.[4]

[4] National Climatic Data Center, www.ncdc.noaa.gov

Section 2 Risk Assessment

2.1 Introduction

Identifying potential hazards is the first step in any effort to reduce community vulnerability. The subsequent identification of the risk and vulnerability for a community are the primary factors in determining how best to allocate finite resources to address what mitigation might take place. The FEMA Plan Review Guide dated October 1, 2011 was used in developing this strategy plan as a basic template to identify the various natural, human-caused, and technologic hazard types. The hazard identification and analysis involved all hazards that potentially threaten the City of Providence, also consistent with the State Hazard Mitigation Plan.

By collecting and analyzing information for each potential hazard that may affect Providence, several determinations have been made:

- Which hazards merit special attention,
- What actions might be taken to reduce the impact(s) of those hazards, and
- What resources are likely to be needed.

2.2 Hazard Identification

The Providence LHMC evaluated each of the hazard types that may affect Providence, and similarly to those identified in the 2013 Plan. For the purposes of the 2019 update, the Providence LHMC decided to organize hazards into the following categories with associated hazards as listed in Table 2-1 below.

Table 2.1 Hazard Identification and Hazard Groupings

Natural Hazards	Human-Caused Hazards	Technological Hazards
Wind-Related	**Terrorism (Intentional)**	**Infrastructure/Utility Failure**
Hurricane	Biological	Communications
Tornado	Chemical/Hazardous Materials Release	Emergency Services
High Winds	Cyber	Energy
Severe Thunderstorm	Explosive	Information Technology
Lightning	Radiological/Nuclear	Transportation Systems
Hail	Civil Disobedience/Unrest	Water/Wastewater Systems
Winter-Related	**Other (Accidental)**	
Heavy Snow	Fire	
Ice Storm	Mass Casualty Incident	
Extreme Cold	Dam Inundation	
Flood-Related	Special/VIP Events	
Riverine Flooding		
Flash Flooding		
Heavy Rain, Inland/Urban Flooding		
Coastal Flooding		
Dam Inundation		
Sea Level Rise		
Fire-Related		
Wildfire		
Urban Fire		
Geologic-Related		
Earthquake		
Drought-Related		
Drought		
Extreme Heat		
Communicable		
Infectious Disease		

The Horsley Witten Group, Inc. developed citywide Geographical Information Systems (GIS) mapping as part of the vulnerability analysis located in Appendix A, including:

- Map 2.1 Hurricane Surge Inundation Areas
- Map 2.2 FEMA Flood Zones
- Map 2.3 Mean Higher High Water
- Map 2.4 Mean Higher High Water Plus One-Foot SRL

- Map 2.5 Mean Higher High Water Plus Seven Feet SRL

2.3 Hazard Profiles: Location, History and Probability of Future Occurrence

In assessing the hazards to a community, both the risk and the vulnerability must be considered. A hazard is the actual event that poses the danger to the community (e.g. the hurricane, tornado, earthquake, etc. that threatens the city). The term "risk" refers to the predicted impact that a hazard would have on people, services, and specific facilities and structures in the community. The term "vulnerability" refers to the characteristics of the society or environment affected by the event that resulted in the costs from damages (Heinz Center Report, 1999, p. 105). The vulnerability of an area refers to its susceptibility to a hazard. The areas of the city affected by extreme natural, human-caused, and technologic events are identified by the hazard risk assessment. In determining the risk and vulnerability of the city, the likelihood, frequency, and magnitude of damage from identified hazards are assessed.

In developing an updated Risk Assessment, Providence defined the risks that the City could face and followed up with an assessment of the vulnerability of the at-risk areas, and the implications of experiencing natural, human-caused, and technologic disasters (e.g., loss of life, damage to the natural environment, property damage, and economic impacts). A risk assessment determines the likelihood of adverse impacts associated with specific hazards, and a vulnerability assessment is concerned with the qualitative or quantitative examination of the exposure of some societal component (i.e. economy, environment, social). The result of this process was the preparation of a Risk Assessment Rubric that quantifies the probability, severity, and overall risk of these hazards impacting the City. The Risk Assessment Rubric was then used to establish mitigation benefits and develop mitigation strategies (Section 4.3).

Risk Assessment Rubric

The Providence LHMC evaluated each of the natural, human-caused, and technologic hazards and collectively determined the likelihood of occurrence, locations affected, and potential impacts of each. This information was used to establish the relative threat each poses to the City of Providence. FEMA's Calculated Priority Risk Index (CPRI) Tool (modified) was used to develop the scoring included below. Several information sources were used to complete the Risk Assessment Rubric including data from the 2018 State Hazard Mitigation Plan, 2013 City of Providence Hazard Mitigation Plan and PEMA staff input (as indicated). The Risk Assessment Methodology and results (Tables 2.2, 2.3, and 2.4) are included below. An additional column was added to allow for comparisons between the 2013 and 2018 relative threat/risk. Each identified hazard is rated in each of the following categories; their ratings are then used to calculate the relative threat (risk) each hazard poses to the city.

Probability: The frequency that the hazard has occurred in the past and the probability that it will occur in the future.

0= Not Applicable (NA)

1= Occurred once or no times in the past, one chance of happening in 50-year

period or more
2= Occurred 5 or fewer times in the past or at least one chance of happening in a 20-year period
3= Occurred more than 5 times but less than 10 times in the past or one or more chances of happening in a 5-year period
4= Occurred more than 10 times in the past or one or more chances of happening in any given year

Human Impact: Possibility of injury, illness, or death.
0= Not Applicable (NA)
1= Injuries are treatable with first aid
2= Injuries/illnesses treatable with medical care, injuries do not result in permanent disability, or disfigurement
3= Injuries lead to permanent disability, disfigurement and/or death

Property Damage: Physical loses and damages.
0= Not Applicable (NA)
1= Isolated, minimal property damage, or no damage at all
2= Sporadic damage to buildings and facilities
3= Widespread, critical damage to building and infrastructure

Business Impact: The interruption of services.
0= Not Applicable (NA)
1= No interruption to daily business
2= Employees/owners/customers unable to reach facility/ place of business
3= Significant damage to facilities requiring temporary/permanent shutdown of facility

Infrastructure Impact: The interruption of services.
0= Not Applicable (NA)
1= No shutdown of infrastructure/facilities
2= Short shutdown of infrastructure/facilities
3= Medium shutdown of infrastructure/facilities

Preparedness: The amount of preplanning or preparedness activities undertaken by the City of Providence for a certain hazard.
0=Not Applicable (NA)
1= A formal plan has been created, mitigation/preparedness activities have been initiated
2= Elements of planning or preparedness exist but no formal plan in writing
3= No planning, training, or other preparedness activities exist/have taken place

Calculation of Risk
Risk% = ((Probability)/4*((Human Impact+ Property Impact+ Business Impact+ Preparedness)/12))*100

Table 2.2 Natural Hazards Risk Assessment Rubric

Event	Probability	Severity = (Magnitude - Preparedness)				Risk (2013)	Risk (2019)
		Human Impact	Property Impact	Business Impact	Preparedness		
	Likelihood this will occur	*Possibility of death, injury, or illness*	*Physical losses and damages*	*Interruption of services*	*Preplanning*	*Relative Threat*	*Relative Threat*
Score	*0 = N/A* *1 = Low* *2 = Moderate* *3 = High* *4 = Highly Likely*	*0 = N/A* *1 = Low* *2 = Moderate* *3 = High*	*0 = N/A* *1 = Low* *2 = Moderate* *3 = High*	*0 = N/A* *1 = Low* *2 = Moderate* *3 = High*	*0 = N/A* *1 = High* *2 = Moderate* *3 = Low*	*0 - 100%*	*0 - 100%*
Wind-Related							
Hurricane	3	3	3	3	2	83%	69%
Tornado	2	1	2	1	2	14%	25%
High Winds	4	1	2	1	2	42%	50%
Severe Thunderstorm	4	0	1	1	3	17%	42%
Lightning	3	0	1	1	3	N/A	31%
Hail	4	0	1	0	3	N/A	33%
Winter-Related							
Heavy Snow	4	2	2	2	2	58%	67%
Ice Storm	4	0	1	2	2	33%	42%
Extreme Cold[1]	3	1	1	1	1	50%	25%
Flood-Related							
Riverine Flooding	4	0	3	3	2	83%	67%
Flash Flooding	4	0	1	2	2	42%	42%
Heavy Rain, Inland/Urban Flooding	3	0	2	2	2	50%	38%
Coastal Flooding	2	0	1	1	2	N/A	17%
Dam Inundation[1,3]	3	2	2	2	2	39%	50%
Sea Level Rise[1]	4	1	1	1	2	N/A	42%
Fire-Related Hazards							
Wildfire[1,3]	2	2	2	2	1	N/A	29%
Urban Fire[1,3]	2	2	2	2	1	58%	29%
Geologic-Related							
Earthquake	2	1	1	1	2	22%	21%
Drought-Related							
Drought	2	1	1	1	2	22%	21%
Extreme Heat[1]	4	1	1	1	2	50%	42%
Communicable							
Infectious Disease[1]	2	3	1	1	2	67%	29%

1. Data obtained from December 2018 State Hazard Mitigation Plan.
2. Data Obtained from City of Providence 2013 Plan.
3. Preparedness ranking completed by City of Providence EMA.

Table 2.3 Human-Caused Hazards Risk Assessment Rubric

Event	Probability	Severity = (Magnitude - Preparedness)				Risk (2013)	Risk (2019)
		Human Impact	Property Impact	Infrastructure Impact	Preparedness		
	Likelihood this will occur	*Possibility of death, injury, or illness*	*Physical losses and damages*	*Interruption of services*	*Preplanning*	*Relative Threat*	*Relative Threat*
Score	*0 = N/A* *1 = Unlikely* *2 = Potential* *3 = Likely* *4 = Highly Likely*	*0 = N/A* *1 = Neglible* *2 = Limited* *3 =Significant*	*0 = N/A* *1 = Neglible* *2 = Limited* *3 =Significant*	*0 = N/A* *1 = Neglible* *2 = Limited* *3 =Significant*	*0 = N/A* *1 = High* *2 = Moderate* *3 = Low*	*0 - 100%*	*0 - 100%*
Terrorism (intentional)							
Biological[1,3]	1	3	2	1	3	14%	19%
Chemical/Hazardous Material Release[1,3]	2	3	1	2	3	22%	38%
Cyber[1,3]	3	2	1	2	3	N/A	50%
Explosive[2,3]	2	3	2	2	3	25%	42%
Radiological/ Nuclear[1,3]	1	1	1	2	3	22%	15%
Civil Disobedience/ Unrest[1,3]	2	2	1	1	2	11%	25%
Other (accidental)							
Fire[1,3]	2	2	2	2	1	58%	29%
Mass Casualty Incident[2,3]	2	3	2	2	3	44%	42%
Dam Inundation[1,3]	3	2	2	2	2	39%	50%
Special/VIP Events[2,3]	3	0	0	1	1	25%	13%

Tabel 2.4 Technologic Hazards Risk Assessment Rubric

Event	Probability	Severity = (Magnitude - Preparedness)				Risk (2013)	Risk (2019)
		Human Impact	Property Impact	Infrastructurel mpact	Preparedness		
	Likelihood this will occur	*Possibility of death, injury, or illness*	*Physical losses and damages*	*Interruption of services*	*Preplanning*	*Relative Threat*	*Relative Threat*
Score	*0 = N/A* *1 = Unlikely* *2 = Potential* *3 = Likely* *4 = Highly Likely*	*0 = N/A* *1 = Neglible* *2 = Limited* *3 =Significant*	*0 = N/A* *1 = Neglible* *2 = Limited* *3 =Significant*	*0 = N/A* *1 = Neglible* *2 = Limited* *3 =Significant*	*0 = N/A* *1 = High* *2 = Moderate* *3 = Low*	*0 - 100%*	*0 - 100%*
Infrastructure/Utility Failure[1]	2	2	1	2	2	N/A	29%

1. Data obtained from December 2018 State Hazard Mitigation Plan.
2. Data Obtained from City of Providence 2013 Plan.
3. Preparedness ranking completed by City of Providence EMA.

The Providence LHMC reached the consensus that the following hazards are the major (50% or higher risk) causes of risk to the community, by relative threat:

Natural Hazards
- Hurricane (69%)
- Heavy Snow (67%)
- Riverine Flooding (67%)
- High Winds (50%)
- Dam Inundation (50%)

Human-Caused Hazards
- Cyber (50%)
- Dam Inundation (50%)

It should be noted that the above hazards are not a complete listing of hazards that may impact Providence. The LHMC agreed that this listing accurately represents those hazards that impact Providence most frequently and have the potential to cause fatalities, injuries, property and infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm of loss. The following hazards will not be addressed in this 2019 Update:

- Avalanche
- Expansive Soils
- Land Subsidence
- Landslides
- Volcanoes
- Tsunamis

These hazards were not considered for the following reasons:

- Lack of frequency in which they occur,
- The minimal probability of their occurrence, and
- The lack of resources to devote any amount of time to further research the likelihood or potential occurrence or impact.

The hazard-specific tables (natural hazards) that follow after each section represent the various significant natural hazard events that have occurred in and around the City of Providence, utilizing National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (http://www.ncdc.noaa.gov/). All events are county wide (Providence County), unless otherwise noted.

Climate Change

Climate change is one of the most pressing issues of our time and its effects are increasingly impacting Rhode Island. In 2015, the Rhode Island Executive Climate Change Coordinating Council (EC4) charged the Science and Technical Advisory Board

(STAB) to assess the state of knowledge on six manifestations of climate change in Rhode Island, including:

- SRL
- Warming air temperatures
- Warming water temperatures
- Storm frequency and severity
- Changing biodiversity
- Precipitation and inland flooding[5]

On September 15, 2017 Governor Raimondo signed an Executive Order to accelerate actions and investments to better prepare the state for these impacts. The result of that Executive Order, *Resilient Rhody*, establishes the framework for collective action, involving state agencies, municipalities, and statewide organizations. *Resilient Rhody* will focus attention on climate resilience actions across public and private sectors. Since climate change has both direct and indirect impacts on the range of natural hazards that the City of Providence is vulnerable to, the LHMC determined it was most appropriate to include a 'climate change impacts on...' section to each natural hazard profiled in this plan. These standard sections within each hazard section include similar findings to those reported in *Resilient Rhody*.

2.3.1 Wind-Related Hazards

Wind is the movement of air caused by a difference in pressure from one place to another. Local wind systems are created by the immediate geographic features in any given area, such as mountains, valleys, or large bodies of water. Wind effects can include blowing debris, interruptions in elevated power and communications utilities, and intensification of the effects of other hazards related to winter weather and severe storms.

Based on historical tornado and hurricane data, FEMA has produced a map that depicts maximum wind speeds for design of safe rooms. Rhode Island is included in Wind Zone II (160 mph). Rhode Island is also within the Hurricane - Susceptible Region. Rhode Island wind events can produce damage often associated with thunderstorms or tornadoes. In some instances, these events have been associated with weakening tropical weather systems, including downgraded tropical and sub-tropical storm systems[6].

Table 2.5 below represents the various significant wind-related hazard events that have occurred in and around the City of Providence over time, utilizing the National Climatic Data Center. All events are county wide (Providence County), unless otherwise noted.

[5] Resilient Rhody: An Actionable Vision for Addressing the Impacts of Climate Change in Rhode Island, page 11.
[6] *Rhode Island 2014 Hazard Mitigation Plan Update*, Rhode Island Emergency Management Agency, page 3-135.

Table 2.5 Significant Wind-Related Events, Providence County

Hazard Type	Date	Level/Description	Damages
Hurricanes			
	9/21/1938	95 mph	$100 M; 262 deaths
	9/14/1944	82 mph	$2 M
	8/31/1954	Carol; 110 mph	$90 M; 19 deaths
	9/11/1954	Edna; 40 mph	$100 K
	8/19/1955	Diane; 75 mph	$170 M
	12/12/1960	Donna; 75 mph	$2.4 M
	9/27/1985	Gloria; 81 mph	$19.8 M; 1 death
	8/19/1991	Bob; 63 mph	$115 M
	8/28/2011	Irene; 60 mph	$75 K
	10/29/2012	Sandy; 60 mph	$10 K; trees/powerlines down
Tornadoes			
	8/7/1986	F2: 4 miles long/200-400 yards wide	Significant property damage; > $1M; Widespread power outages; numerous injuries
	9/23/1989		$250K
Strong Winds			
	12/2/1996	40-50 mph	
Strong Winds			
	12/24/1996	40-45 mph gusts	
	2/20/1997	50-55 mph	
	3/26/1997	50-60 mph gusts	
	3/31/1997	30-40 mph	Widespread power outages; Downed trees/power lines
	11/27/1997	40 -50 mph	
	12/2/1997	40 -50 mph	
	12/14/1997	40 -55 mph	
	2/4/1998	50 mph gusts	
	2/24/1998	40-55 mph	
	3/9/1998	40-55 mph	Flooding
	3/12/1998	50 mph gusts	
	3/21/1998	35-50 mph gusts	
	3/26/1998	35-50 mph gusts	
	4/9/1998	40-50 mph gusts	
	11/11/1998	40-50 mph gusts	
	12/22/1998	35-45 mph	
	1/3/1999	45 mph gusts	
	1/15/1999	55 mph gusts	
	2/2/1999	55-65 mph	
	3/4/1999	50 mph gusts	

Hazard Type	Date	Level/Description	Damages
	3/22/1999	50-60 mph	Downed trees/power lines; Scattered power outages
	10/14/1999	50 MPH gusts	Downed trees/power lines; Scattered power outages
	12/11/1999	40-50 mph	
	1/16/2000	50-55 mph gusts	
	2/14/2000	60 mph gusts	
	4/8/2000	45-55 mph	
	10/28/2000		$8K
	2/10/2001	45-55 mph	
	2/17/2001	45-44 mph	
	2/17/2006		$10K
	4/29/2010	40-50 mph	Scattered wind damage; 15K
	12/27/2011	55 mph gusts	$15K
	9/18/2012		$2K
	1/20/2013		$5K
	11/1/2013		$5K
	11/27/2013		Downed trees; $3K
	1/11/2014	55 mph gusts	$3K
	3/26/2014		$5K
	3/17/2015		$5K
	4/4/2015	35-45 mph	Downed trees/power lines
	10/29/2015		$2K
	2/16/2016	60 mph gusts	$25K
	3/17/2016		$15K
	3/31/2016		Downed trees/power lines; $10K
	4/1/2016		$10K
	9/5/2016		Downed trees; $15K
	10/23/2016	40 mph gust	
	11/21/2016	45-50 mph	$.3K
	12/15/2016	50 mph gusts	$.7K
	1/24/2017		Downed wires; $11K
	10/24/2017	45-55 mph	$3K
	10/25/2017	45-55 mph	$1K
	10/29/2017		$5K
High Wind			
	1/19/1996	40-60 mph	Scattered power outages; Downed trees
	1/27/1996		
	2/25/1996	60 mph gusts	Downed trees/power lines; Many power outages; Some property damage

Hazard Type	Date	Level/Description	Damages
	7/13/1996	< 40 mph gusts	Downed trees/power lines; Many power outages
	3/6/1997	50-60 mph	Downed trees/power lines; Many power outages; Much property damage;
	1/18/1999	55-60 mph	Scattered power outages
	9/16/1999		Downed trees/power lines
	11/2/1999	60 mph gusts	Downed trees/power lines
	2/14/2000	55-60 mph gusts	
	12/12/2000	60 mph gusts	Scattered power outages; Downed trees/power lines
	12/17/2000	60 mph gusts	Scattered power outages; Downed trees/power lines
	9/11/2002	50 mph	Scattered power outages; Downed trees/power lines
	10/15/2003	45-55 mph	Scattered power outages; Downed trees
	11/13/2003	50-60 mph	Downed trees/power lines
	11/5/2004	45-60 mph	
	12/1/2004		Downed trees/power lines
	12/23/2004	60 mph	$25K
	3/8/2005	< 70 mph	Downed trees; $50K
	4/2/2005	60 mph	$35K
	5/7/2005	60 mph	Downed trees/wires; $15K
	9/29/2005	40-60 mph	Scattered power outages; Downed trees/power lines; $15K
	10/16/2005		Scattered power outages; Downed trees/power lines; $25K
	10/25/2005		Scattered power outages; Downed trees/power lines; $5K
	1/18/2006	60 mph gusts	$40K
	1/21/2006		Downed trees/power lines; $50K; 2 injuries
	10/29/2006	50 mph	Downed trees; $10K
	12/1/2006		Downed trees/power lines; $15K
	4/16/2007	< 60 mph	Downed trees/power lines; $15K
	2/10/2008	67 mph gusts	$5K
	3/8/2008	60 mph gusts	
	1/25/2010	60 mph gusts	$10K
	12/8/2011	63 mph gust	
	10/29/2012	55-65 mph (Superstorm Sandy)	Major coastal flooding; Many power outages; $10K
	1/31/2013	60-70 mph gusts	$25K
	2/25/2016		$20K

Hazard Type	Date	Level/Description	Damages
Thunderstorms			
	6/19/1957		
	4/26/1961	60 mph	
	5/26/1969		Downed trees/power lines
	6/8/1971		
	3/21/1974		
	5/3/1976		
	8/10/1979		
	10/18/1981	60-70 mph gusts	Downed trees/property damage
	6/15/1983		
	6/13/1984		
	10/18/1990	40-60 mph	Downed trees
	6/12/1991		Downed trees; Numerous power outages; Scattered property damage
	4/4/1995		
	8/4/1995		
	5/21/1996	71 mph gust	Downed trees/power lines
	6/22/1997	80-90 mph gusts	Major power outages; Many downed trees/power lines; Considerable property damage; $70K
	7/23/2002	60 mph	Downed trees; $5K
	6/20/2006	60 mph	$25K
	7/2/2008	60 mph	Downed trees/power lines; $6K
	9/9/2008	60 mph	$5K
	6/20/2010	60 mph	Downed trees/power lines; $10K
	6/28/2010	60 mph	
	8/5/2010	60 mph	Downed trees; $15K
	6/8/2011	60 mph	Downed trees; $3K
	6/9/2011	60 mph	Numerous downed trees (< 200)/power lines; 250K
	8/10/2011	60 mph	$5K
	7/1/2012	60 mph	Downed trees/power lines; $30K
	7/18/2012	60 mph	Downed trees/power lines; $10K
	7/24/2012	60 mph	
	6/23/2015	60 mph	$5K
	8/4/2015	60-80 mph gusts	Widespread power outages; Numerous downed trees/power lines; Transportation disrupted
	2/25/2016	50 mph	$5K
	7/17/2016	50 mph	

Hazard Type	Date	Level/Description	Damages
	8/12/2016	60 mph	$10K
	7/12/2017	60 mph	$1K
	8/2/2017	60 mph	$1K
Hail			
	5/17/1965	1.25" in diameter	
	5/29/1969	1.00" in diameter	
	5/11/1973	0.75" in diameter	
	6/27/1992	0.75" in diameter	
	7/18/2000	0.75" in diameter	
	7/2/2004	0.75" in diameter	
	6/17/2008	0.88" in diameter	
	7/2/2008	0.88" in diameter	
	7/23/2008	1.75" in diameter	
	4/22/2010	0.75" in diameter	
	5/26/2010	1.00" in diameter	
	5/7/2011	0.88" in diameter	
	7/1/2012	0.75" in diameter	
	7/18/2012	2.0" in diameter	
	7/24/2012	0.75" in diameter	
	7/23/2016	0.88" in diameter	
	9/30/2017	0.75" in diameter	
Lightning			
	6/11/2001		$10 K
	7/18/2006		Multiple strikes caused local fires; power outages/downed trees
	7/20/2013		$5 K; isolated fire from strike

Source: NOAA National Climatic Data Center, www.ncdc.noaa.gov

Hurricanes

Hurricanes are defined as a large circulating windstorm covering hundreds of miles that forms over warm ocean water. To be officially classified as a hurricane, the wind speeds must exceed 74 mph. In the Northern Hemisphere winds circulate in a counter clockwise direction. A great dome of water as much as fifty miles in diameter (called the "storm surge") is pushed ahead of the storm by its winds. In some coastal locations, this can result in tides 20 feet higher than usual. Occasionally, storm surge is responsible for damage to property and potential deaths.

The winds that accompany hurricanes have the potential to cause serious damage. Downed power lines leave residents without electricity and can impede business for days. Fallen trees can damage buildings and block roadways. Unsecured building components, including gutters, screened enclosures, roof coverings, shingles, car ports, porch coverings, overhangs, siding, decking, windows, walls, and gables, can be blown

off structures and carried by the wind to cause damage in other places. Wind driven rain often causes water damage in roof and wall envelopes.

Measuring the Intensity of a Hurricane
Hurricane damages come from wind, rain, tornadoes, floods/storm surge, and the effects of very low air pressure. The Saffir-Simpson Hurricane Wind Scale (SSHWS) intensity category system was developed in the 1970s to characterize a hurricane's destructive potential by indicating wind speeds and range of damage, see Table 2.6 below. The SSHWS category system measures sustained wind speed, central pressure, storm surge height, and coastal damage potential within five intensity categories.

Table 2.6 Saffir-Simpson Hurricane Wind Scale

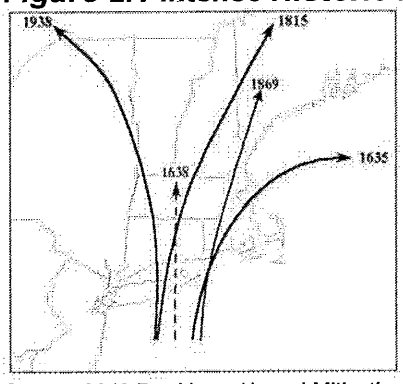
Scale No. (Category)	Wind (mph)	Potential Damage
1	74 - 95	Minimal: Damage is primarily to shrubbery and trees, mobile homes, and some signs. No real damage is done to structures.
2	96 – 110	Moderate: Some trees topple, some roof coverings are damaged, and major damage is done to mobile homes.
3	111 – 130	Extensive: large trees topple, some structural damage is done to roofs, mobile homes are destroyed, and structural damage is done to small homes and utility buildings.
4	131 – 155	Extreme: Extensive damage is done to roofs, windows and doors; roof systems on small buildings completely fail; and some curtain walls fail.
5	> 155	Catastrophic: Roof damage is considerable and widespread, window and door damage are severe, there are extensive glass failures, and entire buildings could fail.
Additional Classifications Tropical Storm 39 – 73 Tropical Depression < 38		

Source: NOAA.

The National Weather Service (NWS) will issue a hurricane warning when sustained winds of 74 mph or higher are reached and expected within a coastal area within 24 hours. On average, there are approximately 10 named tropical storms along the east coast of the U.S. each year, six of which are likely to develop into hurricanes, with only two or three likely to reach category 3 on the SSHWS. The SSHWS has undergone a minor modification for 2012 in order to resolve awkwardness associated with conversions among the various units used for wind speed in advisory products. The change broadens the category 4 wind speed range by one mph at each end of the range, yielding a new range of 130-156 mph.

Since the Hurricane of 1938 (the Great New England Hurricane), Providence County has experienced ten hurricanes of varying magnitude (Figure 2.1 Intense Historic Hurricane Strikes). In 1985, Hurricane Gloria caused $19.8 million in damages and one death. The most recent hurricane event, Hurricane Sandy in 2012, caused approximately $10,000 in damages, along with trees and powerlines downed.

Figure 2.1 Intense Historic Hurricane Strikes



Source: 2013 Providence Hazard Mitigation Plan.

Hurricane season is between June 1 and November 1 each year. Peak times for the City of Providence and the State of Rhode Island are in August and September when the Atlantic Ocean waters are at their warmest. Statistically, the peak of the season is September 10th. The severity and speed of a hurricane will determine how long the inclement weather will affect the city. The duration of time a hurricane or tropical storm will affect the city depends on its size in diameter and the forward speed. Historically these storms increase their forward speed as they approach northern latitudes. Weather forecasting typically allows a few days advanced warning of the onset of a hurricane that will affect Providence. Although the FPHB has significantly reduced the risk of flooding within the City of Providence, a powerful hurricane remains the natural hazard that poses the highest risk to the City of Providence. The entire City of Providence can be uniformly affected by hurricanes.

Storm Surge

Of additional concern to the City of Providence is hurricane storm surge. Storm surge refers to the rise of water levels caused explicitly by a storm and is measured as the height above the normal predicted tide. The combination of SRL and increased storm intensity will result in higher storm surges characterized that will extend further inland, potentially causing greater damage to property and infrastructure. The Intergovernmental Panel on Climate Change (IPCC) in 2014 found that increasing storm surges and other forms of coastal flooding have the potential to disrupt livelihoods and create severe health risks across various sectors.

Over time, as sea levels rise, water levels associated with what is thought of as today's 100-year return period storm will increase, because a higher base sea level will increase the extent and depth of storm-related flooding. As a result, the 100-year return period storm of the future could result in much more flood-related damage than the 100-year return period storm of today. Additionally, from the perspective of water levels, SLR will cause the flooding that would occur with today's 100-year return period storm to become a more regularly-occurring event. For example, a future 20-year return period storm on top of a two-foot SLR will have the same water level and depth as today's 100-year return period storm.

Worst-case hurricane surge inundation areas for Categories 1 through 4 hurricanes striking the coast of Rhode Island were developed by the National Hurricane Center using the SLOSH (Sea Lake and Overland Surge from Hurricanes) Model. This layer was developed to assist emergency management officials in hurricane preparedness and operations. This data layer was created by the U.S. Army Corps of Engineers (USACE), New England District. Using ArcInfo's Grid extension, bare earth elevation data from several sources was subtracted from the worst-case hurricane surge values to determine which areas could be expected to be inundated under various scenarios. Map 2.1 Hurricane Inundation Areas (Appendix A) shows those areas expected to be inundated by Categories 1 through 4 hurricanes. Table 2.7 identifies the critical facilities/parcels impacted by the various hurricane inundation zones.

Table 2.7 Critical Facilities Impacted by Hurricane Categories 1 - 4

Land Use	Facilities Impacted Category 1	Facilities Impacted Category 2	Facilities Impacted Category 3	Facilities Impacted Category 4
College/University	6	9	11	28
Dams				3
Energy/Utility	1	2	5	6
Emergency Response				4
Federal				5
Hazardous Materials	1	1	1	2
Healthcare/Hospitals	3	4	73	84
Ports	22	27	30	30
Public Assembly				8
Schools			1	4
Shelters				
State				8
Transportation				22
Water Infrastructure				
Wastewater Infrastructure	1	6	8	17
Total	**34**	**49**	**129**	**221**

Source: City of Providence Geographic Information System dataset.

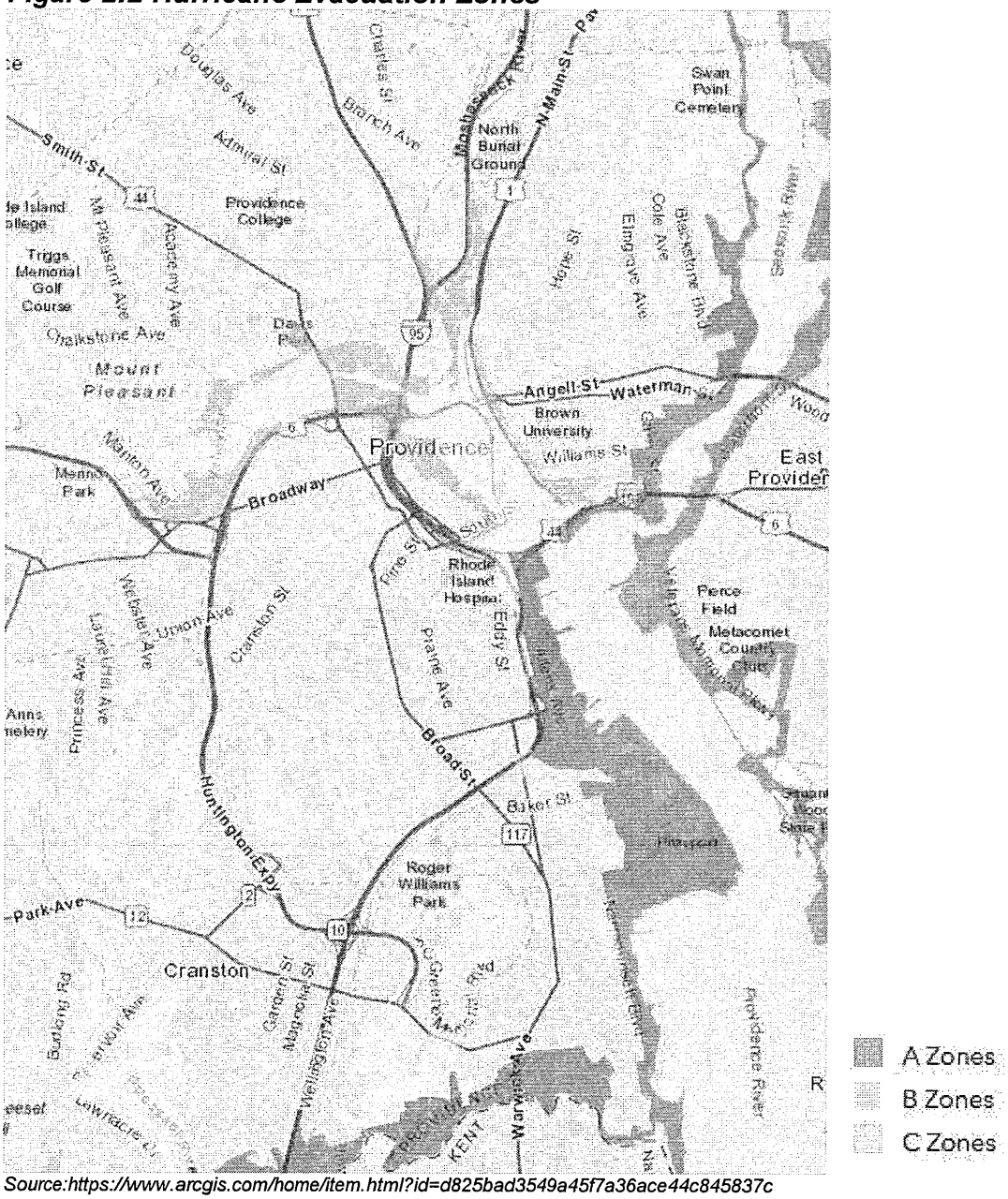
As Providence sits at the top of Narragansett Bay, if a hurricane where to make landfall west of the city, the wind generated on the eastern side of the storm could create serious surge elevations up the Bay that would all funnel at the head of the Bay towards Providence and East Providence. The FPHB was built for this very reason. It protects the central business district and high-rise buildings of downtown Providence from the effects of coastal surge from a hurricane event. The FPHB would hold out to roughly a surge likely generated from a Category 4 Hurricane impact in New England. The design storm for the FPHB is a water elevation of 22.18 feet above mean low water (MLLW). The top of the FPHB is 26.68 feet above MLLW. For comparison, the Hurricane of 1938

had a water elevation of 17.52 feet above MLLW. While this protects large areas of the City, India Point Park as well as the Port would be affected by surges from any category of hurricane. The City is aware that these types of storm surge events can occur during any season and can be associated with winter storms as well as hurricanes.

In 2009, the USACE, New England District under the National Hurricane Program, mapped Hurricane Evacuation Zones based on the hurricane surge inundation that can be expected to result from a worst-case combination of hurricane landfall location, forward speed, and direction for each hurricane category (Figure 2.2). Hurricane surge elevations were determined by the National Hurricane Center using the Boston 2 (PV2) SLOSH model basin and assumed peak hurricane surge arriving at mean high water. Evacuation Zone "A" is recommended to be evacuated prior to an expected category 1 or 2 hurricane. Evacuation Zone "B" is recommended to be evacuated prior to an expected category 3 or 4 hurricane. Evacuation Zone "C", which exists only for the City of Providence, is recommended to be evacuated in the unlikely event that the FPHB was to fail during a worst-case category 3 or 4 hurricane.

In July 2011, the PEMA created a "Fox Point Hurricane Barrier Coordination Guidebook" for all organizations that would be involved in implementing FPHB actions during an event. This guide details the roles and responsibilities for various agencies in control of the hurricane barrier's various component parts such as river gates, street gates, dikes, and release valves. Businesses in the Port have their own evacuation plans in the event of a hurricane and the City of Providence has a hurricane plan for evacuations of India Point Park and adjacent neighborhoods.

Figure 2.2 Hurricane Evacuation Zones



Source:https://www.arcgis.com/home/item.html?id=d825bad3549a45f7a36ace44c845837c

Climate Change Impacts on Hurricanes

Climate change is expected to result in the increased frequency and intensification of hurricanes and tropical storms worldwide. Rising sea levels, coupled with potentially higher hurricane wind speeds, rainfall intensity, and storm surges will combine to create more intense hurricanes, resulting in increased impacts to coastal communities. Research predicts a global increase in the intensity of such storms on average, by 2% to 11%, based on the IPCC mid-range emission scenario projections, as well as a poleward expansion in the latitude at which storms will reach their highest intensity.

Some experts have noted that the three massive storms from the 2017 hurricane season (Harvey, Irma, and Maria) are consistent with this expected intensification.

Hurricanes and tropical storms are expected to result in more rainfall. This increase has been observed and is expected both globally (IPCC 2014) and for the Atlantic basin, including the U.S. east coast. Based on a synthesis of current science, NOAA predicts that Atlantic hurricanes and tropical storms in the coming century will have higher rainfall rates than present storms, especially near the center of the storm. Hurricane Harvey, which resulted in a record 51.9 inches of rainfall at one station west of Houston, Texas, is one recent example of this trend.

Tornadoes/Strong Wind Events

Tornadoes are violently rotating columns of air in contact with and extending between a cloud and the surface of the earth. Generally, winds in most tornadoes are 100 mph or less, but can exceed 250 mph in the most violent and least frequent tornadoes. Several conditions are required for the development of tornadoes and associated thunderstorm clouds, including abundant low-level moisture to contribute to the development of a thunderstorm, along with a trigger/cold front to lift the moist air. Tornadoes usually form in areas where strong winds are turning in a clockwise direction and can be in the traditional funnel shape, or in a slender rope-like form. They typically begin in a supercell (severe thunderstorm), primarily in the month of May.

Measuring the Intensity of a Tornado

Typically, tornadoes are categorized by frequency values from historic data and area impacted based on the length and width of the damage path. Tornado damage severity is measured by the Fujita Tornado Scale, where wind speed is estimated from the amount of damage. As of February 1, 2007, the NWS began rating tornadoes using the Enhanced Fujita-scale (Table 2.8). The Enhanced Fujita scale is more complicated than the original F-scale, allowing for more precise assessments of tornado severity.

Table 2.8 Enhanced Fujita Scale

Fujita Scale			Derived		Operational EF Scale	
F Number	Fastest ¼ mile (mph)	3-second gust (mph)	EF Number	3-second gust (mph)	EF Number	3-second gust (mph)
0	40 - 72	45 - 78	0	65 - 85	0	65 - 85
1	73 - 112	79 - 117	1	86 - 109	1	86 - 110
2	113 - 157	118 - 161	2	110 - 137	2	111 - 135
3	158 - 207	162 - 209	3	138 - 167	3	136 - 165
4	208 - 260	210 - 261	4	168 - 199	4	166 - 200
5	261 - 318	262 - 317	5	200 - 234	5	Over 200

Source: NOAA.

Electrical utilities and communications infrastructure are vulnerable to tornadoes. Damage to power lines or communication towers has the potential to cause power and communication outages for residents, businesses and critical facilities. In addition to lost revenues, downed power lines present a threat to personal safety. Further, downed wires and lightning strikes have been known to spark fires. A structure's tornado vulnerability is based on building construction and standards. In general, mobile homes and wood-framed structures are more vulnerable to damage in a tornado than steel framed structures. Other factors, such as location, condition and maintenance of trees also plays a significant role in determining vulnerability.

Based on the limited frequency and severity of tornado events over time (two within the past three decades), as reported by the National Climatic Data Center and indicated in Table 2.5, the risk of tornadoes is considered low in Providence.

Lightning/Thunderstorms

Thunderstorms are formed when the right atmospheric conditions combine to provide moisture, lift, and warm unstable air that can rise rapidly. Thunderstorms occur any time of the day and in all months of the year yet are most common during summer afternoons and evenings and in conjunction with frontal boundaries. Thunderstorms affect a smaller area compared with winter storms or hurricanes, but they can be dangerous and destructive for several reasons. Storms can form in less than 30 minutes, giving very little warning; they have the potential to produce lightning, hail, tornadoes, powerful straight-line winds, and heavy rains that produce flash flooding.

All thunderstorms produce lightning, and therefore all thunderstorms are dangerous. Lightning often strikes outside of areas where it is raining, and may occur as far as 10 miles away from rainfall. It can strike from any part of the storm and may even strike after the storm has seemed to pass. Hundreds of people across the nation are injured annually by lightning, most commonly when they are moving to a safe place but have waited too long to seek shelter. The City of Providence can be uniformly affected by lightning and thunderstorms, dependent upon the time of day, existing/incoming weather conditions, and time of year.

Building construction, location, and nearby trees or other tall structures will have a large impact on how vulnerable an individual facility is to a lightning strike. A rough estimate of a structure's likelihood of being struck by lightning can be calculated using the structure's ground surface area, height, and striking distance between the downward-moving tip of the stepped leader (negatively charged channel jumping from cloud to earth) and the object. In general, buildings are more likely to be struck by lightning if they are located on high ground or if they have tall protrusions such as steeples or poles which the stepped leader can jump to. Electrical and communications utilities are also vulnerable to direct lightning strikes. Damage to these lines has the potential to cause power and communications outages for businesses, residencies, and critical facilities. Based on the frequency and severity of lightning/thunderstorm events over time, as reported by the National Climatic Data Center and indicated in Table 2.5, the risk of lightning/thunderstorms is considered moderate for Providence County.

Hail

Hail is formed in towering cumulonimbus clouds (thunderheads) when strong updrafts carry water droplets to a height at which they freeze. Eventually, these ice particles become too heavy for the updraft to hold up, and they fall to the ground at speeds of up to 120 mph. Hail falls along paths called swaths, which can vary from a few square acres to up to 10 miles wide and 100 miles long. Hail larger than ¾ inch in diameter can do great damage to both property and crops, and some storms produce hail over two inches in diameter. The City of Providence can be uniformly affected by hail, dependent upon the existing/incoming weather conditions, and time of year.

Structure vulnerability to hail is determined mainly by construction and exposure. Metal siding and roofing are better able to stand up to the damages of a hailstorm than many other materials, although it may also be damaged by denting. Exposed windows and vehicles are also susceptible to damage. Crops are extremely susceptible to hailstorm damage, as even the smallest hail stones can rip apart unsheltered vegetation. Based on the limited frequency and severity of hail events over time, as reported by the National Climatic Data Center and indicated in Table 2.5, the risk of hail is considered low in Providence.

Since the 2013 plan, there have been no significant hurricanes, no tornadoes, 20 strong wind events, two high winds events, seven thunderstorm events, two hail events, and one lightning event recorded in Providence County.

Property at Risk from Wind-Related Events in Providence

Wind events are quite normal in New England and happen regularly each year. Due to a typically mild climate, Providence remains vulnerable to hurricanes and tropical storms. Strong winds and rain can damage infrastructure, isolate community members and limit access to essential services. Although storms may cause some structural damage, the main vulnerabilities to a hurricane are systems and populations that may not be able to withstand temporary isolation or limited transportation.

Most buildings in Providence will be able to withstand the impacts of a hurricane or tropical storm. However, the vulnerability to such a storm varies by the location and the type of structure. Taller buildings are more vulnerable to lightning. Some rooftops may blow off in a hurricane, severely damaging the buildings.

Hurricanes and tropical storms can also impact the natural environment by increasing storm water runoff, as well as increasing flooding and tree displacement. Such alteration of the natural environment will impact fish and wildlife habitat. However, these are natural processes; absent prolonged climate changes, animals and their ecosystems are resilient to temporary changes in weather. However, hurricanes and tropical storms may have an impact on species and habitats that are already stressed. For example, increased runoff could increase the saturation rate of soils, thus increasing the likelihood of downed trees in high wind.

Roads in Providence are vulnerable to hurricanes and tropical storms. Excess precipitation, downed trees and power lines are likely to limit access and isolate community members yet, are unlikely to cause major permanent damage to the transportation network. Heavy rain and wind may make roads impassable or limit visibility to the extent that driving is not safe.

Water supply and sewer facilities may be vulnerable to hurricanes and tropical storms with massive rainwater that quickly accumulates. Stormwater drains and culverts may overflow during a heavy rain event and cause flooding.

Power outages and limited accessibility may force businesses to temporarily shut down. These unexpected closures can result in large financial losses. Loss of power can cause large product losses for food service businesses. Since businesses operate within an inter-connected system, the closure of one may have large impacts on other businesses in the area. Smaller businesses may not be able to recover from the loss of business or damages caused by a hurricane or tropical storm.

Probability of Future Occurrence of Wind-Related Hazards in Providence
Providence, as with the entire coast of Rhode Island, is particularly vulnerable to hurricanes given its geographic location. As previously stated, wind events are quite normal in New England, as evidenced throughout the year. Given the increase in frequency and severity of strong wind events, as well as the acceleration of these type of events as a result of climate change impacts, the City of Providence can expect an increase in wind-related hazard events in the future.

2.3.2 Flood-Related Hazards

Flooding is the accumulation of water within a water body and the overflow of excess water onto adjacent floodplain lands (FEMA, Multi Hazard Identification and Risk Assessment, 1997). The floodplain is the land adjoining the river/stream channel, ocean, or other watercourse or water body that is susceptible to flooding.

Flooding results from large-scale weather systems generating prolonged rainfall, on-shore winds, locally intense thunderstorms, dam failures, or significant snow melt. Floods are capable of undermining buildings and bridges, eroding shorelines and stream banks, uprooting trees, washing out access roads, and causing loss of life and injuries. Also, flash floods (characterized by rapid onset and high velocity waters) carry large amounts of debris that further exacerbate conditions.

Table 2.9 below represents the various significant flood-related hazard events that have occurred in and around the City of Providence over time, utilizing the National Climatic Data Center. All events are county wide (Providence County), unless otherwise noted.

Table 2.9 Significant Flood-Related Events, Providence County

Hazard Type	Date	Level/Description	Damages
Riverine Flooding			
	1/28/1996	1 to 2"; 50-60 mph winds; Blackstone crested at 9.5'	Scattered power outages; downed trees/power poles
	4/17/1996	2 to 3 1/2"; 60 mph winds; Blackstone crested at 9.1'	
	10/21/1996	80 mph winds; Blackstone crested at 9.3'	
	3/10/1998	2 to 4"; 40 to 55 mph winds; Blackstone crested at 10.3'	Many roads closed; scattered power outages;
	6/14/1998	7 to 8"; Blackstone crested at 9.14'	Numerous small streams flooded
	3/22/2001	Blackstone crested at 11.65'	1,400 homes/37 businesses affected; $3 M
	3/31/2001	3 to 4"; Blackstone crested at 10.21'	
	4/14/2004	2 to 4"; Blackstone crested at 9.25'	Roads closed in low-lying areas
	3/28/2005	3 to 4"; Blackstone crested at 10.21'	Transportation disrupted
	10/15/2005	2.5 to 4.5"	Road closures; 500 evacuations across region; $900K
	6/7/2006	2 to 4"	Road closures
	9/6/2008	2 to 6.5" regionally; storm surge 2'	Significant wind damage
	12/12/2008	3 to 5" state-wide	
	3/29/2010	6 to 9";	Significant street/home flooding; transportation disrupted; home evacuations;
	7/28/2012	2 to 3" >1hr.	
	8/15/2012		
	6/7/2013	3-5" regionally	Significant urban flooding
	7/11/2013	< 2" regionally	
	7/20/2013		Strong to damaging winds
	1/11/2014	55 mph; 1" in a short time	Significant urban flooding
	6/13/2014		
	6/21/2015		
	7/7/2016		

Hazard Type	Date	Level/Description	Damages
	7/17/2016		Hail/damaging winds in some areas
	8/6/2016		
	8/12/2016		
	8/13/2016		Damaging winds
	1/13/2018	1-3"; 45-65 mph wind gusts	
Flash Flooding			
	1/12/1996		Massive highway flooding; transportation disrupted
	6/14/1998	7 to 8"; Blackstone crested at 9.14'	Significant urban/small stream flooding
	6/30/1998	3 to 6"	Several rivers overflowed; large hail
	6/24/2008		Hail/damaging winds
	7/2/2009		Road closures
	7/14/2010	2 to 4" per hour	
	9/8/2011	2" per hour	Road closures
	7/28/2012	2 to 3" in >1 hr.	Transportation disrupted
	8/10/2012		Wind damage
	8/13/2014		Transportation disrupted
Heavy Rain/Inland and Urban Flooding			
	7/13/1996		
	9/18/1996		
	10/20/1996		
	11/1/1997		Scatter power outages, hurricane force winds
	2/18/1998	2 to 3.5"	Nor'easter
	2/23/1998	< 2"; 56 mph peak gust	Nor'easter
	3/8/1998	2 to 4"; 40 to 55 mph winds; Blackstone crested at 10.3'	Many roads closed; scattered power outages; basements flooded
	5/9/1998	2 to 4"	Nor'easter
	6/13/1998	7 to 8"; Blackstone crested at 9.14'	Numerous small streams flooded
	1/3/1999	2.35"; 46 mph gusts	
	1/15/1999	< 2"; 55 mph gusts	Severe street flooding
	9/16/1999	2 to 5"	Trees/Power lines down
	3/30/2001	3-4"; Blackstone crested at 10.2'	
	9/22/2002	2 to 3"	
	3/29/2003	2 to 3"	
	2/13/2008	2 to 4"	$30K

Hazard Type	Date	Level/Description	Damages
Coastal Flooding			
	4/15/2007	60 mph gusts	Trees/Power lines down
	4/16/2007	60 mph gusts	Trees/Power lines down

Source: NOAA National Climatic Data Center, www.ncdc.noaa.gov

Under the NFIP, FEMA is required to develop flood risk data for use in both insurance rating and floodplain management. FEMA develops this data through Flood Insurance Studies (FIS). Detailed analyses are used to generate flood risk data only for developed or developing areas of communities. For undeveloped areas FEMA uses approximate analyses to generate flood risk data. Flood hazard areas are identified in the FEMA Flood Insurance Rate Maps (FIRMs). Flood hazard areas are divided into zones (V, X, AO, etc.) depending on the severity and type of flood threat. These zones are those areas subject to inundation (shallow or deep) by a flood (and/or velocity wave action) that has a 1% chance of occurring during any given year.

Floodplains in Providence include 'AE', 'VE', and 'X' Zones (Map 2.2). 'AE' Zones are areas that would be inundated by the 100-year flood. The 100-year flood is a regulatory standard used by federal agencies and most states to administer floodplain management programs and is also used by the NFIP as the basis for insurance requirements nationwide. 'VE' Zones are velocity zones that are subject to breaking wave action where waves greater than 2.9 feet are forecasted during a 100-year flood or storm surge. 'X' Zones are areas that would be inundated by the 500-year flood.

Map 2.2 FEMA Flood Zones (Appendix A) shows those areas expected to be inundated by Categories 1 through 4 hurricanes. Table 2.10 identifies the critical facilities/parcels impacted by the various FEMA flood zones.

Table 2.10 Critical Facilities Impacted by FEMA Flood Zones

Land Use	Facilities Impacted VE Zone	Facilities Impacted AE Zone	Facilities Impacted X Zone
College/University	3	7	22
Dams		7	10
Energy/Utility	1	7	7
Emergency Response		1	2
Federal			4
Hazardous Materials	1	3	4
Healthcare/Hospitals	3	6	7
Ports	14	27	29
Public Assembly		1	1
Schools		8	10
Shelters		1	1
State			7
Transportation		24	25
Water Infrastructure			1
Wastewater Infrastructure	1	4	7
Total	**23**	**96**	**137**

Source: City of Providence Geographic Information System dataset.

Riverine/Flash Flooding

Riverine or inland flooding often occurs after heavy rain, particularly in areas of the state with high water tables. These areas are also particularly susceptible to flash flooding caused by rapid runoff occurring after heavy precipitation events, and in combination with spring snowmelt. Frozen ground conditions can also contribute to low rainfall infiltration and high runoff events that sometimes result in river flooding.

Flood magnitude increases with increasing recurrence interval. The City of Providence can be uniformly affected by riverine/flash flooding events, dependent upon the location (amounts of impervious surfaces within the area), existing/incoming weather conditions, and time of year (frozen ground conditions exacerbate flooding). Based on the increased frequency and severity of riverine flooding events (12 events since the 2013 plan), which caused significant urban flooding as reported by the National Climatic Data Center and indicated in Table 2.9, the City is considered at high risk for future riverine flooding events and moderate risk for future flash flooding events.

Climate Change Impacts on Riverine/Flash Flooding

Riverine flooding will likely be exacerbated by increased storm intensity, as well as by increased precipitation. The IPCC identifies inland flooding in some urban regions as a "key risk" in North America, which may result disrupt people's livelihood and result in severe health risks. It is also important to note that riverine flooding and coastal flooding

due to SRL can have a coupling effect. Rising seas can set a new flood stage in riverine systems, thus increasing flood risk in inland areas adjacent to rivers.

Increased precipitation has been already observed in Rhode Island and is expected to continue. Increased precipitation is expected to increase stream flow in New England, contributing to increases in flooding risk due to increases in peak flows. Vallee and Giuliano (2014) reported a doubling in the frequency of flooding in Rhode Island and an increase in the magnitude of flood events, many of which are riverine flooding events. An example of one such event was in 2010 when the Pawtuxet River overtopped its banks and caused extensive inland flooding following a series of heavy rain storms that took place over a five-week period.

The increase in precipitation and frequency of intense rainfall events has a combined effect on flash flooding in Rhode Island. The vast majority of the state's storm drainage infrastructure was designed based on rainfall frequencies that were derived in the early 1960s. In addition, considerable urbanization has taken place along much of the I-95 corridor in the past 40 years. The combined effects of increased rainfall and urbanization have resulted in increased flooding. Urban areas are seeing increased issues with flash flooding in poor drainage areas, especially where systems are undersized for the new rainfall amounts and intensities. The devastating floods of 2010 illustrated the challenges of managing rain and stormwater in this wetter regime, as multiple heavy rain storms impacted the state over a five-week span.

Heavy Rain/Inland and Urban Flooding

Urban flooding is the result of water flowing into areas faster than it can be infiltrated into the soil, conveyed via a stormwater system, or stored. Heavy rains that cause inland and urban flooding are often exacerbated by stormwater-related issues. Thunderstorms, winter storms, coastal storms, and nor'easters, and hurricanes all contribute to interior flood related hazards due to the large amounts of precipitation associated with them. Development often compounds the magnitude and frequency of urban flooding by increasing impervious surfaces, also increasing the rate of drainage collection, reducing the carrying capacity of the land, and often overwhelming sewer system infrastructure.

The State of Rhode Island experienced heavy rain fall and documented hurricane-force winds during storms that affected the State between the dates of March 12, 2010 through March 31, 2010. Over that timeframe, the most affected areas were Kent County, which received up to 3.68 inches of rainfall, Providence County, which received up to 5.71 inches, and Washington County, which received 5.55 inches. The monthly rain total in Providence was 16.32 inches, making March the city's all-time wettest month on record.

Similarly, to riverine/flash flooding, the City of Providence can be uniformly affected by heavy rain and inland/urban flooding, dependent upon the location (amounts of impervious surfaces within the area), existing/incoming weather conditions, and time of year (frozen ground conditions exacerbate flooding). Given the advancement of impacts

from climate change (described below), the City is considered at high risk for future heavy rain as well as inland and urban flooding.

Climate Change Impacts on Heavy Rain/Inland and Urban Flooding
Heavy precipitation events are becoming more frequent and intense. Whether a hurricane, tropical storm, or extra-tropical storm (e.g. a nor'easter), there has been a global increase in both the frequency and the intensity of heavy precipitation events. This trend is consistent with physical responses to a warming climate, such as an increased amount of moisture in the atmosphere.

Within the US, this trend is most pronounced in the Northeast. For example, between 1958 and 2016, the Northeast region has experienced a 92% increase in the number of two-day events exceeding the largest amount that is expected to occur over a five-year period.

Within Rhode Island specifically, the average annual precipitation is increasing at a rate of more than one inch per year every 10 years, and the frequency of days having at least one inch of rainfall has nearly doubled since 1930 (Vallee and Guiliano, 2014). The increased amounts of precipitation since 1970 have resulted in a much wetter condition in terms of soil moisture and the ground's ability to absorb rainfall, further exacerbating flooding impacts.

Coastal Flooding
Coastal storm surge is typically defined as the abnormal rise in water level caused by the wind and pressure forces of a hurricane and/or nor'easter. Many of the current hazard risks in the City of Providence are associated with flooding, especially in coastal areas where the 100-year floodplain encroaches inland. Providence experiences significant coastal flooding several times per year due to coastal storm surges resulting mainly from winter storms and nor'easters. Additionally, several interior locations experience flooding due to inadequate drainage during significant storm events.

Based on the limited frequency and severity of coastal flooding events in Providence, as reported by the National Climatic Data Center and indicated in Table 2.9, the city is considered at low risk for future coastal flooding.

Climate Change Impacts on Coastal Flooding
Future increases in relative sea level will intensify coastal flooding and will ultimately lead to the loss of recreation areas, public space, and wetlands along the coast. Residential and commercial structures, roads, and bridges on or near the coast will be more prone to flooding. SRL will also reduce the effectiveness and integrity of existing seawalls and revetments, which were designed for historically lower water levels. Lower elevations will become increasingly susceptible to flooding as storm surge reaches further inland due to both SRL in concert with a probable increase in the frequency and intensity of storms predicted from climate change.

The future rise in relative sea level will increase the extent of flood damage over time. Importantly, increased flooding means both an increase in the areas that are flooded and an increase in the depth of floodwaters. This is because SRL will expand existing floodplains, causing flooding in places which have not previously experienced flooding, as well as result in deeper floodwaters in previously-flooded areas.

Nuisance flooding, also referred to as high tide flooding, increasingly occurs in coastal locations both locally and globally as a result of SRL, which causes high tides that are higher than they were historically. Nuisance flooding may affect individual coastal properties, as well as roads, parking lots, and other public or commercial infrastructure in low-lying areas. This type of flooding has increased five- to ten-fold since the 1960s in several U.S. coastal cities, and rates of increase are accelerating in dozens of cities on the U.S. Atlantic and Gulf coasts. Like other types of coastal flooding, nuisance flooding will continue increasing in depth, frequency and extent over the 21st century.

Coastal Erosion/Shoreline Change
Coastal erosion is another hazard that occurs during large coastal storm events and through natural processes. Shorelines change constantly in response to wind, waves, tides, sea level fluctuation, seasonal and climatic variations, human interaction, and other factors that move sand and material within a coastal shoreline system.

Coastal erosion is expected to increase due to the increase in storm intensity and associated flooding. The IPCC found that coastal and low-lying areas have been experiencing increased erosion, and will continue to do so, due to SRL, in North America and throughout the world. Erosion has been noted to be of concern in the northeastern U.S. and in their study of climate change impacts in the northeastern U.S., Horton et al. (2014) noted that increased rates of coastal erosion are likely to compromise aging coastal infrastructure, including transportation, communications, and energy infrastructure.

Dam Inundation
A dam is any artificial barrier with the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or water control. Dam inundation/failure can be a catastrophic type of failure characterized by the sudden, immediate, and uncontrolled release of impounded water, or the likelihood of such an uncontrolled release with secondary impacts to downstream structures within the inundation zone.

A three-tiered hazard classification has been developed by the State of Rhode Island and rates each dam based upon the probable consequences of failure or miss operation of the dam. This system includes:

- **High Hazard** – means a dam where failure or miss operation will result in a probable loss of human life.

- **Significant Hazard** – means a dam where failure or miss operation results in no probable loss of human life but can cause major economic loss, disruption of

lifeline facilities, or impact other concerns detrimental to the public's health, safety, or welfare. Examples of major economic loss include but are not limited to washout of a state of federal highway, washout of two or more municipal roads, loss of vehicular access to residences (e.g. a dead-end road whereby emergency personnel could no longer access residences beyond the washout area), or damage to a few structures.

- **Low Hazard** – means a dam where failure or miss operation results in no probable loss of human life and low economic losses.

In accordance with Rhode Island General Laws, Chapters 46 - 18 and 46 - 19, and two amendments to Chapter 46-19: Section 4 was amended to authorize the Rhode Island Department of Environmental Management (RIDEM), in an emergency, to take necessary action to mitigate an unsafe condition at a dam and to assess the costs of those actions against the dam owner.Section 9 was amended to require a city or town where a high or significant hazard dam is located to complete by July 1, 2008, an Emergency Action Plan (EAP) for the dam. An EAP defines responsibilities and provides procedures designed to identify unusual and unlikely conditions which may endanger a structure in order to safeguard the lives of community members living, working, schooling, recreating, and property within the inundation area.

The historic flooding that impacted the State in March 2010 caused some dams to be washed out and others to be impacted in unforeseen ways. Considering the flooding events, PEMA conducted field visits in the fall of 2010 to all dam sites in the city listed in its GIS point data shapefiles in order to update the state dam inventory list with the most current data for the city. Table 2.11 lists the inventoried dams in Providence considered to be 'functional'.

Table 2.11 Inventoried Dams, Providence

State ID	Dam Name	River/Stream	Hazard
Dams			
138	Atlantic Mills Pond	Woonasquatucket River	Low
94	Canada Lower Pond	West River	Low
140	Rising Sun Pond	Woonasquatucket River	Low
91	Wanskuck Pond	West River	Low
90	Whipple Pond	West River	Low
93	Canada Upper Pond	West River - Trib.	Significant
300	Cunliff Pond	Mashapaug Brook	Significant

Source: City of Providence Dam Profiles, PEMA, February 27, 2017.

Canada Upper Pond Dam and Cunliff Pond Dam are both classified as Significant hazard structures; however, both now have approved EAPs (July 2014). Below lists the most recent inspections conducted for each:

Canada Upper Pond Dam:

- December 19, 2011, Visual Inspection/Evaluation Report (Pare Corp.)
- August 21, 2013, Dam Inspection Report (Diving Service Inc)

Cunliff Pond Dam:

- October 28, 2013, Visual Inspection/Evaluation Report (Pare Corp.)

Based on the increased frequency and severity of rain events in Providence, as reported by the National Climatic Data Center and indicated in Table 2.9, the city is considered at high risk to future dam inundation.

Climate Change Impacts on Dams
The increase in precipitation and frequency of intense rainfall events, which will cause an increase in river discharge and peak flows, may also lead to overtopping and damage of aging dams or structures in need of repair and maintenance.

Sea Level Rise
Sea level is the level of the sea's surface relative to the land. Sea level changes can be caused by absolute changes of the sea level and/or by absolute movements of the land either through post glacial isostatic re-adjustment of the lithosphere, the rigid upper layers of the earth, or by extraction of water or other resources that cause the land to sink. Relative sea levels are also influenced by changes to ocean currents such as the Gulf Stream and by changes in the gravitational pull of the ice sheets as they melt.[7]

The IPCC continues to better understand the science and implications of climate change and SRL. Rising sea levels, as a direct result of warmer temperatures and glacial ice melt, threaten low-lying coastal areas through coastal flooding, coastal erosion, wetland inundation and saltwater intrusion. Localized land subsidence, also on the rise, also contributes to accelerated impacts of SRL. Over the last 100 years, sea levels have risen 0.56 feet globally. The average rate of rise between 1961 and 2003 was 0.07 inches per year; however, that rate nearly doubled to 0.12 inches per year between 1993 and 2003 .[8] Although the rate of SRL is accelerating, it is not expected to be globally uniform, where some areas will be more substantially inundated than others.

Rhode Island's exposure to potential impacts of SLR warrants consideration in long-term land use, development, and critical infrastructure planning. Based on its online sea level change calculator for the Newport tide gauge station, the USACE projects SLR increases in Rhode Island by 2100 range from less than one foot to over 11 feet (Table 2.12). The CRMC has adopted the NOAA High SLR curve (a rise of 8.99 feet by 2100) to use for planning and evaluating projects for coastal hazard risk.[9]

[7] State of Rhode Island State Hazard Mitigation Plan, December 2018, page 3-173.
[8] IPCC. (2007). *Climate Change 2007: The Physical Science Basis. Summary for Policymakers. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Geneva, Switzerland: UNEP.
[9] Ibid, page 3-173.

Table 2.12 NOAA Sea Level Change Newport Station

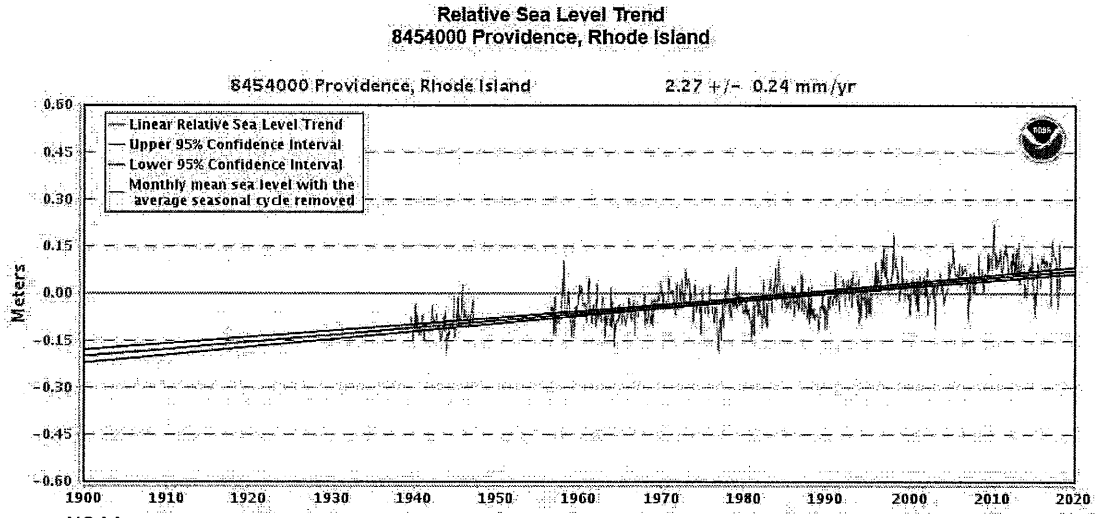
Sea Level Change Curve
Scenarios for NEWPORT
NOAA2017 VLM: 0.00322 feet/yr
All values are expressed in feet

Year	NOAA2017 VLM	NOAA2017 Low	NOAA2017 Int-Low	NOAA2017 Intermediate	NOAA2017 Int-High	NOAA2017 High	NOAA2017 Extreme
2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2010	0.03	0.16	0.20	0.30	0.39	0.46	0.49
2020	0.06	0.33	0.39	0.59	0.75	0.95	0.92
2030	0.10	0.49	0.59	0.89	1.21	1.48	1.57
2040	0.13	0.66	0.79	1.25	1.71	2.20	2.43
2050	0.16	0.82	1.02	1.64	2.26	3.02	3.41
2060	0.19	0.98	1.21	2.07	2.92	4.00	4.63
2070	0.23	1.15	1.41	2.56	3.64	5.02	6.00
2080	0.26	1.25	1.57	3.08	4.49	6.14	7.48
2090	0.29	1.38	1.74	3.64	5.38	7.55	9.28
2100	0.32	1.44	1.90	4.17	6.36	8.99	11.15

Source: https://coast.noaa.gov/digitalcoast/tools/curve.html

Measurements at NOAA's Providence tide gage indicate that sea levels have risen almost nine inches since 1938 in the city (Figure 2.3). The historic rate of SLR at this gage, measured from 1938 to 2018, is 2.27 millimeters (mm) a year, slightly higher than global SLR data, which show sea level has risen by 7.48 inches between 1901 and 2010, an average rate of 1.7 mm a year (IPCC 2014).

Figure 2.3 Relative Sea Level Trend, Providence, RI Tide Gauge (8454000)



Source: NOAA.

The University of Rhode Island Ocean Engineering program developed STORMTOOLS, an online high-resolution Rhode Island-specific model based on the most recent updated state digital elevation data, as part of the Rhode Island CRMC Shoreline

Change Special Area Management Plan (SAMP). Since the initial study, STORMTOOLS can now map the extent and water depths for 1-, 2-, 3-, 5-, 7-, 10-, and 12-foot SLR scenarios as well as several recurrence interval storm parameters with and without SLR.

HW performed a series of Vulnerability Analyses utilizing STORMTOOLS data to illustrate the potential for future impacts across the range of projected SRL scenarios for Rhode Island, according to land use type, critical facilities, and critical infrastructure. After coordination with PEMA, the State Hazard Mitigation Officer and the LHMC, several scenario analyses were conducted to better understand the city's risk at the baseline mean higher high water (MHHW) and projected out to CRMC's adopted 8.99 feet by 2100 (MHHW Plus seven Feet SLR):

MHHW 1/18/2016
MHHW is the mean elevation of the higher of the two daily high tides over a 19-year period, in comparison to the mean high water (MHW), which is the average elevation of all high tides over the same period. MHHW is the chosen baseline for the Rhode Island SLR study since it reflects a realistic average tidal elevation that communities will experience regularly.

- MHW = average of all high tides over 19-year tidal epoch
- MHHW = average of the highest daily tide over a 19-year tidal epoch

MHHW Plus One-Foot SLR 1/18/2016
Historically, sea level has already risen about 11 inches in the past 100 years. A rise of nine inches has been noted at North Kingstown based on data since 1930 when the Newport tide gauge was installed. With accelerated SLR already being observed in Rhode Island, models show that global sea levels are likely to rise one foot in the next 20 to 50 years. MHHW Plus one-foot SLR scenario depicts:

- Areas inundated at mean high tide levels with one foot of SLR, or
- Areas inundated at spring high tide today.

MHHW Plus Seven Feet SLR 1/18/2016
With accelerated SLR already being observed in Rhode Island, models show that sea levels in Rhode Island are projected to rise to 8.99 feet by 2100. MHHW Plus seven feet SLR scenario depicts:

- Areas inundated at mean high tide levels with seven foot of SLR

Map 2.3 MHHW (Appendix A) shows those areas in Providence expected to be inundated by a realistic average tidal elevation today in 2018. Table 2.13 identifies the critical facilities/parcels impacted by the MHHW scenario.

Table 2.13 Critical Facilities Impacted by MHHW

Land Use	No. of Facilities Impacted
College/University	2
Dams	
Energy/Utility	3
Emergency Response	
Federal	
Hazardous Materials	1
Healthcare/Hospitals	3
Ports	16
Public Assembly	
Schools	
Shelters	
State	
Transportation	
Water Infrastructure	
Wastewater Infrastructure	1
Total	**26**

Source: City of Providence Geographic Information System dataset.

Map 2.4 MHHW Plus One-Foot SRL (Appendix A) shows those areas in Providence expected to be inundated by mean high tide levels with one foot of SLR. Table 2.14 identifies the critical facilities/parcels impacted by the MHHW Plus One-Foot SLR scenario.

Table 2.14 Critical Facilities Impacted by MHHW Plus One-Foot SLR

Land Use	No. of Facilities Impacted
College/University	3
Dams	0
Energy/Utility	3
Emergency Response	0
Federal	0
Hazardous Materials	1
Healthcare/Hospitals	3
Ports	16
Public Assembly	1
Schools	0
Shelters	0
State	0
Transportation	1
Water Infrastructure	0
Wastewater Infrastructure	1
Total	**29**

Source: City of Providence Geographic Information System dataset.

Map 2.5 MHHW Plus Seven Feet SLR (Appendix A) shows those areas in Providence expected to be inundated by mean high tide levels with seven feet of SLR. Table 2.15 identifies the critical facilities/parcels impacted by the MHHW Plus Seven Feet SLR scenario.

Table 2.15 Critical Facilities Impacted by MHHW Plus Seven Feet SLR

Land Use	No. of Facilities Impacted
College/University	17
Dams	0
Energy/Utility	4
Emergency Response	0
Federal	0
Hazardous Materials	1
Healthcare/Hospitals	4
Ports	20
Public Assembly	4
Schools	0
Shelters	0
State	8
Transportation	1
Water Infrastructure	0
Wastewater Infrastructure	2
Total	**61**

Source: City of Providence Geographic Information System dataset.

Based on the frequency and severity of SLR events in Providence, the city is considered at moderate risk for future coastal flooding.

Since the 2013 plan, there have been 12 riverine flooding events, one flash flood event, and no heavy rain/inland and urban flooding or coastal flooding events reported by the National Climatic Data Center. However, based on recent trends with physical responses to a warming climate, which is more particularly pronounced in the Northeast, Providence can expect to experience impacts from increased flood-related events.

Property at Risk from Flood-Related Hazards in Providence

Flooding most frequently occurs in the six-month period from October through March. In the winter and early spring, there is less vegetation to absorb precipitation and there is typically more rainfall. The duration of a flooding event may be limited to a few hours or may extend for several days or more. Given the increases in frequency and severity, projections further exacerbated by climate change, and the presence of seven functioning dams, flooding poses its most significant threat in the form of property damage and disruption of infrastructure.

The City's topography and location along three rivers at the head of Narragansett Bay also contributes to its vulnerability to storms and flooding. The Woonasquatucket River runs from Smithfield to Providence with areas surrounding this river as densely populated and developed with a combination of mixed-use lots, including residential and commercial properties. The Blackstone River, which forms in Worcester, Massachusetts follows a southeast course through northern Rhode Island until it reaches Pawtucket Falls where it tidal and turns into the Seekonk River.

Some of the existing structures in the flood zone are older buildings, which have not been brought up to current floodplain standards. Due to the City's low mean sea level elevation of +6.20 feet and the Providence River's mean sea level elevation of +3.50 feet, Providence remains vulnerable to extensive flood damage. In July of 1961, construction began on the FPHB, and was completed in January 1966 – at a cost of $16 million. The barrier provides protection against tidal flooding from hurricanes and other coastal storms for approximately 280 acres of downtown Providence. The USACE operates and maintains the barrier, which is tested four times a year and is not likely to fail for mechanical reasons. The barrier protects the commercial and industrial centers, various transportation facilities, public utilities, and many residential areas.

Probability of Future Occurrence of Flood-Related Hazards in Providence
As new development and urbanization continues, increasing impervious surface and the rate of drainage collection, reducing the carrying capacity of the land, it is likely interior flooding and stormwater runoff events will also occur on a more frequent basis even lower storm events. Most evident in predictions of future flooding occurrences are the impacts of rising sea levels and climate change. Considering the continuation of urbanization, increases in significant rain events (and timing of events relative to saturated ground levels), it is expected that Providence will continue to experience flood events on an annual basis.

2.3.3 Winter-Related Hazards

Winter weather events can include heavy snows, ice, and extreme cold and can affect the entire City of Providence. Heavy snow can bring the community to a standstill by inhibiting mobility (transportation networks, pedestrian travel), knocking down trees and utility lines, and cause structural collapses in older buildings. Ice buildup can down utility lines and communication towers. The impacts of both events can cause indirect issues such as freezing/rupturing pipes from lack of heat, while also changing the ground's frost level, creating problems for underground infrastructure.

Table 2.16 below represents the various significant winter-related hazard events that have occurred in and around the City of Providence over time, utilizing NOAA's National Climatic Data Center. All events are county wide (Providence County), unless otherwise noted. Figure 2.4 illustrates the average snowfall for Providence County. The City of Providence can be uniformly affected by snowfall dependent upon intensity and duration of the event, with a typically average snowfall around 42 inches.

Table 2.16 Significant Winter-Related Events, Providence County

Hazard Type	Date	Level/Description	Damages
Snow			
	1/2/1996	2 to 12"	School/Business closings
	1/7/1996	1 to 2' (Blizzard of '96)	School/Business closings; Transportation disrupted; homes damaged
	2/2/1996	6 to 8"	Transportation disrupted
	2/16/1996	5 to 7"	Transportation disrupted
	3/2/1996	6 to 11"	Transportation disrupted
	3/7/1996	7"	
	4/7/1996	6 to 8"	
	4/9/1996	7"	Scattered power outages
	12/6/1996	2 to 5"	Scattered power outages; Transportation disrupted
	12/7/1996	2 to 10"	
	1/11/1997	4 to 7"	
	3/31/1997	1 to 1.5' (blizzard)	Downed trees/power lines; Widespread power outages; Transportation severely disrupted; School closures; $ .1M
	12/23/1997	7 to 14"	Transportation disrupted
	2/25/1999	<1'	School/Business closings; Transportation disrupted
	3/15/1999	7 to 12"	School/Business closings; Transportation disrupted
	1/13/2000	1 to 4"	Numerous automobile accidents
	1/25/2000	4 to 8"	Transportation disrupted
	2/18/2000	6 to 8"	Treacherous driving; Many flights cancelled
	12/30/2000	6 to 9"	
	1/20/2001	8"	Transportation disrupted; Scattered power outages
	2/5/2001	7 to 15"	Transportation disrupted; Scattered power outages
	3/5/2001	> 1'	Numerous power outages; Schools/businesses closed (3 days); $10M
	3/9/2001	6 to 8"	$.5M
	11/27/2002	4 to 8"	Transportation disrupted
	12/5/2002	2 to 5"	
	3/16/2004	4 to 8"	
	11/12/2004	4 to 8"	

Hazard Type	Date	Level/Description	Damages
	2/24/2005	5 to 8"	
	3/23/2005	4 to 8"	
	12/13/2007	1'	Transportation disrupted
	12/16/2007		
	1/14/2008		Downed trees/power lines; $30K
	12/19/2008	8 to 12"	
	12/31/2008	4 to 10"	Strong winds; Bitter cold
	1/18/2009	6 to 7"	
	3/2/2009	7 to 10"	Transportation severely disrupted
	12/19/2009	14 to 19"	Transportation severely disrupted; school cancellations
	1/12/2011	10 to 22"	Transportation disrupted; Homes damaged
	1/26/2011	12 to 17"	
	12/29/2012	8 to 13"	
	2/8/2013	21 to 28" (blizzard); 30 to 50 mph winds	Many hospitalizations occurred; Widespread power outages
	3/7/2013	5 to 12"	
	12/14/2013	4 to 8"	
	1/2/2014	7 to 8"	
	1/21/2014	6 to 10"	
	2/5/2014	5 to 10"	
	2/13/2014	5 to 10"	
	1/24/2015	4 to 7"	
	1/26/2015	1.5 to 3'; 50 to 60 mph gusts (Blizzard)	Roads closed; several fatalities; Federal disaster declaration
	2/2/2015	3 to 13"	
	2/8/2015	6 to 16"	
	2/14/2015	8 to 13"	
	1/23/2016	4 to 8"	Hurricane-force winds
	2/5/2016	5 to 12"	Downed trees/power lines
	2/8/2016	6 to 9"	Blizzard conditions
	4/4/2016	4 to 7"	
	3/14/2017	7 to 13"; 45 to 60 mph winds	
Blizzard			
	2/8/2013	2 to 2.5 feet	Blizzard conditions
	1/26/2015	1.5 to 2 feet	Blizzard conditions
Ice Storms			
	3/3/1996	snow squalls; 40-50 mph winds	

Hazard Type	Date	Level/Description	Damages
	1/31/1997	freezing rain	Numerous automobile accidents
	11/26/2000	freezing rain	Numerous automobile accidents
	1/30/2001	freezing rain	Numerous automobile accidents
	2/25/2001	freezing rain/sleet	Numerous automobile accidents
	2/1/2008	freezing rain/sleet	Numerous automobile accidents
	10/29/2011	3 to 6" (nor'easter)	Downed trees/power lines
	1/19/2012	2 to 5"	Downed trees/power lines; Widespread power outages
	1/21/2012	3 to 5"	
	2/29/2012	3 to 6"	
	11/7/2012	2 to 5"	
	2/17/2013	2 to 4"	
	3/7/2013	5 to 6"	
	3/18/2013	2 to 5"	
	12/9/2014	freezing rain/sleet	
	2/5/2015	2 to 4"	
	2/21/2015	1 to 5"	
	2/25/2015	1 to 4"	
	3/1/2015	4 to 6"	
	3/5/2015	3 to 4"	
	3/21/2016	1 to 3"	
	4/3/2016	3 to 7"	
	12/17/2016	3 to 5"	
	12/9/2017	2.5 to 4.5"	
	12/23/2017	freezing rain	Downed trees/power lines
	1/30/2018	4 to 6"	
	2/14/2018	freezing rain	Transportation disrupted
Extreme Cold			
	2/16/2015	wind chill as low as 30 below	
	2/14/2016	wind chill as low as 32 below	

Source: NOAA National Climatic Data Center, www.ncdc.noaa.gov

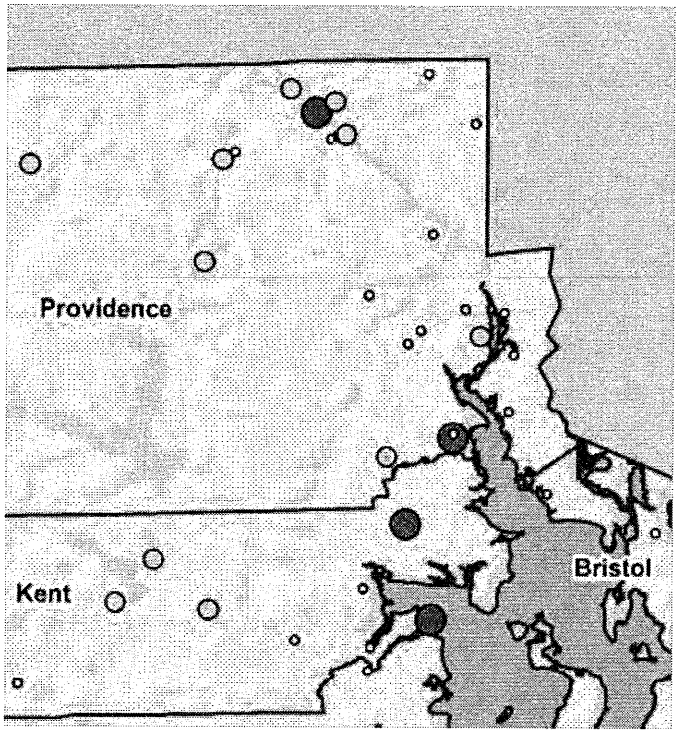
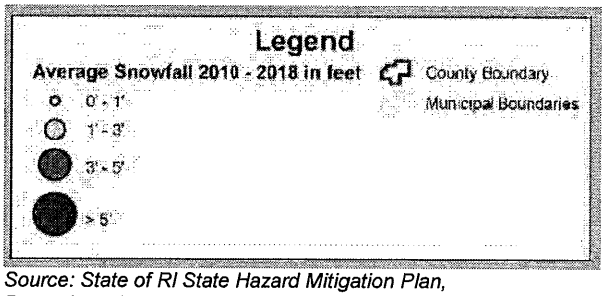


Figure 2.4 Average Annual Snowfall, Providence County



Source: State of RI State Hazard Mitigation Plan, December 2018

Blizzards/Heavy Snow/Nor'easters

Winter storms often include natural hazards such as extreme winds, coastal erosion, and flooding. Utility and power lines can break from the weight of snow or ice coupled with strong winds. This could put residents at risk of losing heat, electricity, and water (if using well water). Snow melting poses problems as well, such as road flooding in low lying areas.

Although somewhat variable in distribution, northwest portions of Providence and Kent counties see heavier snowfall events with greater frequency. Heavy snow affects the entire State, but the highest amounts occur in the northern and northwestern areas of the State. Typically, the impact and vulnerability of winter weather is measured in terms of the financial costs associated with preparing for, responding to, and recovering from the event.

The city uniformly continues to experience heavy snow and winter storms with greater frequency and severity, as reported by the National Climatic Data Center and indicated in Table 2.16 (17 events since the 2013 plan). Near blizzard conditions experienced in late January 2015 has been the most significant snow event in Rhode Island since the February 2013 snow event, followed by the Blizzard of 1978. The city is considered at high risk for heavy snow/winter storm events.

Climate Change Impacts on Heavy Snow Events
Climate change will result in increased average global temperatures. These impacts are already being felt in New England, as average winter temperatures in the region have risen 3.8°F in the last 30 years. Although at first glance this would appear to make winters less severe the Northeast has experienced the largest increase in extreme precipitation events in the country, which often fall as heavy wet snow in the winter.

Ice Storms
Ice storms result from the accumulation of freezing rain, or rain that becomes super-cooled and freezes upon impact with cold surfaces. Most commonly, freezing rain occurs in a narrow band within a winter storm that is also producing heavy amounts of snow and sleet in other locations. The City of Providence is uniformly susceptible to the impacts of ice storms.

Infrastructure (utility lines/power outages, roads, and bridges) are at great risk from ice storms. Based on the increased frequency and severity of ice storm events over time, as reported by the National Climatic Data Center and indicated in Table 2.16 (16 events), Providence is at moderate risk of any future ice storm events.

Extreme Cold
Extreme cold events often accompany or are left in the wake of winter storms or occur without any associated storm activity. Such events can lead to hypothermia and frostbite. Extreme cold events vary depending on the normal climate of the region, but Providence can expect to be uniformly affected. Extreme cold in Rhode Island typically means temperatures below zero degrees Fahrenheit.

Extreme cold can adversely affect people, some more than others - infants and people over 65 years of age are especially vulnerable. Based on the limited frequency and severity of extreme cold events over time, as reported by the National Climatic Data Center and indicated in Table 2.16, Providence is considered at moderate risk of extreme cold.

Climate Change Impacts on Extreme Cold Temperatures
Climate change will result in increased average global temperatures, which will likely decrease the number of extreme cold days. This decrease in extreme cold days has already been documented and is expected to continue. For example, prior to 1980, experiencing minimum temperatures at or below freezing typically exceeded 120 days in the year. Since 2000, not one year has experienced 120 or more days below 32°F(Vallee and Guiliano, 2014).

Since the 2013 plan, there have been 17 significant heavy snow/blizzard events, 16 ice storm-related events, and two extreme cold temperature events impacting Providence/Providence County.

Property at Risk from Winter-Related Hazards in Providence
New England experiences winter storms in more extreme ways than most of the rest of the country. The City of Providence receives between 36 inches to 72 inches of snow per year (high frequency), with a typically average annual snowfall around 42 inches.

Much of the building stock in Providence will be able to withstand the impacts of a snow, wind, or ice storm. However, the vulnerability to such a storm varies by the location and the type of structure. Buildings located on hilltops are more vulnerable to lightning and those located on steep slopes are vulnerable to landslides. Flat-roofed buildings and other structures that accumulate snow may be susceptible to collapse under heavy snow.

Winter storms and nor'easters impact the natural environment by increasing storm water runoff, as well as increasing flooding and tree displacement. Such alteration of the natural environment will impact fish and wildlife habitat. However, these are natural processes; absent prolonged climate changes, animals and their ecosystems are resilient to temporary changes in weather. However, severe storms may have an impact on species and habitats that are already stressed. For example, increased runoff could increase the saturation rate of soils, thus increasing the likelihood of downed trees in high wind. Sand on roadways to provide friction on icy surfaces may create sedimentation problems in local streams and rivers, thereby affecting salmon habitat. Roads in Providence are vulnerable to winter storms and nor'easters. Excess precipitation is likely to limit access and isolate community members, but it is unlikely to cause major permanent damage to the transportation network. Heavy rain, ice or snow may make roads impassable or limit visibility to the extent that driving is not safe. Water supply and sewer facilities may be vulnerable to winter storms and nor'easters with massive rainwater that quickly accumulates. Storm water drains and culverts may overflow during a heavy rain event and cause flooding.

Power outages and limited accessibility may force businesses to temporarily shut down. These unexpected closures can result in large financial losses. Loss of power can cause large product losses for food service businesses. Since businesses operate within an inter-connected system, the closure of one may have large impacts on other businesses in the area. Smaller businesses may not be able to recover from the loss of business or damages caused by a severe storm.

Winter storms and nor'easters can leave residents completely isolated and without access to emergency assistance. Road closures may prevent residents that require significant medical care from access to necessities.

Probability of Future Occurrence of Winter-Related Events in Providence
According to recent history and climatic conditions, and the inability to predict extreme snow and temperature events, it is likely that winter-related hazards (heavy snow and ice storms) have a high probability of occurring on a yearly basis.

2.3.4 Geologic-Related Hazards

For this update, geologic-related events include earthquakes. Table 2.17 below represents the various significant geologic-related hazard events that have occurred in and around the City of Providence over time, utilizing NOAA's National Climatic Data Center. All events are county wide (Providence County), unless otherwise noted.

Table 2.17 Significant Geologic-Related Events, Providence County

Hazard Type	Date	Point of Origin	Magnitude/Impact on Rhode Island
Earthquakes			
	2/28/1925	St. Lawrence River Region	Intensity V affects felt on Block Island and in Providence
	11/18/1929	Grand banks of New Foundland	Moderate vibrations felt on Block Island and in Chepachet, Newport, Providence, and Westerly
	11/1/1935	Quebec, Canada	A magnitude of 6.25 with intensity IV felt on Block Island, Providence, and Woonsocket
	12/20/1940	Lake Ossipee, NH	Intensity V affects knocked pictures off the wall in Newport; Intensity IV affects were felt in central Falls, Pascoag, Providence, and Woonsocket; Intensity I-III were felt in Kingston, New Shoreham, and Wakefield
	9/4/1944	Massena, NY	Intensity I-III was reported in Kingston, Lonsdale, Providence, Wakefield and Woonsocket
	6/14/1973	Unknown	Explosion-like or sonic boom noises were heard throughout RI and Houses/windows shook, but nothing reported by seismographs

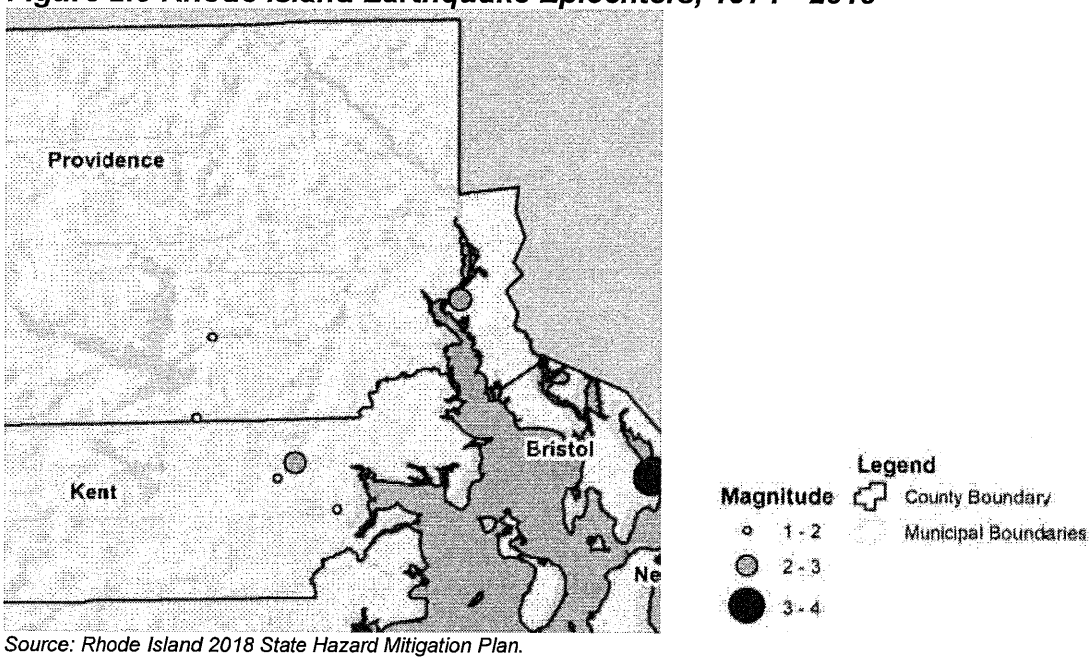
Source: NOAA National Climatic Data Center, www.ncdc.noaa.gov

Earthquakes

An earthquake is the sudden release of strain energy in the Earth's crust resulting in energy waves that radiate outward from the earthquake source. The point on the Earth's surface directly above the focus is called the earthquake epicenter. The severity of earthquake effects is dependent upon magnitude of energy released, proximity to the epicenter, depth to the epicenter, duration, geologic characteristics, and type of ground motion.

When earthquakes occur, much of the damage is a result of structures falling under the stress created by the ground movement. Another significant effect is damage to the public and private infrastructure (i.e. water service, communication lines, drainage system). Because earthquakes are highly localized it is difficult to assign regional boundaries that share the same relative degree of risk. Figure 2.5 illustrates the locations of earthquake epicenters since 1974 in Rhode Island.

Figure 2.5 Rhode Island Earthquake Epicenters, 1974 - 2018



Source: Rhode Island 2018 State Hazard Mitigation Plan.

Measuring the Intensity of an Earthquake

An earthquake's severity can be expressed in terms of intensity and magnitude. Intensity is defined by the observed effects of ground shaking on people, buildings, and the natural environment, which varies dependent upon the location of the observer with respect to the epicenter. Currently in the U.S., the Modified Mercalli (MMI) Intensity Scale is used to evaluate the effects of earthquakes – specifically, it describes how strongly an earthquake was felt at a location, Table 2.18 below. Magnitude is defined by the amount of seismic energy released at the hypocenter of the earthquake, based on the amplitude of the earthquake waves recorded on seismographs (using the Richter Magnitude Scale, Table 2.19). Another measure of the relative strength of an earthquake is the expanse of area the shaking is noticed.

Table 2.18 Modified Mercalli Intensity Scale

Mercalli Intensity	Description
I	Felt by very few people, barely noticeable.
II	Felt by few people, especially on upper floors.
III	Noticeable indoors, especially on upper floors, but may not be recognized as an earthquake.
IV	Felt by many indoors, few outdoors. May feel like passing truck.
V	Felt by almost everyone, people have trouble standing. Small objects move, trees and poles may shake.
VI	Felt by everyone, people have trouble standing. Heavy furniture can move, plaster can fall off walls. Chimneys may be slightly damaged.

Mercalli Intensity	Description
VII	People have difficulty standing. Drivers feel cars shaking. Some furniture breaks. Loose bricks fall from buildings. Damage is slight to moderate in well-built buildings; considerable in poorly built buildings.
VIII	Buildings suffer slight damage if well-built; severe damage if poorly built. Some walls collapse.
IX	Considerable damage to specially built structures; buildings shift off their foundations. The ground cracks. Landslides may occur.
X	Most buildings and their foundations are destroyed. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, lakes. The ground cracks in large areas.
XI	Most buildings collapse. Some bridges are destroyed. Large cracks appear in the ground. Underground pipelines are destroyed.
XII	Almost everything is destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move.

Source: U.S. Geological Survey (USGS), 2012.

Table 2.19 Richter Magnitude Scale

Richter Magnitude	Earthquake Effects
2.5 or less	Not felt or felt mildly near the epicenter, but can be recorded by seismographs
2.5 to 5.4	Often felt, but only causes minor damage
5.5 to 6.0	Slight damage to buildings and other structures
6.1 to 6.9	May cause a lot of damage in very populated areas
7.0 to 7.9	Major earthquake; serious damage
8.0 or greater	Great earthquake; can totally destroy communities near the epicenter

Source: USGS, 2012.

Since the 2013 plan, there have been no significant geologic-related events impacting Providence/Providence County. Based on the limited frequency and severity of geologic-related events, Providence is considered at low risk to earthquakes.

Property at Risk from Geologic-Related Hazards in Providence
The entire City of Providence can be uniformly affected by earthquakes, dependent upon the precise location of the epicenter. Buildings that are most at risk from earthquakes are the old masonry buildings and older, large wooden structures scattered throughout the city.

Probability of Future Occurrence of Geologic-Related Hazards in Providence
New England is not considered to be a hot spot for earthquakes, especially when compared to the western U.S. Rhode Island is on the North Atlantic tectonic plate and is in a region of historically low seismicity, therefore, probability of future occurrence is unlikely for Providence/Providence County.

2.3.5 Fire-Related Hazards

Urban fires often occur in areas where residential structures and/or businesses are clustered closely together, such as downtown Providence, where the potential exists for a fire to spread rapidly. Urban fires are often the result of one of the following:

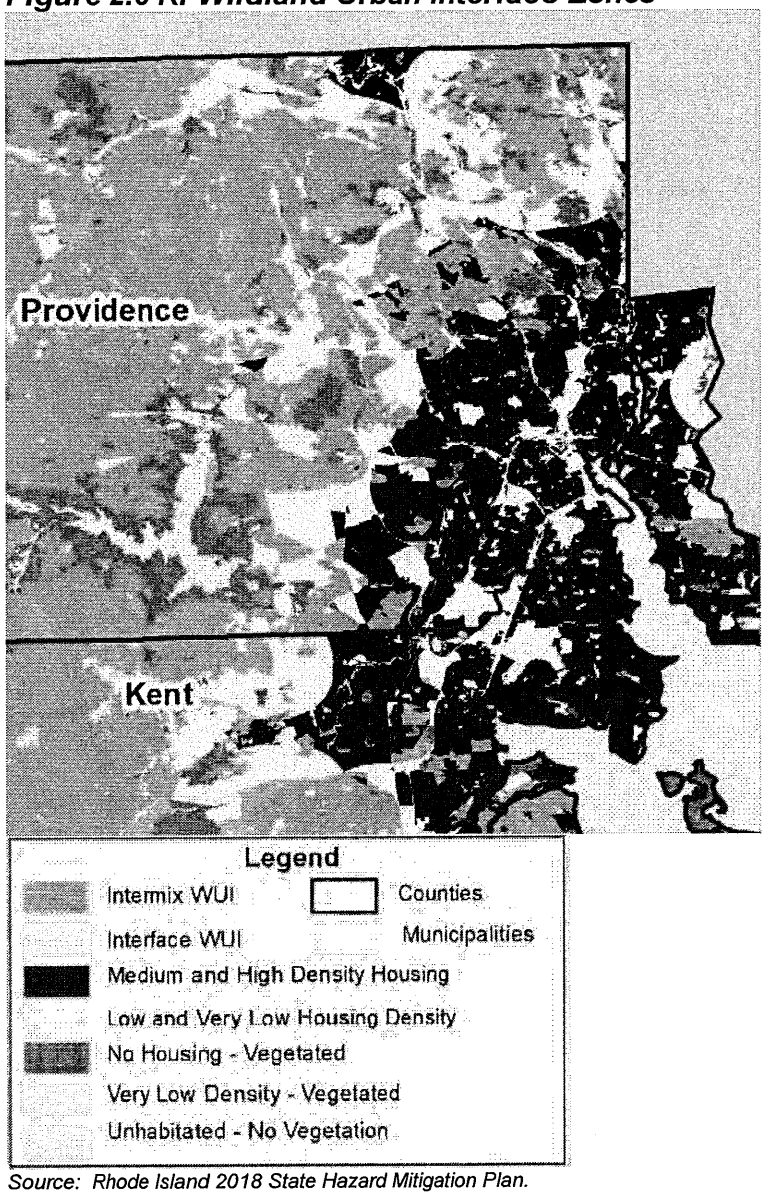
- Criminal acts (arson, explosive devices, acts of terrorism),
- Residential accidents (improper use of electrical appliances, faulty connections, grease fires),
- Industrial accidents (hazardous material incidents, explosions, transportation accidents), and
- Acts of nature (lightning strikes, earthquake byproduct).[10]

Wildfires are defined as any non-structure fire that occurs in the vegetative wildland, including grass, shrub, leaf litter/debris, and forested tree fuels. Most susceptible to the hazard are pitch pine, scrub oak, and oak forests – the most flammable vegetative fuels. Small wildfires are common throughout the State, especially when drought or near-drought conditions warrant, the potential for spreading wildfires is real.

The State's Wildland Urban Interface (WUI), the area where structures and human development meet and intermingle with undeveloped wildland, creates an environment in which fire can move readily between structural and vegetative fuels. The State's WUI includes the Intermix WUI, areas where housing and vegetation intermingle,[11] mapped in orange as shown below (Figure 2.6) as part of the State's Hazard Mitigation Plan. Intermix WUI areas identified in Providence are mainly characterized by medium to high-density housing and development (commercial, office, and industrial).

[10] Ibid, page 3-103.
[11] Radeloff, V.C., R.B. Hammer, S.I. Stewart, J.S. Fried, S.S. Holcomb, and J.F. McKeefry. 2005. The Wildland Urban Interface in the United states. Ecological Applications 15:799-805.

Figure 2.6 RI Wildland Urban Interface Zones



Source: Rhode Island 2018 State Hazard Mitigation Plan.

Since the 2013 plan, there have been limited urban fire-related incidents, and no wildfire-related events impacting Providence. For this update, Providence is considered at moderate risk to future fire-related hazards events.

Property at Risk from Fire-Related Hazards in Providence

The City of Providence housing stock consists of approximately 35,000 wood frame buildings constructed between 1865 and 1940. These structures are mostly three-story structures of balloon construction, which enables fire to rapidly spread between floors due to the absence of any 'stops' in the walls. Compounding this is the proximity of

structures, not only downtown, but throughout the city. Roger Williams Park and Neutaconkanut Park remain the two primary areas vulnerable to wildfire in Providence.

Probability of Future Occurrence of Fire-Related Hazards in Providence
In the future, the possibility of more frequent short-term drought associated with a changing climate could result in more frequent occurrence of wildfire. For this update, the probability of future occurrence of fire-related hazards is likely for Providence/Providence County.

2.3.6 Drought-Related Hazards

Drought is a temporary irregularity characterized by long durations of below normal precipitation. Drought occurs in virtually all climatic zones yet varies significantly from one region to another, due to its relationship to normal precipitation in that specific region. Drought can affect agriculture, water supply, aquatic ecology, wildlife, and plant life.

Drought can be defined or grouped by the following:

- Meteorological drought is a measure of departure of precipitation from normal, defined solely on the degree of dryness,
- Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts with a focus on precipitation shortages, differences between actual and potential evapo-transpiration, soil water deficits, reduced groundwater or reservoir levels, etc.,
- Hydrological drought is associated with the effects of precipitation (including snowfall) shortfalls on surface or subsurface water supply and when water supplies are below normal, and
- Socioeconomic drought is associated with the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought.

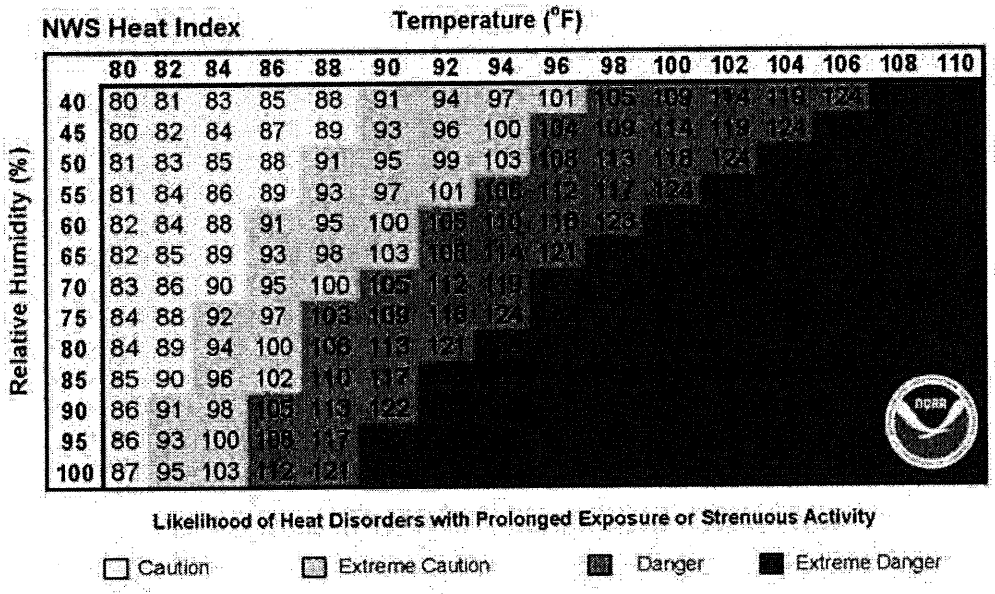
Climate Change Impacts on Drought
More intense heat waves predicted with climate change may result in more frequent and prolonged drought conditions

Extreme heat occurs when a system of high atmospheric pressure moves into an area. In such a high-pressure system, air from upper levels of our atmosphere is pulled toward the ground, where it becomes compressed and increases temperatures. This high concentration of pressure makes it difficult for other weather systems to move into the area, which is why periods of extreme heat can last for several days, or even weeks. The longer the system stays in an area, the hotter temperatures become. The high pressure inhibits winds, making them faint to almost non-existent. Because the high-pressure system also prevents clouds from entering a region, sunlight can become punishing, increasing temperatures even more. The combination of all these factors

come together to create what is known as a heat wave. Typically, a heat wave can last two or more days with significant impacts on human health and/or infrastructure. Heat waves can also cause catastrophic crop failures, cause roads to crumble, and can cause the ground around residences to dry out, leaving them susceptible to subsidence. The NWS maintains a Heat Index (Figure 2.7), which is a measure of how hot it really feels when relative humidity is also factored in with actual air temperatures. As an example, if the air temperature is 96°F and the relative humidity is 65%, the heat index, how hot it feels, is 121°F. The NWS also initiates alert procedures when the Heat Index is expected to exceed 105°-110°F (depending on local climate) for at least two consecutive days:

- Caution – fatigue possible,
- Extreme Caution – sunstroke, muscle cramps, and/or heat exhaustion possible,
- Danger – sunstroke, muscle cramps, and/or heat exhaustion likely, and
- Extreme Danger – heat stroke or sunstroke highly likely.

Figure 2.7 RI Wildland Urban Interface Zone Temperatures

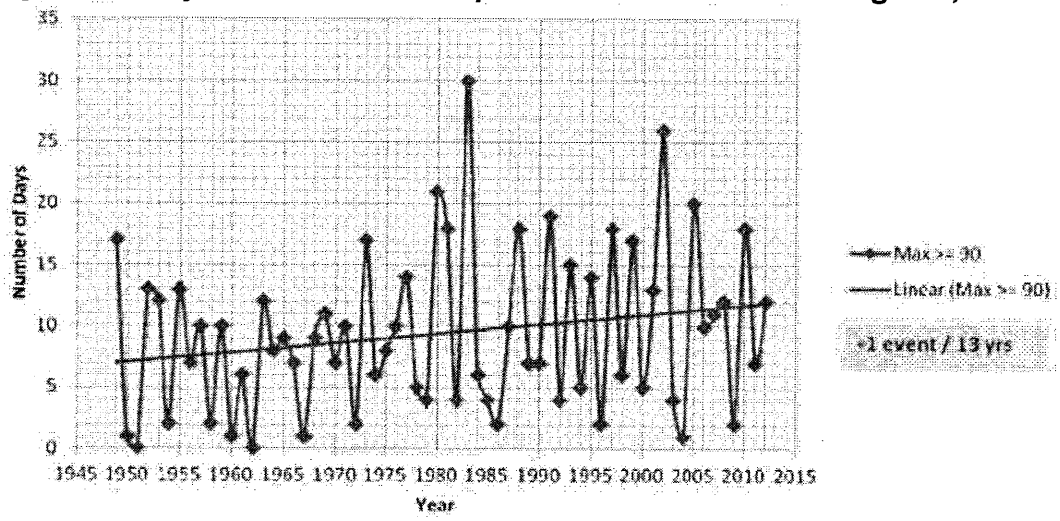


Source: https://www.weather.gov/safety/heat-index

Climate Change Impacts on Extreme Heat

More intense and prolonged heat waves are predicted with climate change. The frequency of days with high temperatures at or above 90°F has already increased (Vallee and Giuliano, 2014). The average number of days expected to be above 90°F in 1950 was about seven, while the new normal is 12. Figure 2.8 illustrates days experiencing maximum temperatures of 90°F or greater for the period of 1949 to 2012, as recorded at the NWS office at T.F. Green Airport.

Figure 2.8 Days of Maximum Temperature At or Above 90 Degrees, 1949 - 2012



Source: Vallee and Giuliano, 2014.

The City of Providence can expect to be uniformly affected by drought conditions. Table 2.20 below represents the significant drought-related hazard events that have occurred in and around the City of Providence over time, utilizing NOAA's National Climatic Data Center. All events are county wide (Providence County), unless otherwise noted.

Table 2.20 Significant Drought-Related Events, Providence County

Hazard Type	Date	Level/Description	Damages
Drought			
	4/12/2012	Severe/ Half of normal precipitation from 01/2012-04/2012	High fire danger
	8/2/2016	Severe	
	9/1/2016	Severe	Declared primary disaster area; effects on agriculture
	10/1/2016	Severe	
	11/1/2016	Moderate	
Extreme Heat			
	7/22/2011	Temperature at above 105 degrees for several hours	

Source: NOAA National Climatic Data Center, www.ncdc.noaa.gov

Since the 2013 plan, there have been four significant drought-related events (all in 2016) and no extreme heat events impacting Providence/Providence County. Based on the frequency and severity identified in Table 2.20, Providence is considered at low risk to drought events and moderate risk to extreme heat-related events.

Property at Risk from Drought-Related Hazards in Providence
Past drought events in Rhode Island have affected the entire state. Summer dry spells, during which lawns and vegetation may require irrigation, are common. In addition, the amount of tall buildings, concrete, and asphalt common in cities can trap heat and contribute to a 'heat island effect.' The entire City of Providence can be uniformly affected by drought-related hazard events. Of most concern in Providence are residents living without air-conditioning units, or the means to stay hydrated and cool, making them vulnerable to dehydration, injury or even death.

Probability of Future Occurrence of Drought-Related Hazards in Providence
According to recent history and climatic conditions, and the inability to predict drought and extreme heat events, it is likely drought-related hazards have a likely probability (one or more chances) of occurring on a yearly basis.

2.3.7 Communicable (Infectious) Disease-Related Hazards

An infectious disease is an illness due to a specific infectious agent or its toxic products that arises through transmission of that agent or its products from an infected person, animal, or inanimate source to a susceptible host; either directly or indirectly through an intermediate plant or animal host, through a vector, or through contact with the inanimate environment. Diseases such as influenza, pertussis, tuberculosis, and meningitis are examples of infectious diseases that can pose a threat to a community's population. Global, federal, state, and local agencies for human and animal health closely monitor for diseases with the potential to cause outbreaks or that could cross species, and work to develop strategies to contain their spread and to provide medical countermeasures such as antibiotics and antiviral medications to prevent or treat infection[12].

To gauge the potential impact of disease on Rhode Island's human population, it is helpful to classify disease occurrence in the following fashion:

- **Isolated case of a high-consequence disease:** One or more cases of a particularly serious disease (e.g., botulism), whose further spread is unlikely, but place significant strain on the resources required to isolate and provide treatment for the infected.
- **Institutional outbreak:** Two or more cases of similar illness with a common exposure at an institution (e.g., a school, nursing home, correctional facility).
- **Epidemic:** An increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area.
- **Pandemic:** An epidemic that has spread over several countries or continents, usually affecting many people.[13]

[12] Ibid, page 3-158.
[13] Ibid.

The extent of an infectious disease's impact depends on a variety of factors, including, though certainly not limited to:

- The disease's virulence, transmissibility, and pathogenesis,
- Environmental conditions, including temperature and rainfall,
- Modes of transmission,
- Individuals' vulnerability factors, such as underlying medical conditions, malnutrition, behavior, and pregnancy,
- Quality and availability of healthcare services,
- Immunization prevalence, and
- Availability and accessibility of medical countermeasures that protect against and treat the disease.[14]

Table 2.21 presents data from the Rhode Island Department of Health's (RIDOH) Center for Acute Infectious Disease Epidemiology for infectious disease incidents in 2017 across the state, that, can be correlated for the City of Providence, as an urban center.

Table 2.21 Infectious Disease Outbreaks, Rhode Island, 2017

Category		Total Number of Outbreaks Identified
Enteric[1]	Waterborne	0
	Enteric Foodborne	6
	Enteric Person-to-Person	53
	Enteric Animal Contact-associated Outbreaks	3
	Enteric Environmental Exposure-associated Outbreaks	0
	Other enteric outbreaks of Unknown Transmission	6
Respiratory	Influenza	1,400 (hospitalizations)
	Other Respiratory	7 (pneumonia/unknown)
Mosquito borne		0
Tickborne (excluding Lyme)		0
Select Vaccine-preventable Diseases[2]		16
Select Healthcare Associated Infections[3]		1
Other		3 (Coxsackie, Scabies, and Herpes Simplex Virus)
Total		216

1. Outbreaks of all pathogens that result in gastroenteritis with the exception of those specifically named further down in the table.

2. Diphtheria, Haemophilus influenza Type B, Measles, Meningitis, Mumps, Pertussis, Rubella, and Varicella
3. Healthcare-acquired methicillin-resistant Staphylococcus aureus, Clostridium difficile, and Carbapenem-resistant Enterobacteriaceae, also CLABSI, CAUTI, SSI
Source: RIDOH Center for Acute Infectious Disease Epidemiology.

[14] Ibid.

Climate Change Impacts on Communicable (Infectious) Disease-Related Hazards
Climate change will likely impact the public's general health differently across a range of socioeconomic factors, including age (children and the elderly), gender (particularly pregnant women), and social marginalization (poverty). Many infectious diseases, including water-borne illnesses, are extremely sensitive to changing climate conditions. Warming temperatures will also extend the transmission season and geographical range of many diseases. Projections for increased warming such as more days with increased temperatures and heat waves can also impact the cardiovascular and respiratory health of people.

Based on the extrapolated frequency and severity of infectious disease incidents identified for the State of Rhode Island in 2017, Providence is considered at moderate risk to infectious disease events.

Population at Risk from Infectious Disease-Related Hazards in Providence
The entire State of Rhode Island is susceptible to the spread of infectious diseases, however, in crowded urban centers where people are in close-proximity and contact with one another such as Providence, transmission can be exacerbated. Compounding the potential risk for the City of Providence, are the number of colleges and universities with students from a wide range of socioeconomic, ethnic, and cultural backgrounds, which increases risks.

Probability of Future Occurrence of Infectious Disease-Related Hazards in Providence
The probability of incidents that result from infectious disease occurring in Providence is difficult to predict, however, with such incidents occurring every year, the probability of an incident over the next year has a significant probability. The probability of an event progressing to the epidemic or pandemic stage within the same time period, is less clear.

2.3.8 Terrorism (Intentional) Hazards

One positive take-away of natural hazards is that those that pose the highest risk to the City of Providence are predictable and storm-tracking technology is now able to warn communities of possible danger and give them time to prepare. Unfortunately, human-caused hazards are very unpredictable.

The term terrorism most often refers to intentional, criminal, malicious acts that originate from human activity. Although there is no single, universally accepted definition of terrorism, the Code of Federal Regulations (CFR) defines terrorism as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives."[15]

[15] 28 CFR, Section 0.85.

Biological Incident

A biological incident is characterized by the accidental or intentional release of naturally occurring biological diseases (both communicable and non-communicable). A biological agent can be organisms or toxins that can kill or incapacitate people, livestock, and crops, and include the following:[16]

- **Bacteria:** single-cell organisms that are the causative agents of anthrax, brucellosis, tularemia, plague, and numerous other diseases. They vary considerably in infectivity and lethality.
- **Rickettsia:** microorganisms that resemble bacteria in form and structure but differ in that they are intracellular parasites that can reproduce inside animal cells. Examples of rickettsial diseases that could be employed as biological agents include Typhus, Rocky Mountain spotted fever, and Q fever.
- **Viruses:** intracellular parasites that are about 100 times smaller than bacteria. They can infect humans, crops, and domestic animals. A virus's strength can be altered to increase its efficiency. A particularly powerful strain of an endemic pathogen could simply be blamed on a chance natural mutation.
- **Fungi:** can cause severe disease in humans, such as coccidioidomycosis (valley fever) and histoplasmosis. Examples of plant fungal pathogens include rice blast, cereal rust, and potato blight.
- **Toxins:** poisonous substance made by a living system, or a synthetic analogue of a naturally occurring poison. A wide variety of toxins are produced by bacteria, fungi, marine organisms, plants, insects, spiders, and other animals.15 Examples of biological toxins include ricin and botulinum toxin.

Biological agents used as weapons fall into three groups: bacteria; viruses; and toxins. Many are difficult to grow and maintain, while many become non-toxic when exposed to environmental factors such as sunlight. On the other hand, others can be very long-lived. Biological agents are deadly in and of themselves, however, the method and accuracy of their delivery determines the overall severity of their damage.

Predicting and understanding the potential severity of a biological incident depends heavily on the routes of exposure and means of delivery, including:[17]

- **Inhalation:** Requires that a biological agent be aerosolized in a particle size that could be inhaled by an individual. Scenarios include airborne dissemination, for instance, via crop dusting aircraft, or dispersal through a building air handling system.
- **Injection:** Involves the introduction of an agent into an individual by penetrating the skin barrier. Scenarios include targeted attacks with an injection device such as a syringe.
- **Ingestion:** Involves an individual swallowing the agent or toxin. Scenarios include the introduction of an agent into a food or water source.

[16] State of Rhode Island 2018 State Hazard Mitigation Plan, page 3-20.
[17] Ibid, page 3-21.

- **Absorption:** Involves absorption of an agent by an individual's body, most readily through the mucous membranes. Scenarios include aerosolized liquid dispersal via a backpack sprayer.
- **Person-to-person:** Involves infecting an individual through a variety of means (including those listed above), with the hope that that individual will subsequently infect those with whom he or she comes into contact.

There have not been any significant human-caused biological incidents in the State of Rhode Island. Providence is considered at low risk to infectious disease events.

Population at Risk from Biological Incident-Related Hazards in Providence
The entire City of Providence is equally susceptible to a biological incident dependent upon the route of exposure and means of delivery, as described above. In crowded urban centers where people are in close-proximity and contact with one another such as Providence, risks can be increased.

Probability of Future Occurrence of Biological Incident-Related Hazards in Providence
There is an unlikely probability of a biological incident occurring in Providence.

Chemical/Hazardous Materials Release Incident
A chemical incident is characterized as an unexpected uncontrolled release of a chemical from its containment, and typically occur at fixed-site facilities that manufacture, store, process, or otherwise handle hazardous materials. Also, chemical incidents can also occur along major roadways, railways, waterways, and pipelines.

Common routes of exposure include inhalation, ingestion, and physical contact, which may lead to respiratory distress, organ failure, burns, or death. Absorption rates vary and depend on the concentration of the chemical, the duration of the exposure, air temperature, humidity levels and the age of the person affected. The severity of a chemical incident depends on the type and amount of the material released, proximity to populations or sensitive areas such as waterways, and environmental factors such as wind velocity and direction, and sunlight exposure.

Several facilities in Providence store, use, dispose, or handle hazardous materials on a regular basis. These facilities are commonly known as "Tier I" or "Tier II" facilities regulated by Title III of the Emergency Planning and Community Right to Know Act. As a result, the City of Providence is at greater risk of a chemical incident.

The City of Providence is also home to Liquified Natural Gas (LNG) and Liquefied Petroleum Gas (LPG) facilities. The LNG facility stores 600,000 barrels of LNG - a cryogenic gas that is cooled to -260°F for storage. It is primarily methane with a flammable range between 5 and 15% in air. When used, the temperature is elevated, and the liquefied gas expands 600 times and is transported to homes and businesses via the gas main system for commercial use. The tank is filled during the summer months for winter use by trucks coming from the LNG facility in Everett, Massachusetts. The tank is diked to contain a liquid leak equal to one and a half times the capacity of

the tank. The hazard is that should such a leak occur the liquid would eventually heat up and migrate from the diked area until it contacted an ignition source where it would ignite and flash back to the diked area, igniting the rest of the pool causing an extremely intense fire beyond the capabilities of any municipal fire department.

The LPG facility is located approximately one mile away from the LNG facility. The LPG facility contains 400,000 barrels of LPG. LPG is a gas cooled to -44°F, with an expansion ratio of 270 to 1 and is mainly propane. The flammable range is 2 to 9% in air. The LPG facility is also approximately 500 feet from the largest chemical storage company in the city. LPG is used commercially for heating and is distributed under pressure via truck. LPG is brought to the city via ship. The facility receives approximately 12 deliveries annually. The main hazard of propane is that it is heavier than air, and should a leak occur, the gas will seek an ignition source and flash back to the container.

Both hazards present the potential for cascading events. An LPG or LNG tank fire may ignite other containers. The LPG tank would undoubtedly expose the chemical facility to heat that would compromise other containers located onsite.

There have been several chemical incidents in Providence over time, with the most recent incident occurring in October 2018 when a tractor trailer carrying 11,000 gallons of gasoline rolled over on the Allens Avenue ramp to Route 95, spilling an undetermined amount in the Providence River. Providence is considered at moderate risk to chemical incident-related events.

October 2018 gasoline spill, Allens Avenue Ramp to Route 95.

Source: https://www.providencejournal.com/news/20181004/dem-hopes-environmental-impact-from-providence-gasoline-spill-will-be-limited--video

Population at Risk from Chemical/Hazardous Materials Release Incident-Related Hazards in Providence

The entire City of Providence is equally susceptible to a chemical incident. Many chemical shipments move through Rhode Island annually at any time, day or night, via

roadway networks, rail, air and water, and often through urbanized areas like Providence.

Probability of Future Occurrence of Chemical/Hazardous Materials Release Incident-Related Hazards in Providence
Based on the number of facilities, the highly urbanized areas, and transportation routes in and through Providence, there is a likely probability of a chemical incident occurring.

Cybersecurity Incident
A cybersecurity incident is characterized by an incident that threatens the confidentiality, integrity, and accessibility of an information system or its' processes, violating security policies and practices. Significant cybersecurity incidents not only require effective response to minimize loss of critical information, but also continuity of services and security. Although cybersecurity incidents occur almost daily, the efficacy of the 'threat actors' or type of attacks, can vary significantly and be classified into three categories:[18]

- **Hacktivists/Petty Criminals**: Constitute most cyber-attacks on the Internet, typically conducted by single individuals or small unaffiliated groups. These unstructured attacks exploit unprotected targets with known vulnerabilities and can be completely automated, using little technical skill and sophistication.
- **Organized Crime/Cyber-terrorists**: Target a specific person or entity for financial gain, intellectual property, or blackmail. These structured attacks, for instance a Distributed Denial-of-Service (DDoS) or intellectual property theft, tend to be more organized and planned, and often rely on insider knowledge.
- **Sophisticated Nation States**: Although fewest in number, these adversaries conduct reconnaissance over long periods of time, with extreme preparation and organization. These highly structured attackers use multiple methods of reconnaissance and multiple attack techniques to achieve their goal that may combine a physical attack with a cyber incident.

Natural hazard events can often indirectly contribute to the threat of cybersecurity incidents through long-term loss of power, or extreme heat. Risks associated with cybersecurity incidents in Rhode Island include:[19]

- **Internet of Things (IoT):** Presents unique security challenges due to the number of interconnected devices and systems present in the state. As this concept was not created with security in mind, many hackers will compromise these connections. Whether it be the healthcare industry or the energy sector, all infrastructure is vulnerable to these compromises, placing the data belonging to Rhode Island businesses and community members at risk.
- **Cyber theft:** Is an increasingly lucrative business for cyber criminals. For instance, while the Target breach was not an isolated incident in Rhode Island, many Rhode Island community members fell victim to this act of cyber theft.

[18] Ibid, page 3-39.
[19] Ibid.

Cyber thieves hacked as many as 40 million accounts, stealing customer names, credit and debit card numbers, encrypted PIN data, and card expiration dates, which affected as many as 110 million people. This incident highlights the financial risks posed against community members' personally identifiable information (PII) and the economy.

- **Advanced Persistent Threat (APT):** Is of significant concern as sophisticated threat actors are gaining unauthorized access to computer systems as a means of carrying out various disruptive actions to achieve political or social objectives. Deploying a targeted, long-term pattern of complicated attacks, nation-states conduct malicious network activity and reconnaissance. While this activity would be a rarity in Rhode Island, if it were to happen the risk would be detrimentally crippling to the state.

Instances of cyberattacks continue to grow. A prominent Providence law firm was hacked in 2016, having their files encrypted and a $25,000 ransom request to restore access. This not only held up the work of staff, it cost the firm approximately $700,000 in lost revenue. Most recently, three state agencies were infected with malicious software originating from a phishing email. Providence is considered at moderate risk to cybersecurity incident-related events.

Population at Risk from Cybersecurity-Related Hazards in Providence
The entire City of Providence is equally susceptible to a cybersecurity incident as most day-to-day activities rely on the Internet in one aspect or another.

Probability of Future Occurrence of Cybersecurity-Related Hazards in Providence
Based on the widespread use of electronic devices and our society's reliance on technology to support daily functions, the probability of future cybersecurity incidents is significant.

Explosive Incident
The Federal Bureau of Investigation (FBI) defines terrorism as the "the unlawful use of force or violence against persons or property to intimidate, or coerce a government, civilian population, or any segment thereof in the furtherance of political and social objectives."[20] A trend in terrorist threats is the use of improvised explosive devices (IEDs). IEDs make a lethal impact while requiring a relatively low level of technical skill to produce them.[21]

The threat an IED poses begins within an adversary's motives and intent to do harm. It becomes a "credible" threat if and when the adversary has the "capability" of doing the intended harm, and if the target has the vulnerability that will facilitate the harmful contact. Specific to IED attacks, 'capability' would include possessing (1) knowledge to build, place, and function an explosive device, and (2) access to materials needed to construct the device (possibly to manufacture the explosive itself). Components

[20] Federal Bureau of Investigation, 2005, Terrorism 2002 – 2005.
[21] State of Rhode Island 2018 State Hazard Mitigation Plan, page 3-194.

consistent with IED threat capabilities include financial support, physical support networks, size of cell with direct operational responsibility, amounts of constituent materials reasonably accessed for the device, gadgeteering skills in construction, technical expertise, and tactical proficiency. If the adversary possesses all the necessary capabilities to carry out the intended threat, they then become limited only by their imagination.

A major part of recognizing the threat is having a detailed knowledge and understanding of past events and targets involved. Emphasis on past IED events show that targets are both symbolic locations that represent U.S. interests and sovereignty, as well as locations of tactical importance. The City of Providence was included in a regional evaluation that identified possible local terrorist targets, including the Port of Providence and the Rhode Island Convention and Entertainment Complex.

Port of Providence
The Port of Providence (ProvPort) is one of America's most strategically located port facilities. Currently operated by Waterson Terminal Services, it is located at the convergence of Narragansett Bay and the Providence River. The ProvPort campus is more than 105 acres, and the facility offers in excess of one mile of linear berthing, capable of working six vessels at any one time. As one of New England's only deep-water operations, ProvPort has an on-dock rail with three rail spurs, 20 acres of open lay down area, 300,000+ square feet of enclosed warehouse facilities, adjacent to pier face and on-dock rail lines, and fixed and mobile cranes available.

ProvPort provides both domestic and international bulk, break bulk, and project cargo clients. Providence and East Providence are key entry points for gasoline used in the region. Tankers arriving at those ports provide fuel for Rhode Island, as well as Southeastern Massachusetts, Cape Cod, and northern Connecticut.

In 2008, cargo exceeded 3.1 million tons, making it the second busiest port in New England after Boston. ProvPort is a critical economic engine for New England, with an estimated $200 million total economic impact on the region. The port is host to more than a dozen companies. Combined, the activities at ProvPort provide more than $60 million in direct business revenues and $16 million in revenue to local and state government.

The port is the main entry for the bulk of home heating fuel and motor fuels for the New England region. Additionally, a major LNG storage and transfer facility is present; 8.5 million gallons of liquid ethanol is transported through the Blackstone Valley via cargo trains each year and blended at the port terminals for distribution.

The port is in very close proximity to the City of Providence to the north, East Providence to the east, and Cranston to the west.

The level of hazardous materials stored and transported through the port makes this site an appealing target. It has high potential to cause massive citywide and regional disruption by fire or explosion.[22]

Rhode Island Convention and Entertainment Complex
This high occupancy sports and entertainment facility consists of three separate component venues: the Rhode Island Convention Center, Veteran's Memorial Auditorium, and the Dunkin' Donuts Center. These facilities accommodate notable conventions, exhibits, concerts, and sporting events. The Dunkin' Donuts Center is a multi-use, 31,000-square foot entertainment arena with a 13,000-seat capacity that hosts a variety of professional and college sporting events as well as music concerts and family entertainment shows. The Convention Center has 100,000 square feet of exhibit space, a 20,000 square foot ballroom, and 23 additional meeting rooms. Veteran's Memorial Auditorium is home to the Rhode Island Philharmonic Orchestra, Providence Singers, and Festival Ballet of Providence. The complex is close to numerous lodging locations, as well as parking areas.

Because its events draw large-capacity crowds, the complex is well-suited for a high-impact IED attack. As such, security at this complex is high, which makes entry into the facility with IEDs difficult.

There has not been an explosive incident-related event in the State of Rhode Island, however, this does not reduce the significance of the threat. Providence is considered at moderate risk to explosive incident-related events.

Population at Risk from Explosive-Related Hazards in Providence
The entire State of Rhode Island is vulnerable to explosive incidents, particularly the densely populated urban areas and many crowded venues in Providence.

Probability of Future Occurrence of Explosive-Related Hazards in Providence
It is difficult to predict when and where the next IED incident is likely to occur. Based on past hazard data, there is potential for an IED incident to occur in Providence.

Radiological/Nuclear Incident[23]
A radiological incident can be defined as the uncontrolled release of radioactive material that can harm people or damage the environment. Radiological incidents typically involve nuclear assemblies, research, production, or power reactors and chemical operators. Although these sites do not exist within Rhode Island boundaries, sites within neighboring states, including the Millstone Nuclear Power Station in Waterford, Connecticut, and the Pilgrim Nuclear Power Station in Plymouth, Massachusetts , place the population of Rhode Island potentially in harm's way following an incident.

[22] Fogarty, Raymond, et al. "ProvPort, The ReNEWable Port – A Benefit Cost Analysis." 20 Aug 2010. http://provport.com/tiger_docs/Bryant_BenefitCost082010FINAL.pdf
[23] State of Rhode Island 2018 State Hazard Mitigation Plan, page 3-166.

Radiological incidents may also include the use of Radiological Dispersal Devices (RDDs), such as "dirty bombs," which cause the purposeful dissemination of radioactive material without a nuclear detonation. Other radioactive materials, such as radioactive medical devices, or radioactive recyclable metals, may also become a hazard.

Although Rhode Island does not have any commercial nuclear power plants within its borders, the City of Providence does fall within the 50-mile Ingestion Exposure Pathway for both area nuclear power plants. RDDs may disseminate radioactive materials at any location, but the range of dispersal varies based on the design of the device, type and quantity of radioactive material, and pattern of dispersion. The Nuclear Regulatory Commission (NRC) has developed an emergency classification system which indicates the risk of radiological incident to the public, and includes four types of alerts:

- Notification of Unusual Event: Under this category, events are in process or have occurred which indicate potential degradation in the level of safety of the plant. No release of radioactive material requiring offsite response or monitoring is expected unless further degradation of the safety systems occur.
- Alert: If an alert is declared, events are in process or have occurred which involve an actual or potential substantial degradation in the level of safety of the plant. Any releases of radioactive material from the plant are expected to be limited to a small fraction of the Environmental Protection Agency (EPA) Protective Action Guidelines (PAG) exposure levels.
- Site Area Emergency: A site area emergency involves events in process, or which have occurred that result in actual or likely major failures of plant functions needed for protection of the public. Any releases of radioactive material not expected to exceed the EPA PAG exposure levels except near the site boundary.
- General Emergency: Events are in process or have occurred which involve actual or imminent substantial core degradation or melting with potential loss of containment integrity. Releases can reasonably be expected to exceed the EPA PAG exposure levels offsite for more than the immediate site area.

No previous high impact incidents have been reported at both the Pilgrim and the Millstone locations. Millstone Power Station has had periodic shutdown of its Unit 2 and Unit 3 reactors, with its Unit 1 reactor permanently shut down in 1998. The Pilgrim site is scheduled to be closed soon. Providence is considered at low risk to both nuclear and radiological incident events.

Population at Risk from Radiological/Nuclear-Related Hazards in Providence
Providence, and the entire State of Rhode Island is vulnerable to nuclear and radiological.

Probability of Future Occurrence of Radiological/Nuclear-Related Hazards in Providence
Though the risk remains, there is an unlikely probability of a nuclear or radiological incident occurring in the immediate future.

Civil Disobedience/Unrest

FEMA defines civil disturbance activity as "an activity such as a demonstration, riot, or strike that disrupts a community and requires intervention to maintain public safety."[24] Often, civil disturbances arise from spontaneous acts by individuals or a group seeking to gain attention for something they feel in unjust, such as a political grievance, social justice conflict, or response to the demand for goods and services. Community members have the right to peaceful assembly, and not all assemblies result in violence. The public safety concern is for those assemblages that cause an immediate danger or result in damage or injury to property or person(s) participating or passersby.

As civil disturbances are often spontaneous in nature, it is difficult to predict when and where they may occur. With advancements in technology, such as social media, small gatherings can quickly turn into large, disruptive gatherings. The City of Providence, as an urban center, is likely to experience a civil disturbance. Several times in the past, Providence City Hall has been the focus of such gatherings, viewed as the hub of all things political.

The severity of a civil disturbance incident varies and depends on the nature of the disturbance as well as the size of the crowd gathered. A low severity disturbance often results when police are dispatched to control traffic. A moderate severity disturbance is considered when businesses are disrupted or the result of property damage, requiring police intervention to restore order. Severe disturbance incidents typically involve some form of rioting, arson, assault, and potential death, warranting aggressive police intervention.

Rhode Island has experienced several local incidents related to civil disturbances in recent years. Demonstrations as part of the Occupy Wall Street and Black Lives Matter movements impacted local response efforts, and in late 2014, significant protests and demonstrations led to shutdowns on I-95 within Providence as protesters flooded the roadway.[25] Providence is considered at low risk to civil disobedience/unrest incidents.

Population at Risk from Civil Disobedience/Unrest-Related Hazards in Providence

The entire City of Providence is vulnerable to civil disobedience and unrest incidents, particularly the densely populated urban core.

Probability of Future Occurrence of Civil Disobedience/Unrest-Related Hazards in Providence

Civil disturbances will continue to occur in the future. There is a likely probability of a civil disobedience/unrest incident to occur in the immediate future.

[24] FEMA, n.d. Glossary: Civil Disturbance.

[25] State of Rhode Island 2018 State Hazard Mitigation Plan, page 3-34.

2.3.9 Other (Accidental) Hazards

This section incorporates human-caused hazards considered to be 'accidental' in nature rather than 'intentional' or acts of terrorism previously discussed. Fire-related (Wildfire and Urban Fire) hazards, Dam Inundation-related hazards, and Hazardous Materials Release have been profiled and assessed in Section 2.3.7.

Mass Casualty Incident

FEMA defines a mass casualty incident as "any event, planned or unplanned, that results in the need to provide medical care to patients outside of traditional hospital settings. Broadly, incidents are divided into planned events (special events—like a sporting event or political protest) and unplanned incidents (such as terrorism, earthquakes, natural disasters, or weather-related triggering mechanisms)."[26] Typically, a mass casualty incident is an emergency situation where the number of patients overwhelms available resources and triggers a change in the way patients are handled to more efficiently allocate resources to treat those most in need as quickly as possible. Often, this means patients are handled in order of severity rather than first come, first served (also known as triage).

There have not been any mass casualty incidents in Providence since the 2013 plan. Providence is considered at moderate risk to mass casualty incidents.

Population at Risk from Mass Casualty Incident-Related Hazards in Providence

The entire City of Providence is equally susceptible to a mass casualty incident. In particular, the many transportation corridors (automobile and rail) around and through the city as well as the density of population immediately adjacent to these corridors are most at risk.

Probability of Future Occurrence of Mass Casualty Incident-Related Hazards in Providence

Based on the number of transportation systems and networks throughout the city, there is a likely probability of a mass casualty incident occurring.

Special/VIP Events

As the capital city for the state of Rhode Island, Providence is home to many Special/VIP events, including PVD Fest, PRIDE, the Mayor's inauguration, 'One Providence' New Year's Eve celebration, and various other cultural and arts festivals. Most Special/VIP events go off without interruption, however, publicizing the appearance of a high-profile speaker or a cultural/municipal festival mandates having a risk management plan to handle any disturbance should one arise. In addition, the assembly of people in confined spaces combined with advancements in technology, small gatherings can quickly turn disruptive.

[26] FEMA Operational Templates and Guidance for EMS Mass incident Deployment, June 2012.

For most Special/VIP events, PEMA utilizes an Incident Action Plan (IAP) under a Unified Area Command Post. FEMA defines an IAP as "an oral or written plan containing general objectives reflecting the overall strategy for managing an incident. It may include the identification of operational resources and assignments. It may also include attachments that provide direction and important information for management of the incident during one or more operational periods."[27] A Unified Area Command is established when incidents under an Area Command are multijurisdictional. FEMA defines Unified Area Command as "An application of Incident Command System (ICS) utilized when there is more than one agency with incident jurisdiction or when incidents cross political jurisdictions. Agencies work together through the designated members of the Unified Command, often the senior person from agencies and/or disciplines participating in the Unified Command, to establish a common set of objectives and strategies and a single IAP."[28]

Population at Risk from Special/VIP Event Hazards in Providence
Should a Special/VIP event turn disruptive, for whatever reason, the entire City of Providence would be vulnerable, particularly the densely populated urban core.

Probability of Future Occurrence of Special/VIP Event Hazards in Providence
Special/VIP events occur throughout the year, and often in the case of cultural/arts festivals, on an annual basis. There is a low probability that a Special/VIP event would turn to civil disobedience/unrest in the immediate future.

2.3.10 Technologic Hazards

Technologic hazards generally refer to the critical infrastructure/utility facilities or 'lifeline sectors' important to the safety, security, and economic well-being of the State and its cities and towns. Infrastructure failure is considered any disruption to critical infrastructure that could have cascading effects that negatively impact a community's security, public health and safety, and economic vitality. The State of Rhode Island has designated six lifeline sectors whose resources and assets are critical to every aspect of daily lives, in addition to their interdependence on each other and all other sectors (Table 2.22).

Providence is served by the following public utilities:

- Electricity is supplied by National Grid
- Natural gas is supplied by National Grid
- Water is supplied by the Providence Water Supply Board from the Scituate Reservoir
- Wastewater is managed by the Narragansett Bay Commission (NBC)
- Telephone service and Internet access is provided by Verizon and Cox Communications

[27] FEMA Incident Command System Training, May 2008, page 5.
[28] Ibid, page 12.

Table 2.22 Lifeline Sectors

Lifeline	Description
Communications	The communications sector includes any services that enable both routine and emergency communications, such as cell towers, phone lines, dispatch systems, radio infrastructure, and satellite communications.
Emergency Services	The emergency services, which include police, fire, emergency management, public works, and emergency medical services life line sectors, provide support to the public during daily response operations. The emergency services sector represents the first line of defense in the prevention and mitigation of risk from hazards such as terrorist attacks, human-caused incidents, and natural disasters. In addition, the emergency services sector has a myriad of specialized capabilities such as hazardous materials response, search and rescue, and tactical teams.
Energy	The energy sector provides power to the community, public and private sectors, government, and first responders. The energy sector is divided into three interrelated segments: electricity, oil, and natural gas.
Information Technology	The information technology sector includes all system networks, hardware, software, information technology systems and services, and the Internet.
Transportation Systems	Transportation systems include roadways (federal, state, and local managed), railway (passenger and freight), airports, and marine ports (passenger and freight). Transportation incidents include a large-scale crash, collision, or incident involving the disruption of an air, land (road), rail, or marine mode of transportation. The State of Rhode Island is home to major highways, airports, railroads and marine ports.
Water and Wastewater Systems	Water and wastewater systems ensure the provision of clean water and the treatment of all water and wastewater. Safe drinking water is a prerequisite for protecting public health and all human activity and properly treated wastewater is vital for preventing disease and protecting the environment.

Source: State of Rhode Island 2018 State Hazard Mitigation Plan.

Communications

The City of Providence is home to communications infrastructure for several phone and telecommunications providers. The services that rely heavily on communications include emergency response providers and healthcare providers. Disruptions in their ability to communicate effectively can result in delays in emergency response, medical treatment, and potentially loss of life. Disruptions in the general public's communications systems can result in delays regarding the dissemination of emergency information warnings and/or alerts.

Climate Change Impacts on Communications

Natural hazard events can often directly contribute to communications threats primarily through the long-term loss of power. Projected increases in the frequency and severity of natural hazards, particularly wind-related events such as downed power lines, will likely impact the continuity of communications.

Energy

Rhode Island's electrical grid is part of the larger New England power grid, comprised of 8,000 miles of transmission lines serving 6.5 million households and businesses. National Grid is the distribution company serving Providence. The *RI Energy Assurance Plan* states, "National Grid's system contains a considerable amount of redundancy and system protection to minimize the impact of events to its customers. National Grid's electric system is reported to be designed to withstand the loss of any single high voltage element (e.g., transmission lines, transformers or power plants) without any impact to customers, which is compliant with North American Reliability Corporation (NERC) standards."[29]

National Grid also is the state's only natural gas distribution company serving Providence. National Grid maintains redundant pipeline and storage capacity for system reliability and resilience, including for RI's power generation which is almost entirely dependent on natural gas supply.[30] The local gas distribution system operated by National Grid serves approximately 257,000 residential, commercial, and industrial customers using a network of over 3,200 miles of mains. In addition, the City of Providence is also home to two LNG and LPG facilities, previously discussed.

Petroleum-based fuels used in Rhode Island include gasoline, distillate fuel, propane, kerosene, residual fuel oil, and jet fuel. Petroleum products supply fuel needs mainly in the thermal and transportation sectors, and to a lesser extent, in the electric sector. Petroleum-based fuels are not locally produced in Rhode Island, the state receives shipments of refined petroleum product via six marine import terminals in East Providence, Providence, and Tiverton. Most of the product arriving at the terminals is subsequently trucked to end users in Rhode Island, eastern Connecticut, and parts of Massachusetts.[31]

Climate Change Impacts on Energy

Climate change and projected increases in warmer temperatures is likely to both increase electricity demand for cooling in the summer and decrease electricity, natural gas, heating oil, and wood demand for heating in the winter. SRL projections and increases in the frequency and intensity of intense storm events could disrupt energy production and delivery by damaging electricity infrastructure, fuel delivery infrastructure and equipment, power plants, or storage facilities.

Information Technology

Information technology systems and services include the networks, hardware, software, and the Internet that so many residents, businesses, and agencies/organizations rely on every day. Threats to information technology systems and services require effective responses to minimize loss of critical data and continuity of services and security.

[29] R.I. Energy Assurance Plan, page 9-8.
[30] Ibid, page ES 7.
[31] RI State Guide Plan Element: Energy 2035, page 14.

Climate Change Impacts on Information Technology
Natural hazard events can often indirectly contribute to information technology threats through long-term loss of power, or extreme heat. Projected increases in the frequency and severity of natural hazards, particularly wind-related events such as downed power lines, will likely impact the provision for and security of information technology.

Transportation Systems
The quality of the City's transportation systems (roads and highways) contribute significantly to the response of a disaster. Poor quality systems and structures can hinder access or limit ability to evacuate if necessary. Bridges are also a component of the critical infrastructure within Providence. Approximately one-quarter of Rhode Island's bridges are rated as structurally deficient. In 2013, Rhode Island spent $93,870,443 on bridge capital projects. The RIDOT started or completed reconstruction of 32 structurally deficient bridges and acted on 77 more to prevent them from becoming structurally deficient since the 2016 passing of the sweeping, $4.9 billion piece of legislation called RhodeWorks, which focused on infrastructure management and maintenance.[32] A number of these are located in Providence and scheduled for rehabilitation or preservation through the Transportation Improvement Plan (TIP) projected through 2027 (See Table 3.2).

Climate Change Impacts on Transportation Systems
R.I. Statewide Planning developed *Technical Paper 167 - Vulnerability of Transportation Assets to Sea Level Rise and Storm Surge* (Rhode Island Statewide Planning Program, Division of Planning – Department of Administration, 2016) which utilized a GIS-based methodology to assess transportation assets under state jurisdiction (including roadways, rail, Rhode Island Public Transit Authority (RIPTA), passenger intermodal hubs, ports and harbors, bridges, bicycle infrastructure) at risk under one, three, and five-foot scenarios across the state (Table 2.23). The study is intended to be a resource for the state and affected communities to incorporate SRL data into informed decision-making regarding spending, planning, goal setting, communication, and capacity building, and for additional analysis. The following assets were identified for Providence:

Table 2.23 Transportation Assets Impacted by 1, 3, and 5-Foot SLR Scenarios

Asset Type	Impacted at 1 Foot SLR	Impacted at 3 Feet SLR	Impacted at 5 Feet SLR
Roads			
State Roads	0	0	0
Local Roads	0.4 miles	1.8 miles	4.7 miles
Rail	10 LF	120 LF	277 LF
RIPTA BUS Routes		221 LF	1.7 miles
Bicycle Infrastructure	5 LF	101 LF	.13 miles
Ports and Harbors	4.3 acres	8.6 acres	24 acres

Source: Technical Paper 167 – Vulnerability of Transportation Assets to Sea Level Rise and Storm Surge, RI Statewide Planning Program, 2016.

[32] State of Rhode Island 2018 State Hazard Mitigation Plan, page 3-146.

Other Transportation Infrastructure
The Port of Providence, located at the convergence of Narragansett Bay and the Providence River, is one of the busiest deep-water ports in the Northeast. The facility offers 4,200 feet of berthing space and 130,000 square feet of covered storage, and accommodates both domestic and international bulk, break bulk, and project cargo clients. Primary imports include petroleum, asphalt, cement, liquefied petroleum gas, coal, aluminum oxide, project cargoes, and road salt.[33]

The RIPTA operates the statewide intra- and intercity bus transport out of its hub in Kennedy Plaza in downtown Providence. Additional hubs are in Pawtucket and Newport. Services in Providence include fixed route, flex service, beach bus service, and the paratransit program, totally 58 routes.

Additionally, the Massachusetts Bay Transportation Authority (MBTA) Commuter Rail Providence/Stoughton line links Providence and T.F. Green Airport in Warwick to the City of Boston to the north and Kingston Station to the south.[34] Amtrak's Northeast Regional and Acela Express train lines also serve Providence.

In 2016, ferry services managed by a private operator resumed between Providence and Newport on a seasonal basis between May and October.

Climate Change Impacts on Other Transportation Infrastructure
Natural hazard events can often directly impose threats on other transportation infrastructure throughout the City. Projected increases in the frequency and severity of natural hazard events for wind-, flood-, and snow-related events could certainly impact the movement of goods and services within the port, as well as disrupt public transportation in, out, and throughout the City.

Wastewater Treatment Facilities (Narragansett Bay Commission (NBC))
As part of the *Implications of Climate Change for RI Wastewater Collection & Treatment Infrastructure* study (March 2017), the Bucklin Point and Fields Point wastewater treatment facilities (WWTFs) were assessed for risk to coastal flood hazards, SRL, wave hazards, and coastal erosion.

Bucklin Point
The WWTF is in East Providence on Bucklin Point, a promontory on the east bank of the Seekonk River. Although this site is in East Providence, sections of the City of Providence are served by this facility and if process components at the Fields Point WWTF are functional but unsafe to operate locally, critical systems are capable of operation from Bucklin Point. Three sides of the facility are adjacent to this tidally influenced waterbody and protected by a berm.

[33] Ibid, page 3-147.
[34] Ibid.

The berm surrounding the WWTF adequately protected the facility during the March 2010 storm events, however, the berm was subsequently raised an additional 12 to 18 inches in 2014 to above the 500-year flood elevation mapped on the FIRM. This berm protection incorporates tide gates for the plant effluent and stormwater from the north and south retention ponds. Although the facility's EAP does not address procedures for rising floodwaters, the operators close the outfall tide gates and pump the effluent out to the river when the river level exceeds 8 NAVD88. Also, during storm events, operators close the tide gates on the discharge lines from the onsite stormwater collection ponds.

Two of the four effluent pumps failed during the March 2010 storms, but the remaining two were able to maintain outfall wet-well levels. Operators expressed confidence that no major weak points remained after the post-2010 upgrades.[35]

Climate Change Impacts on the Bucklin Point Wastewater Treatment Facility
With the addition of one foot of SLR, the extent of flooding during a 100-year storm would reach the centrate holding tanks located up the hill. With five feet of SLR, the entire centrate tank area would be inundated during a 100-year storm event.

A wave analysis was conducted at two transects through the Bucklin Point facility. The analysis predicted that the significant wave height for a 100-year storm event would be approximately five feet as it approached the berm. Because waves are additive to the storm surge, wave action would lead to overtopping of the berm, even for storms that are less severe than the 100-year event. The berm will dampen wave action so that the significant wave height experienced at the facility components would be approximately one to two feet without SLR, and approximately three to four feet with five feet of SLR.[36]

Identified in the *Implications of Climate Change for RI Wastewater Collection & Treatment Infrastructure* study (March 2017) across the vulnerability scenarios described above, are the following critical components at risk at this facility:

- Influent Pump Station
- Preliminary Treatment
- Primary Clarifiers
- Aeration Tanks
- Secondary Clarifiers
- Generator
- Solids handling/Equipment Storage
- Digestors
- Sludge/Filtrate Holding Tanks
- Wet Weather Holding Tank
- Disinfection System
- Effluent Pump Station

[35]Implications of Climate Change for RI Wastewater Collection and Treatment Infrastructure, page 3-14.
[36] Ibid.

- Maintenance Building
- Operations Building

Fields Point
The Fields Point WWTF located on Ernest Street in Providence is Rhode Island's largest facility and has an estimated 226,000 customers from portions of Johnston, North Providence, Providence, and Cranston. The only barrier between the facility and the Providence River is a strip of flat terrain less than 400 feet wide. Originally constructed in 1901, the WWTF is also home to three historic buildings, which remain in use as the influent pump station, maintenance building, and disinfection building.
To equalize high wet weather influent flows, the facility operates off a main interceptor carrying roughly three million gallons (MG) of capacity and a "deep rock tunnel" designed to hold 65 MG of excess influent making its collection system unusual and complex.

Three outlying pump stations in the Fields Point service area are also owned, operated, and maintained by the NBC. The Washington Park and Reservoir Avenue Pump Stations are located within the City of Providence, and the Central Avenue Pump Station is in Johnston. The Ernest Street Pump Station is located adjacent to the Fields Point WWTF and handles 98% of the flow into the WWTF. The NBC also maintains six permanent flow metering stations and is responsible for 38 combined sewer overflows (CSOs), 32 tide gates, and 80 miles of interceptors in the Fields Point service area.

Many facility systems are operated below grade, and buildings on site appear to be constructed predominately with entrances at grade, offering little protection. These include the influent pump station, primary clarifier systems for wet weather equalization, aeration tank systems, secondary clarifier systems, and disinfection controls. Some buildings, such as the influent pump station, have stop-logs installed for increased flood protection, while other buildings remain unprotected, such as the wet weather pump building with ventilation louvers at grade. The treatment systems are capable of operation on generators located on site and portable stand-by generators are available for augmentation.

If electrical service to the facility is lost, the generators will be the sole source of electrical power. This facility also includes three wind turbines that generate up to 1.5 megawatts each, providing 40% of the power necessary to operate the facility. Several bird-related environmental issues have emerged related to the turbines. As a safety feature, the wind turbines will automatically shut down in the event of an electrical service outage to prevent them from energizing failed electrical systems that are being repaired. Additionally, if process components are functional but unsafe to operate locally, critical systems are capable of operation from Bucklin Point, or from a remote location with access to the virtual private network (VPN).[37]

[37] Ibid, page 3-36.

Climate Change Impacts on the Fields Point Wastewater Treatment Facility
NBC has a combined system with multiple relief points, however, rising sea levels could have a significant impact on capacity if the receiving waters enter the sewage collection system. Tide gates are installed at the CSO discharge points, but they can easily fail with debris becoming lodged in the gates. NBC acknowledges that more intense rain storms are difficult for the system to handle and, during extreme high tides and associated flood conditions, flow leaving the Fields Point chlorine contact tank may be impeded by high water levels in the Providence River. Flow has never backed up into the chlorine contact tank, but it has backed up into the discharge conduit area of the chlorine contact tank.

The Ernest Street Pump Station is in a low-lying area with some entryways elevated and doors that can be reinforced with stop logs for added protection, but this has not been done in the recent past. Similarly, the tunnel access points adjacent to the Ernest Street Pump Station have elevated walls and covers to prevent intrusion of rain or inflow of flood waters. According to operators, after the 2010 storms, there were no mitigation projects completed associated with the pump stations. NBC has been eliminating or elevating tide gates and their relevant weir heights to account for surcharged conditions, but no site mitigation projects have been conducted.[38]

With the addition of two feet of SLR, the extent of flooding during a 100-year storm would reach the maintenance building and preliminary treatment area, which though slightly elevated, will also be inundated along with equipment that is stored below ground.

A wave analysis was conducted at two transects through the Fields Point facility. The analysis for Transect 1 predicted that the significant wave height for a 100-year storm event would be approximately five feet at the shoreline and then drop gradually to two feet approximately 1,000 feet inland as the grade gradually rises. With five feet of SLR and the 100-year storm event, the significant wave height experienced at the facility would be approximately five feet and gradually drop to four feet approximately 1,350 feet inland.

The analysis for Transect 2 showed different results because of the steep rise in grade approximately 350 feet from shore. Here, the significant wave height for a 100-year storm event would be approximately five feet up until about 350 feet from shore where it drops to about one foot moving inland until approximately 750 feet from shore. With five feet of SLR, the significant wave height is approximately six feet at the shoreline and follows the same trajectory and drop off pattern until approximately 350 feet from the shoreline to approximately 750 from shore where a one-foot wave height would be experienced to approximately 1,100 feet from shore.[39]

[38] Ibid.
[39] Ibid., page 3-37

Identified in the *Implications of Climate Change for RI Wastewater Collection & Treatment Infrastructure* study (March 2017) across the vulnerability scenarios described above, are the following critical components at risk at the facility:

- Influent Pump Station (Ernest Street)
- Preliminary Treatment
- Deep Rock Tunnel System
- Wet Weather Tanks
- Preliminary Clarifiers
- Intermediate Pump Station
- Secondary Clarifiers
- Disinfection System
- Gravity Thickeners
- Solids Handling
- Generators
- Chemical Storage
- Operations Building
- Maintenance Building

Recommended Adaptive/Mitigation Strategies were provided for both sites to provide guidance for future system upgrades. Several include more than one strategy that could be implemented. Due to facilities with a low risk of failure by inundation from the events modeled could experience localized site flooding or other hazard situations that could partially or fully disable operations, in addition to the planning horizon for this update (five years), the top three mitigation priorities for each site (to maintain existing operations) are included in Section 4.0 Mitigation Strategy.

Drinking Water Facilities - Providence Water Supply Board (PWSB)

Providence Water is the largest water utility in Rhode Island supplying high-quality drinking water to more than 600,000 retail and wholesale consumers across the state. Its transmission and distribution system consist of approximately 1,040 miles of mains, ranging in size from six to 102 inches. The Scituate Watershed Complex is the source for the PWSB distribution system, located in the north central part of the Rhode Island. This system provides water to the metropolitan areas of the State and about 600,000 persons or about 60% of State's residents.

It is noted that several large public water suppliers that formerly relied upon their own sources of water have switched to entirely or partially relying upon the PWSB as a supply source. This increasing reliance on the largest public water system in the State points out the paradox of water supply issues in Rhode Island; the overall perceived abundance of the water resource is a false measure of its adequacy and security. The Scituate was never designed to be the single source of supply for the State and it has

no backup supplies, which was one of the factors considered in the State's purchase of the Big River Watershed.[40]

Climate Change Impacts on the Drinking Water Systems
Research conducted for the *SafeWater RI* project shows that average air temperatures in Rhode Island will increase dramatically over the next century. In addition to warmer temperatures, more extreme rain and snow events are anticipated, which will lead to both increased flow volume of local streams and rivers and prolonged or severe droughts. Warmer temperatures will also cause sea levels to rise, which in turn will foster stronger storm surges and could contaminate ground water supplies. These weather changes will result in a variety of conditions that could negatively impact water utilities in the State.[41]

SafeWater RI also provides an overall ranking for vulnerability to five hazards – drought, SRL, coastal flooding, riverine flooding, and hurricane storm surge/wind speeds. The following rankings were identified for the PWSB system:

- Drought: Not Available
- SRL: 4 (High Risk)
- Coastal Flooding: 2 (Low to Moderate Risk)
- Riverine Flooding: 4 (High Risk)
- Hurricane: 4 (High Risk)

Critical infrastructure in each sector is located throughout the City, including communications infrastructure for multiple phone and telecommunications companies, energy facilities, major highways, and water and wastewater facilities. Predicting the precise location of the next infrastructure failure is often difficult and generally dependent on the quality, upkeep, and maintenance of each piece of infrastructure as well as any protective actions that can mitigate or prevent acts of terrorism or cyber-attacks.[42]

Providence periodically experiences small scale infrastructure failures, often as secondary impacts from natural hazards, power and communication outages. Providence is considered at moderate risk of infrastructure failure incidents.

Population at Risk from Infrastructure Failure-Related Hazards in Providence
The entire City of Providence is equally susceptible to an infrastructure failure incident.

Probability of Future Occurrence of Infrastructure Failure-Related Hazards in Providence
Although the State of Rhode Island has not experienced recent, prolonged catastrophic infrastructure failures, a significant failure could result in severe disruptions to public life

[40] Element 721: Rhode Island Water 2030, page 720.2.
[41] SafeWater RI: Ensuring Safe Water for RI's Future, page 10.
[42] State of Rhode Island 2018 State Hazard Mitigation Plan, page 3-149.

and overall emergency response efforts. There is a likely probability of an infrastructure failure in Providence within the next few years.

2.4 Vulnerability

Vulnerability indicates what is likely to be damaged by the identified hazards and how severe that damage could be. After identifying types and areas of risk, a vulnerability analysis can help to determine the gaps in the community. This section examines the vulnerability of the built environment in terms of economic, social and environmental vulnerability. A vulnerability analysis also estimates the number of people exposed to hazards, including elderly populations and concentrated populations. This also includes such things as whether the shelter capacity is enough for the affected population, and whether businesses are likely to face temporary closure due to natural disasters. Historical damages are often good indicators for current exposure and potential damage.

2.4.1 Development Trends

Since the 2013 plan, Providence's vulnerability to natural, human-caused, and technologic hazards has not significantly changed.

Residential Development Trends
The 2017 U.S. Census American Community Survey estimates Providence's population to be 180,393, with a total of 70,766 housing units.[43] The number of households in Providence has increased 4.2% since the 2000 census. The City issued 62 building permits in 2016, up from a steady low experienced since 2010, and down from a high of 373 in 2006. The off-campus student populations of the various colleges and universities located in Providence also contribute to the number of households. Of the total housing units, 34% are owner-occupied units and 66% are renter-occupied. Most housing units in Providence are multi-family units (76.7%), followed by single-family detached (26.8%), and other (0.4%).

Commercial and Industrial Development Trends
Providence is a compact city with limited land area available for new commercial and industrial development. Approximately one-third of the city's 18.4 square miles is stable residential neighborhoods where significant change away from residential use or growth is unlikely. In addition, a large percentage of the city's land area is taken up with land uses that do not generate property taxes, such as schools, churches, hospitals, state offices, and public rights of way. These areas are unlikely to change as well.

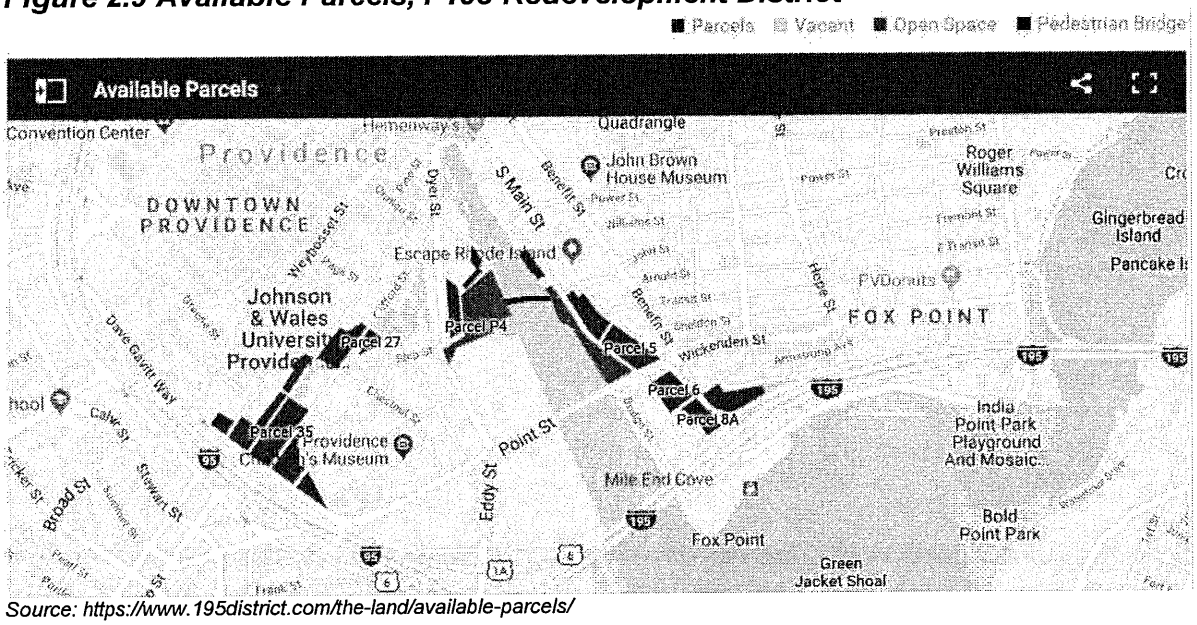
What remains is a small area of available land for new development that generates new revenue for the City.[44] The city's Future Land Use Map (FLUM) identifies these areas as Growth Districts. These areas are centered around the downtown core, in industrial

[43] U.S. Census Quick facts, https://www.census.gov/quickfacts/providencecityrhodeisland.
[44] Providence Tomorrow, Department of Planning and Development, November 24, 2014, page 22.

areas, and along the waterfront. Although these areas have many different physical characteristics, they are well-suited for pedestrian-oriented development with proximity to the roadway network and public transit. These very same areas are also at risk of impacts to natural hazards as discussed earlier. The older buildings in these areas are most at risk because they have not been brought up to current floodplain standards. These areas will remain at risk due to the extreme flooding that has occurred in the past, most recently in 2010, and future projections that call for continued increases in rain events and flooding.

The land made available by the relocation of Interstate 195 provides the most opportunity for new development within the City. Established in 2011, the I-195 Redevelopment District Commission was created to serve as the responsible authority for the sale, marketing, and oversight of this land. Figure 2.9 illustrates just over 20 acres of land that remains available for development, totaling just under 5.3 million maximum allowed square feet of potential development.

Figure 2.9 Available Parcels, I-195 Redevelopment District



Source: https://www.195district.com/the-land/available-parcels/

Current development projects include:

- South Street Landing: a 270,000-square-foot office and academic center, including 13 administrative units from Brown University, the Rhode Island Nursing Education Center (a joint venture of Rhode Island College and the University of Rhode Island), a 270-bed graduate and medical student housing complex, and a 744-space parking garage.
- Innovation Center and Starwood Brand Aloft Hotel: includes two ground-up construction buildings: a 191,000-square foot Innovation Center office building and the Starwood Brand Aloft Hotel, an approximately 170-room hotel with ground floor retail. The Innovation Center is anchored by Brown's School of

Professional Studies, which will occupy about 50,000 square feet, and the Cambridge Innovation Center (CIC), which will feature approximately 66,000 square feet of office space.

- Johnson & Wales University Science and Innovation Center: a 71,000-square-foot Science and Innovation Center that houses the Alan Shawn Feinstein Technology & Design Center, biology labs that support physics, chemistry, organic chemistry, and microbiology, as well as faculty offices.
- Pedestrian Bridge: the pedestrian bridge and adjacent parks are important pieces of the economic development of the Providence Innovation and Design District and the 195 land.
- Chestnut Commons: approximately 110,695 square feet of mixed-use development with 91 upscale, urban residential units, approximately 5,300 square feet of streetscape retail, 30 covered parking spots, and 5,000 square feet of open green space.

Natural, Historic and Cultural Development Trends

Providence is built upon innovation and creativity. The local creative sector, a cornerstone of Providence's past, present and future, continues to be the driving force behind re-imagining the city, and establishing its unique sense of place.

Through the collaborative efforts of the City, the Providence Tourism Council and the myriad of arts and cultural organizations in the City, Providence is now a regional tourist destination. There have been significant public and private investments in the arts economy including the moving of the rivers and resulting creation of Waterplace Park and Waterfire, and the renovation of the Providence Performing Arts Center. A large contributor to Providence's appeal is its growth in the convention and hospitality industries. Construction of new hotels and the completion of the Rhode Island Convention Center have attracted thousands of people to Providence. Other attractions include a strong architectural history and the variety and quality of restaurants located throughout the city, boosting Providence's reputation as a culinary destination.[45]

Providence has a diversified open space, public park and recreation system that are essential to the quality of life and sense of place of the city. Over the last several years, there has been significant investment in new development of parks and recreation facilities, including community gardens, walking/jogging paths, water parks, a skateboard park, dog parks, the Fred Lippitt Woonasquatucket River Greenway, and the pedestrian bridge and adjacent parks under construction along the Riverwalk.

The very same amenities contributing to the sense of place which draws so many residents, students, businesses and visitors, are also vulnerable to a range of hazards, particularly those located downtown, along the waterfront and those along the rivers.

[45] Ibid, page 76.

2.4.2 Economic Vulnerability

NFIP-Insured Property Damage
As seen in Table 2-24, FEMA estimated that the value of property insured by the NFIP in Providence is over $163 million as of October 1, 2018 (RI State Floodplain Coordinator). There are 24 (8 residential and 16 non-residential) properties that have experienced repetitive loss damages. The general locations of these repetitive flood loss areas are shown on Map 2.2 FEMA Flood Zones. According to the State Floodplain Coordinator and since the 2013 plan, there have been eight repetitive loss claims totaling just over $143,000 in payments, citywide.

Table 2.24 National Flood Insurance Program Activity in Providence, RI

Total Policies	Coverage Value	Policies in V-Zone*	Policies in A-Zone*	Claims Since 1978
590	$163,096,600	2	98	334

Source: FEMA, NFIP, Loss Statistics from January 1, 1978 through October 1, 2018.
** V-zone refers to the velocity zone, where waves greater than 2.9 feet are feasible during a 100-year flood. A-zone refers to other areas within the 100-year flood zone with less than 2.9-foot waves (FEMA, 1997).*

The majority of the NFIP insured properties are located along the coast, along with several interior low-lying commercial and residential areas vulnerable to flooding from stormwater collection deficiencies.

Impacts of FEMA Flood Zones
Because flood-related hazards are the second greatest risk to the city, HW performed an analysis to estimate the total assessed values (land and buildings) of properties located within coastal and inland flooding areas. The number and types of residential, commercial, industrial, and publicly-owned structures are described earlier in Section 2.3 and quantified in Table 2.25 Total Vulnerability FEMA Flood Zones Summary, Providence, RI. All flood zone data presented is based on the FEMA FIRMs as revised through 2014 and includes both critical facilities (structures) and vacant land for the land use categories.

Table 2.25 Total Vulnerability FEMA Flood Zones Summary Providence, RI

Flood Zone	VE Zone		AE Zone		X Zone	
Land Use	No. of Parcels Impacted	Total Value	No. of Parcels Impacted	Total Value	No. of Parcels Impacted	Total Value
Residential	8	$4,675,400	614	$155,845,400	845	$251,152,500
Commercial	28	$29,978,500	245	$394,027,300	347	$764,451,500
Office	2	$5,255,900	50	$212,914,100	68	$702,252,000
Industrial	7	$20,287,800	95	$116,917,600	147	$452,357,400
Non-Profit	1	$6,613,700	4	$14,582,800	4	$11,666,400
Cemetery	1	$68,136,500	2	$68,197,300	2	$68,197,300
Charitable			4	$7,824,000	8	$13,277,300

Flood Zone	VE Zone		AE Zone		X Zone	
Land Use	No. of Parcels Impacted	Total Value	No. of Parcels Impacted	Total Value	No. of Parcels Impacted	Total Value
Hotel/Motel					2	$31,011,500
Mixed Use	1	$304,000	9	$2,452,200	20	$5,420,000
College/University	8	$39,648,300	18	$136,907,400	29	$265,209,000
Dams			7	$137,257,200	11	$137,653,600
Energy/Utility	1	$9,035,000	15	$311,923,900	19	$346,315,200
Emergency Response			1	$645,900	2	$15,556,900
Federal			3	$8,930,200	7	$21,908,400
Hazardous Materials	1	$2,912,400	3	$5,521,200	4	$8,810,700
Healthcare/Hospitals	6	$222,105,500	15	$500,634,800	14	$512,513,700
Ports	14	$36,995,600	27	$66,868,800	29	$69,807,600
Public Assembly			5	$6,620,800	11	$8,024,600
Schools			15	$101,003,700	17	$128,083,800
Shelters			1	$53,839,700	1	$57,073,100
State	5	$2,510,000	33	$33,879,400	37	$40,796,500
Transportation			24	$15,985,400	26	$16,058,300
Water Infrastructure					1	$9,630,000
Wastewater Infrastructure	1	$6,217,200	4	$12,642,800	7	$33,411,100
Missing Data	10		67		71	
Total	**36**	**$454,675,800**	**171**	**$2,365,421,900**	**215**	**$3,970,638,400**

Source: City of Providence Geographic Information System dataset.

Impacts of Sea Level Rise

Concerns about the accelerated rate SRL in Rhode Island and the impacts on coastal areas, HW performed a second analysis to estimate the total assessed values of properties across a range of projected SRL scenarios. As discussed earlier in Section 2.3.2, HW utilized STORMTOOLS data to illustrate the potential for future impacts across the range of projected SRL scenarios for Rhode Island, according to land use type, critical facilities, and critical infrastructure. The Providence LHMC determined that three scenarios would be appropriate to cover the range of impacts over time and given the planning horizon for this plan (five years). The following scenario projections were utilized:

- **MHHW:** the mean elevation of the higher of the two daily high tides over a nineteen-year period, in comparison to the mean high water (MHW), which is the average elevation of all high tides over the same period. MHHW is the chosen baseline for the Rhode Island SLR study since it reflects a realistic average tidal elevation that communities will experience regularly.

- **MHHW Plus One-Foot SLR:** sea level has already risen about 11 inches in the past 100 years. A rise of nine inches has been noted at North Kingstown based on data since 1930 when the Newport tide gauge was installed. With accelerated SLR already being observed in Rhode Island, models show that global sea levels are likely to rise one foot in the next 20 to 50 years.
- **MHHW Plus Seven Feet SLR:** with accelerated SLR already being observed in Rhode Island, models show that sea levels in RI are projected to rise to 8.99 feet by 2100. MHHW Plus Seven Feet SLR scenario depicts:

The number and types of residential, commercial, industrial, and publicly-owned structures are described earlier in Section 2.3 and quantified in Table 2.26 Total Vulnerability MHHW, MHHW Plus One-Foot SLR, and MHHW Plus Seven Feet SLR, Providence, RI (total value = land and buildings). All flood zone data presented is based on the STORMTOOLS data and includes both critical facilities (structures) and vacant land for the land use categories.

Table 2.26 Total Vulnerability MHHW, MHHW Plus 1-Foot SLR, MHHW Plus 7 Feet SLR

Scenario	MHHW		MHHW Plus 1-Foot SLR		MHHW Plus 7 Feet SLR	
Land Use	**No. of Parcels Impacted**	**Total Value**	**No. of Parcels Impacted**	**Total Value**	**No. of Parcels Impacted**	**Total Value**
Residential			233	$79,549,000	416	$150,587,000
Commercial	27	$26,497,100	38	$48,028,900	126	$174,055,400
Office	3	$22,015,700	12	$114,134,900	148	$487,651,200
Industrial	7	$20,287,800	12	$38,848,000	32	$75,693,200
Non-Profit	1	$6,613,700	1	$6,613,700	2	$6,725,100
Cemetery	1	$68,136,500	1	$68,136,500	1	$68,136,500
Charitable					3	$413,300
Hotel/Motel					4	$136,691,300
Mixed Use					4	$20,658,900
College/University	4	$14,693,100	4	$14,693,100	38	$296,888,630
Dams						
Energy/Utility	4	$3,679,200	5	$291,042,700	6	$292,877,500
Emergency Response					2	$2,759,300
Federal					3	$79,681,500
Hazardous Materials	1	$2,912,400	1	$2,912,400	1	$2,912,400
Healthcare/Hospitals	5	$219,573,100	6	$222,105,500	7	$228,598,100
Ports	16	$37,079,300	16	$37,079,300	20	$56,751,500
Public Assembly			1	$698,109,800	4	$880,192,300
Schools						
Shelters						
State	6	$3,679,200	6	$3,679,200	16	$16,514,100
Transportation			1	$3,113,700	1	$3,113,700
Water Infrastructure						
Wastewater Infrastructure	1	$6,217,200	1	$6,217,200	2	$25,880,400
Missing Data	10		23		39	
Total	**76**	**$431,384,300**	**361**	**$1,634,263,900**	**875**	**$3,006,781,330**

Source: City of Providence Geographic Information System dataset.

Impacts of Hurricane Surge Inundation Areas

Wind-related hazards, hurricanes, are the number one hazard impacting the City of Providence. HW performed an analysis to estimate the total assessed values of properties located within the worst-case hurricane surge areas for Categories 1 through 4 hurricanes developed by the National Hurricane Center using the SLOSH Model. The number and types of residential, commercial, industrial, and publicly-owned structures are described earlier in Section 2.3 and quantified in Table 2.27 Total Vulnerability Hurricane Categories 1 and 2 Inundation Areas and Table 2.28 Total Vulnerability

Hurricane Categories 3 and 4 Inundation Areas. The economic data presented includes both critical facilities (structures) and vacant land for the land use categories presented (total value = land and buildings).

Table 2.27 Total Vulnerability Hurricane Categories 1 and 2 Inundation Areas

Hurricane Category	Category 1		Category 2	
Land Use	**No. of Parcels Impacted**	**Total Value**	**No. of Parcels Impacted**	**Total Value**
Residential	1	$1,332,200	32	$12,195,800
Commercial	30	$33,793,100	59	$40,842,900
Office	3	$8,788,300	7	$17,227,800
Industrial	12	$37,035,200	29	$60,228,200
Non-Profit	1	$6,613,700	4	$7,842,600
Cemetery	1	$68,136,500	1	$68,136,500
Charitable			2	$7,340,600
Hotel/Motel			1	$6,913,900
Mixed Use			2	$701,500
College/University	9	$72,308,800	15	$105,653,600
Dams				
Energy/Utility	2	$9,351,100	4	$11,894,700
Emergency Response				
Federal				
Hazardous Materials	1	$2,912,400	2	$6,201,900
Healthcare/Hospitals	6	$222,105,500	7	$224,901,500
Ports	22	$54,431,000	27	$65,922,900
Public Assembly				
Schools				
Shelters				
State	5	$3,125,700	10	$4,118,000
Transportation				
Water Infrastructure				
Wastewater Infrastructure	1	$6,217,200	6	$16,439,300
Missing Data	9		8	
Total	**46**	**$526,150,700**	**216**	**$656,561,700**

Source: City of Providence Geographic Information System dataset.

Table 2.28 Total Vulnerability Total Vulnerability Hurricane Categories 3 and 4 Inundation Areas

Land Use	No. of Parcels Impacted	Total Value	No. of Parcels Impacted	Total Value
Hurricane Category	**Category 3**		**Category 4**	
Residential	133	$45,535,000	1,578	$689,440,400
Commercial	63	$42,042,200	431	$361,793,500
Office	17	$17,277,800	254	$553,706,200
Industrial	30	$60,545,400	179	$159,242,800
Non-Profit	4	$7,842,600	10	$24,399,400
Cemetery	1	$68,136,500	1	$68,136,500
Charitable	5	$7,809,200	16	$14,838,800
Hotel/Motel	1	$6,913,900	7	$173,320,300
Mixed Use	3	$1,038,100	61	$34,475,000
College/University	16	$105,768,600	99	$764,954,530
Dams			3	$132,780,300
Energy/Utility	7	$686,357,100	10	$689,415,000
Emergency Response			4	$19,380,301
Federal			5	$112,854,701
Hazardous Materials	2	$6,201,900	4	$10,358,100
Healthcare/Hospitals	75	$258,898,300	95	$820,999,600
Ports	30	$73,388,600	30	$73,388,600
Public Assembly			48	$1,005,999,800
Schools	1	$19,646,300	10	$85,749,900
Shelters				$79,368,800
State	12	$5,068,100	38	$11,455,300
Transportation			22	$0
Water Infrastructure				
Wastewater Infrastructure	8	$17,741,800	17	$38,922,100
Missing Data	3		51	
Total	**411**	**$1,430,211,400**	**2,973**	**$5,924,979,932**

Source: City of Providence Geographic Information System dataset.

Impacts of Business Interruption

Notwithstanding the obvious costs of commercial property damage, the impacts of potential business interruption from a natural, human-caused, or technologic disaster in Providence cannot be under estimated. Business closures result in a reduction of revenues to proprietors and a loss of wages to employees. In addition, state and local tax revenues can be significantly reduced. In addition to the costs of commercial

property damage, the impacts from potential business interruption following a disaster in Providence could have long-lasting effects on the local economy, quality of life, and sense of place that has been maintained and revered for generations.

2.4.3 Social Vulnerability

A critical step in assessing risk and vulnerability of Providence to natural, human-caused, and technologic hazards is to identify the links between the potential destructive impacts to the built and natural environments and that relationship to the social structure. The social assets/potential losses continue to be key components of the community and include the closure of institutions, loss of vital services (communication, transportation, and utility systems), disruption in the movement of goods and services, and emotional strain from financial and physical losses.

The vulnerability of a community obviously includes the potential for direct damage to residential, commercial and industrial property, as well as, schools, government and critical facilities. However, it also includes the potential for disruption of communication and transportation following disasters. Any disruption to the infrastructure, such as a loss of electric power or break in gas lines, can interrupt businesses and cause stress to affected families. This is especially the case where residents are forced to evacuate their homes and become subject to shortages of basic supplies.

Public Infrastructure and Emergency Life Lines
As previously stated in Section 2.3.10, infrastructure failure is considered any disruption to critical infrastructure that could have cascading effects that negatively impact a community's security, public health and safety, and economic vitality (Table 2.29). Review of the various vulnerability analyses conducted across several projected scenarios indicates the vulnerability of many critical facilities, including healthcare/hospitals, colleges/universities, ports, emergency services, energy/utilities, hazardous materials, and wastewater infrastructure. A range of mitigation actions will be necessary to remediate these potential threats across the primary lifeline sectors.

Table 2.29 Lifeline Sectors Impacted by Infrastructure Failure

Lifeline	Description
Communications	An integral component of the underlying operations of all businesses, public safety organizations, and government. Communications (e.g., phone, cable, Internet) infrastructure can also be affected through loss of power to system components or direct physical damage to system components caused by natural disaster or intentional acts. Failure of communications infrastructure would impact all facets of public and private life within Rhode Island.
Emergency Services	Disruption of emergency services (police, fire, emergency management, public works, and emergency medical services), could inhibit response, which could have cascading impacts to include serious injury or death to those who do not receive emergency services.
Energy	Is uniquely critical because it provides and enables the functionality of all infrastructure sectors. Failure of this component would have direct and sizeable cascading impacts on the community, public and private sectors, government, and first responders.
Information Technology	Central to security, economy, and public health and safety as businesses, governments, academia, and private community members. As Rhode Island becomes increasingly dependent upon technological functions for communications and operations, failure off this system would be catastrophic.
Transportation Systems	Incidents become critical when they negatively impact or affect critical infrastructure dependent on transportation systems for operations. Transportation incidents which would have a direct and sizeable impact on Rhode Island would include those that affect transportation and energy systems, defense installations, banking and financial assets, water supplies, chemical plants, food and agricultural resources, police and fire departments, hospitals and public health systems, and government offices.
Water and Wastewater Systems	Water distribution can be affected in three ways: the amount of water available; the quality of the water; and the viability of the physical components of the distribution systems. Contamination of the water supply can occur naturally, as a result of human error, or intentionally. Occasionally, the release of agricultural run-off, manure or other farming byproducts can contaminate water. Accidents resulting in hazardous material spills can also adversely affect groundwater. Disruption to the distribution system can occur because of loss of power to pumping and treatment stations; it can also be caused by direct physical damage to pump and treatment stations caused either by natural disaster or intentional acts. Lack of access to safe drinking water would pose a direct public health incident. Because a large percentage of wastewater treatment facilities dispose of their sewage sludge via trucking to Woonsocket or Cranston's wastewater facilities, a disruption of interstate and/or some local transportation systems could impact wastewater treatment operations.

Source: State of Rhode Island 2018 State Hazard Mitigation Plan.

Historical and Cultural Resource Areas

Another component of the social vulnerability includes the long-standing 'sense of place' or cultural traditions associated with the City of Providence. The city is characterized by several outstanding features: its topography and open spaces, its waterways and shoreline, its unique scale in terms of buildings and population, the many respected private and public learning and health institutions, and its history and historically-

significant architecture. Equally prominent is its proximity to a variety of economic, recreational, and cultural areas, including the cities of Boston and New York, the Atlantic Ocean, and the mountains in northern New England, all adding to the significance of Providence as the capital city of the state of Rhode Island.[46] A significant hurricane with flooding would impact many of the historic properties and cultural resources within Providence. It is important to balance mitigation in a manner that is consistent with historical preservation policies and laws.

Evacuation/Population at Risk

The use of mass care facilities during an emergency is dependent on a variety of circumstances. These include warning time, public awareness of the hazard, the level of encouragement from public officials, and the availability of shelters. The City of Providence uses a co-sheltering strategy that brings together the general population, which includes individuals with non-medical special needs and unattended children in each facility. The appropriate agencies will be present at each facility to provide their services, including the Rhode Island Chapter of the American Red Cross (ARC-RI), Aramark, Salvation Army, Child and Family Services (CFSA) for unattended children, and other special needs services.[47] Shelter use is not easily predicted because each emergency situation has different variables such as the length of the warning period, official encouragement of the evacuation, public awareness of the location and availability of shelter, and the severity of the approaching hazard. Shelter use may be higher in the winter, such as an ice storm, since homes would be without heat.

Of the city's estimated population of 180,393, it is anticipated that approximately 18,039+ will evacuate and 162,354 will remain in place. Of the evacuating 18,039, it is estimated that one-third (or 6,013 residents) will seek some sort of short-term shelter, and one-half (3,007) will require long-term sheltering in the city (Table 2.30). These statistics are based on the number of residents that would be affected by the predicted category 3 hurricane storm surge from the Providence Port traveling up the Providence and Seekonk Rivers and inundating the 100-year floodplain in the city.

Table 2.30 Shelter Capacity Roll-Up

American Red Cross Hurricane Certified Shelters				
Shelter Name	Square Footage	Short Term Capacity (20 SF/Person)	Long Term Capacity (40 SF/Person	Address
Springfield Middle School	6,000	300	150	152 Springfield St.
Levington Complex	8,000	300	150	152 Springfield St.
B. Jae Clanton Elementary	7,800	390	195	672 Prairie Ave.
Mount Pleasant High	10,431	521	260	434 Mount Pleasant Ave.
Hope High School	10,000	500	250	324 Hope Street

[46] Ibid, page 19.

[47] Providence Shelter data and Red Cross standards taken from City of Providence all Hazard Gap Analysis Plan September 9, 2010 (not available for public distribution).

American Red Cross Hurricane Certified Shelters				
Shelter Name	Square Footage	Short Term Capacity (20 SF/Person)	Long Term Capacity (40 SF/Person	Address
Neutaconkanut Rec. Center	11,000	550	275	675 Plainfield St.
Providence Career and Technical	56,000	2,800	1,400	91 Fricker Street
Anthony Carnevale, Jr. Elementary	3,200	160	80	50 Springfield Street
Subtotal	**112,431**	**5,622**	**2,811**	
Spaces Required for Short Term		**6,013**		
Spaces Required for Long Term			**3,007**	
Shortage (-) / Overage (+)		**-391**	**-196**	
City Shelters				
Shelter Name	Square Footage	Short Term Capacity (20 SF/Person)	Long Term Capacity (40 SF/Person	Address
Wheeler Academy	12,822	641	320	216 Hope Street
Samuel W. Bridgham Middle	2,000	100	50	1655 Westminster Street
Robert Bailey, III Elementary	2,000	100	50	65 Gordon Avenue
Pleasant View Elementary	2,000	100	50	50 Obadiah Brown Rd.
George J. West Elementary School	3,000	150	75	145 Beaufort Street
Martin Luther King Elementary	2,000	100	50	33 Camp Street
Gilbert Stuart Middle School	3,000	150	75	188 Princeton Avenue
Subtotal	**26,822**	**1,341**	**671**	
Total	**139,253**	**6,963**	**3,481**	
Spaces Required for Short Term		**6,013**		
Spaces Required for Long Term			**3,007**	
Shortage (-) / Overage (+)		**950 (surplus)**	**474 (surplus)**	

Source: Providence Emergency Management Agency, 2018.

The City of Providence's capability to accommodate 5,800 people sheltering is more than adequate. In fact, with the addition of the Providence Career and Technical Academy, there is a surplus in both short-term capacity (+950) and long-term capacity (+474). PEMA has a clearly outlined plan to accommodate most aspects of emergency sheltering. There are 6,963 shelter spaces among eight shelters as designated by the National ARC standards for Certified Hurricane Shelters. However, there are also seven other facilities designated as public general population shelters.

2.4.4 Environmental Vulnerability

Natural, human, and technologic-related hazards can all have impacts on the natural and built environment. For natural hazards, differences in a variety of factors make for high variability in impacts and related costs. These would include storm size, speed of movement, wind speeds, storm surge heights, timing with respect to tides, and landfall location relative to vulnerable resources. Human-caused hazards, such as a biological or chemical incident, can vary significantly dependent upon the type and amount of the material released, proximity to populations or environmentally sensitive areas, and existing environmental conditions such as wind velocity and direction and sunlight. Technologic-related incidents, such as a disruption of lifeline systems, can result in cascading negative impacts to both the natural and built environment.

When the natural environment is impacted, there are both direct and indirect costs. Impacts to the natural environment can include both direct (loss of habitat and salinization of land/ groundwater) and indirect costs (widespread inland damage to built environment, threats to ecosystems and species, and contamination of potable water supply).

2.5 FEMA Disaster Grant Assistance

FEMA has provided the City of Providence with approximately $998,201.00 in grant assistance in recent years for the following disasters:

- Disaster Number: 4107
  $ 438,416.55
  Main Items for Funding Provided for:
  - Snow removal costs
  - Sand/Salt costs
  - Personnel overtime costs (Department of Public Works (DPW))
  - Snow removal contractors/Fire Department costs
- Disaster Number: 4212
  $ 559,884.32
  Main Items for Funding Provided for:
  - Snow removal costs
  - Sand/Salt costs
  - Personnel overtime costs (DPW)
  - Snow removal contractors/Fire Department costs

Section 3 Capability Assessment

3.1 Introduction

The Capabilities Assessment section has been structured to better document local, state, and federal department, agency, and program capabilities in terms of pre- and post-disaster activities. It has been organized into three main sections: Planning and Regulatory Capabilities, Administrative and Technical Capabilities, and Financial Capabilities to better define the programs, policies, and funding opportunities each department or agency is implementing to reduce risk and work towards implementing hazard mitigation programs targeted at increased resiliency.

The City of Providence implements several hazard mitigation policies and procedures, state laws, executive orders, and regulations to promote the safety of its residents and minimize risk to community assets. This section presents a brief description of each of the primary mitigation programs currently in place.

3.2 Planning and Regulatory Capabilities

Providence Tomorrow: The Comprehensive Plan
The Comprehensive Plan is a 20-year Comprehensive Plan that outlines goals, policies, issues, and actions formulated by assessing the changing conditions and needs over the next 20 years. In 2014, the City adopted an updated Comprehensive Plan, which includes many of the mitigation actions included in the 2013 Hazard Mitigation Plan, still relevant for this 2019 Update. Moving forward, the City will integrate new mitigation actions from this 2019 Update into the next update of the Comprehensive Plan.

<u>Sustainability and the Environment</u>

- Goal 1 – Protect and preserve the natural environment and strive to make Providence a "green", sustainable city.
    - Objective SE1 – Climate Protection and Air Quality. Implement measures to mitigate the effects of global warming and SRL and improve air quality.
    - Objective SE2 – Nature and the City. Promote environmental sustainability and the stewardship of natural resources.
    - Objective SE3 – Resource Conservation. Conserve resources, including water, energy and materials, and plan for the long-term needs of the city and region.
    - Objective SE4 – Sustainability and the Built Environment. Promote and implement environmentally sustainable design and development.
    - Objective SE5 – Public Awareness. Promote environmental sustainability by educating and encouraging residents and business owners and managers to adopt environmentally sound practices.
    - Objective SE7 – The Environment and the Region. Coordinate local planning, education and implementation efforts with the efforts and resources of neighboring communities, the state and the federal

government to address issues of regional sustainability, including transit and alternative transportation; air and water quality; brownfields remediation; flood mitigation and stormwater management; protection of wildlife habitat; composting and recycling; local agriculture and food; and provision of recreation areas and multi-use trail systems and amenities.

The Built Environment

- Goal 2 – Protect, preserve and promote a high-quality built environment.
    - Objective BE6 – Ensure that the City of Providence takes the lead in design excellence and historic preservation.
    - Objective BE8 – Public Awareness. Promote public awareness of urban design and historic preservation principles through education and collaboration with partners and schools.
    - Objective BE10 – The Built Environment and Natural Hazards. Protect the built realm from future natural hazards through proper mitigation of the city's vulnerabilities.

People and Public Spaces

- Goal 7 – Create a sustainable, high-quality parks and recreation system that reflects the unique identity of Providence.
    - Objective PS2 – Sustain our Park and Recreation Assets. Provide the necessary resources to build and maintain a park and recreation system that offers a diversity of recreational opportunities for all residents.
    - Objective PS5 – Stewardship of Resources. Protect natural and cultural resources by incorporating them into the fabric of an overall system of public open space.

Community Services and Facilities

- Goal 8 – Sustain a high quality of life by providing efficient, cost-effective city services.
    - Objective CS2 – Police, Fire and Public Safety. Ensure the safety and welfare of residents by providing fire and police protection and adequate resources and knowledge to perform the vital services.
    - Objective CS3 – Sustain a high quality of life by providing efficient, cost-effective city services, Emergency Management. Minimize damage to property, life and resources from natural or man-made emergencies.
    - Objective CS8 – Energy. Provide for the energy needs of City residents and the State by supporting the expansion of these utilities in a way that lessens the impact on the environment.

Land Use

- Goal 11 – Promote a balance of uses to support sustainable patterns of development providing healthy, walkable neighborhoods, thriving business districts, and a high quality of life.

- Objective LU6 – Maintain and Enhance Open Spaces and Civic Areas. Preserve and protect Providence's open and public spaces to enhance the overall quality of life for city residents.
- Objective LU8 – Sustainability and the Environment. Promote sustainability and environmental quality through appropriate land use controls.
- Objective LU15 – Land Use and the Region. Work with the State of Rhode Island and neighboring communities to promote the smart, efficient and equitable use of land.

The Waterfront

- Goal 10 – Strengthen Providence's waterfront as the city's primary economic, cultural and natural resource.
  - Objective W1 – Protect the long-term viability and sustainability of Narragansett Bay as an economic, cultural and natural resource through the development of appropriate plans and regulations.
  - Objective W2 – Sustainability and the Environment. Maintain and improve the ecological health and functions of Narragansett Bay.
  - Objective W3 – Built Environment. Develop the full potential of the Narragansett Bay waterfront in a way that showcases design excellence, enhancing the Bay's unique aesthetic qualities and maritime character, and creating visual and physical access to the water.
  - Objective W10 – Rivers. Improve the water quality and riparian buffers along the city's rivers while improving access to the riverfront for all city residents.
  - Objective W11 – Ponds. Improve the water quality of ponds throughout the city to improve their value as recreation areas and wildlife habitat.

Flood Zone Management

The City of Providence elects to comply with the requirements of the National Flood Insurance Act of 1968 (P.L. 90-488, as amended). It also references Use Regulations in Article IX of the City of Providence Code of Ordinances (Sections 5-121 through 5-125), which includes additional floodplain management measures to ensure public safety, minimize hazards to persons and property from flooding, protect watercourses from encroachment, and maintain capability of floodplains to retain and carry off floodwaters.

The Inspection and Standards Department is the designated floodplain management agency for the city and oversees the adoption and maintenance of flood zone regulations and the FIRMs in collaboration with other departments according to NFIP and FEMA regulations. Special Flood Hazard Areas regulations were amended in 2009 (Section 423 of the Zoning Ordinance) along with the adoption of new digitized FIRMs. The maps are updated every few years to reflect new information and are developed in consultation with City staff. This process includes the Hazards US (HAZUS) and Risk MAP projects and periodic meetings with planning, emergency management and other City staff. The FIRM and FIS reports and any revisions and amendments are on file with

the City Clerk, Department of Planning and Development, Building Official, PEMA, and Department of Inspection and Standards.

The Division of Structures and Zoning within Inspection and Standards is charged with issuing zoning certificates, building and demolition permits, review and approval of plans, building inspections, the issuance of certificate of occupancy, compliance with the building codes as mandated by the State of Rhode Island, and issuance of notice of violation when a building is not in compliance with the building codes or zoning ordinance.

The USACE conducted a four-municipality *Woonasquatucket Flood Reconnaissance Study*, a preliminary study of conditions to address implementation strategies for flood control and mitigation, particularly in the Olneyville and Valley neighborhoods.

Floodplain/Special Flood Hazard Areas
Floodplains are important natural features providing extra storage capacity during storms too large to be accommodated by a river or water body or too great to be absorbed into the ground. The City of Providence is subject to flooding partly due to the funnel-like shape of Narragansett Bay, which amplifies the height of a storm surge as it moves up the Bay, resulting in the highest flood levels in the state occurring along the Providence River. To address this problem the FPHB was built at Fox Point in 1966 to protect the downtown area. The barrier requires frequent maintenance and improvement. In 2010, the USACE assumed control of the water side of operations of Hurricane Barrier, while the city assumed land-side operations.

Floodplain areas cover certain areas of the city and are influenced by:

- Hurricanes and strong storms along the waterfront in areas not protected by the Hurricane Barrier at Fox Point; and
- Overflow from rivers and ponds and the accumulation of water in depressed areas due to sustained heavy rainfall and/or melting snow.

The special flood hazard areas are established as a floodplain overlay district. The district includes all special flood hazard areas within the City of Providence designated as Zone A, AE, AH, AO, A99, V, or VE on the Providence County FIRM and Digital FIRM issued by FEMA for the administration of the NFIP. The exact boundaries of the special flood district may be defined by the 100-year base flood elevations shown on the FIRM and further defined by the Providence County FIS report dated October 2, 2015.

FEMA "modernized" FIRMs in 2007 and delineated eight flood zone classifications. The maps are now GIS-based, more publicly accessible, and user-friendly. The new maps do not include new data, however, and an update is expected within the decade. The maps are on file in the Providence Department of Planning and Development. The Floodplain Management Guidelines (43 FR 6030) establish specific requirements of compliance with Executive Order 11988 by all federal agencies. Before any development may commence, the significance of a floodplain must be determined.

Therefore, projects must conform with or significantly outweigh the following requirements of:

- Avoid direct or indirect support of floodplain development wherever a practicable alternative exists,
- Reduce the risk of flood loss,
- Minimize the impact of floods on human safety, health and welfare, and
- Restore and preserve the natural and beneficial floodplain values.

All development in Providence, including structural and non-structural activities, whether permitted by right or by special permit, must comply with the following:

- RI State Building Code,
- Coastal Resources Management Act,
- Endangered Species Act,
- Freshwater Wetlands Act, and
- Minimum standards related to Individual Sewage Disposal Systems (ISDS) and water quality regulations.

The NFIP Special Flood Hazard Area requires permits for all projects that meet the definition of development, not just "building" projects. Development projects include any filling, grading, excavation, mining, drilling, storage of materials, and temporary stream crossings. If the construction or other development within a special flood hazard area is not covered by a building permit, all other non-structural activities is permitted by either the CRMC and/or RIDEM, as applicable. Therefore, if another state agency issues a permit, the local building official has the opportunity for input and keeps a copy of the respective permit in their files. If alteration to a river is proposed or a river will be impacted by a project, the building official will collaborate with adjacent communities/ bordering states (optional), RIEMA NFIP State Coordinator, and FEMA Risk Analysis Branch for any alteration or relocation of a watercourse.

Article VII Soil Erosion and Sediment Control Ordinance
The City Council found that excessive quantities of soil are eroding from certain areas that are undergoing development for non-agricultural uses such as housing developments, industrial areas, recreational facilities, and roads. This erosion makes necessary costly repairs to gullies, washed out fills, roads, and embankments. The resulting sediment clogs the stormwaters and road ditches, muddies streams, and deposits silt in ponds and reservoirs. Sediment is considered a major water pollutant.

The purpose of this ordinance is to prevent soil erosion and sedimentation from occurring as a result of non-agricultural development within the city by requiring proper provisions for water disposal, construction waste disposal and the protection of soil surfaces during and after construction, in order to promote the safety, public health and general welfare of the city. These types of developments are required to submit a plan

prepared by a professional engineer for approval and are subject to inspections during construction.

Stormwater Management
Municipal staff participated in review of the 2009 *Rhode Island Stormwater Design and Installation Standards Manual* and related low impact development (LID) Guidelines, emphasizing the urban perspective. Innovative approaches to managing a decaying and overburdened stormwater system are encouraged in the *Providence Tomorrow The Comprehensive Plan* and grant funding sources for implementation continue to be sought.

The City of Providence is one of 32 Rhode Island municipalities located completely or partially in an urbanized area automatically designated under the Phase II program. In Rhode Island, Phase II regulated communities will be required to apply for a Rhode Island Pollutant Discharge Elimination System (RIPDES) permit which will be issued by RIDEM. These communities will be required to reduce the discharge of pollutants from their storm sewer systems to the "maximum extent practicable" to protect water quality.

In the City of Providence, the Engineering Division is responsible for coordinating the City's *Stormwater Management Plan* in conformance with the requirements of RIPDES. The City has the authority and discretion to invoke penalties and/or impose a lien whenever a stormwater management facility is not implemented, operated, and/or maintained in accordance with its approval and Article VI. Any penalty invoked shall be in accordance with this section.

All applicants are required to develop and submit a stormwater management plan. These plans must address stormwater management on a site-by-site basis and all requirements of this article. All stormwater management practices must be consistent with the *Rhode Island Stormwater Design and Installation Standards Manual* and the *Rhode Island Soil Erosion and Sediment Control Handbook*, as amended. This includes demonstrating that a proposed project provides for protection of life and property from flooding and flood flows. Water quantities must be controlled in accordance with the manual and handbook or a municipally approved regional stormwater management plan for the watershed in which the project site is located. Project stormwater management plans must include the following standards:

- Control and maintenance of post-development peak discharge rates from the two-year, 10-year, 25-year, and 100-year storm events and predevelopment levels.
- Downstream analysis of the one hundred-year storm event and control of the peak discharge rate for the 100-year storm to mitigate significant downstream impacts.
- Discharge from any stormwater facility must be conveyed through properly constructed conveyance system to provide for non-erosive flows during all storm events. The proposed stormwater conveyance system consisting of open

channels, pipes, and other conveyance devices shall at a minimum accommodate the runoff from a 25-year storm event. The stormwater conveyance system must provide for non-erosive flows to receiving waters.

Recently, the NBC's Phase II program contracted to control CSOs within NBC's district. The primary objective of this project was to provide flow reduction and capacity modifications to reduce overflows to less than four events per year. The project included the installation of approximately 40,000 linear feet of new storm drains, including new catch basins and drainage manholes. New catch basins have been installed to replace existing catch basins. To enhance the quality of the water prior to discharge, the catch basins utilize four-foot sumps and incorporate water quality hoods. The project also included installation of approximately 18,000 linear feet of new water mains.

The work included curb to curb roadway resurfacing/pavement rehabilitation for 38 streets within the entire project area, including North Main Street (Route 1) a major arterial and collector roadway such as Hope Street and Blackstone Boulevard. Pavement markings, curbing, and sidewalk areas impacted by the utility installations have been restored in accordance with city standards. The project involved extensive coordination with local and state agencies including the City of Providence, RIDEM, RIDOT, various utility companies, and Miriam Hospital.

Zoning Ordinance

The City of Providence Zoning Ordinance regulates the use of land in the city. Examples of when special approvals may be required are when a project is in an overlay district such as the Capital Center District, or if a project requires a subdivision of land. If a project is not consistent with the ordinance, a property owner may apply for a special use permit or variance from the Zoning Board of Review. The Department of Inspection and Standards administers zoning conformance and can guide property owners through this process. Even if a property owner does not require any special permits or board reviews, the Department must still review building plans to confirm that they are compliant with the Zoning Ordinance. Once it is confirmed that a project is conformant with zoning, the permitting process moves into the plan review phase, where one applies for a building permit.

The City Plan Commission is responsible to ensure that subdivision, land development projects, and institutional master plans are consistent with the Comprehensive Plan. No public or private improvement, project or subdivision, or zoning ordinance can be initiated or adopted unless it conforms to the Comprehensive Plan.

Rhode Island Climate Change Commission November 2012 Report

The Rhode Island Climate Change Commission recognized of the coming change with impacts to the State's natural resources and infrastructure and worked with a range of stakeholders from Rhode Island's public and private sectors, including environmental researchers and advocacy representatives and State and local housing organizations, to plan for the state. The Commission released its November 2012 report, which is a summary of the risks of climate change to the state and points of weakness in

infrastructure critical for state and local officials to make thoughtful and informed policy decisions.

Planning for Climate Change
Municipal staff participate regularly in conferences and workshops on climate change and SLR, which allows them to continuously amend the Comprehensive Plan to improve public and private practices related to these issues. They also give presentations on planning for climate change in the community and region.

The City of Providence participates in the Global Covenant of Mayors, previously known as Compact of Mayors, a global coalition of city leaders addressing climate change by pledging to cut greenhouse gas emissions and prepare for the future impacts of climate change. Mayor Elorza was an early signatory to this effort (85th in the world, and number 11 in North America). Providence joined in the summer of 2015, and with that, committed to developing a greenhouse gas inventory, assess climate risks and vulnerabilities of the city, define climate mitigation targets, and create a climate action plan. The City of Providence reports progress through the Carbon Disclosure Project which provides the global platform for cities to measure, manage and disclose their environmental data.

Historic Preservation Planning
The Department of Planning and Development strives to preserve the historic buildings, districts and areas that contribute positively to Providence's urban fabric. Historic preservation planning covers a wide range of issues, including, but not limited to, the protection and preservation of historic resources citywide using design standards, historic district zoning and other tools.

Many of the historical buildings in the flood zone have not been brought up to current floodplain standards and this is one of the City's main concerns.

Narragansett Bay Commission (NBC) Emergency Operations Plan
As the primary wastewater manager in the city and situated along the waterfront, the NBC's focus has been on resilience planning. Recently, the *Implications of Climate Change for RI Wastewater Collection & Treatment Infrastructure* study included several alternatives to ensure the facility's resilience such as hardening of the shoreline, protection of power supply, and reducing recovery time. No future expansion plans exist, as the facility is built out.

Providence Water
Providence Water is the largest water utility provider in Rhode Island, and primary supplier for the City of Providence. The Water System Supply Management Plan has been updated since 2013 and includes an Emergency Response Plan that identifies vulnerability, criticality, and response. All operations are on Supervisory Control and Data Acquisition , a system of software and hardware elements that allows industrial organizations to control industrial processes locally or at remote locations, and monitor,

gather, and process real-time data. Security and cyber threat plans are currently in development. Additional capabilities include the following:

- 800 Mhz radio exercises with Rhode Island National Guard
- Table Top Exercises with State Cyber Team
- 120 million gallons of storage (2 days of supply)
- CodeRed: customer notification system
- Hurricanes: employ proactive response and pull flashboards out to handle flows and transfer to generator power prior to a storm
- Blizzards: plow their own facilities to ensure fuel supply to specific sites

Waterson Terminal Services
As the ProvPort facility manager, Waterson Terminal Services views wind- and flood-related impacts to infrastructure as the primary issues since 2013. Expansion plans are in the works for additional storage locations, with the anticipation of one to two additional parcels over the next two years. During hazard events, port assets are made available to the city (heavy machinery, crane equipment, rail access, access to trucks, etc.).

Rhode Island Sea Grant Fact Sheets/Climate Change Science Summary
Rhode Island Sea Grant (RISG), collaborating with scientists from the University of Rhode Island and other institutions, continue to better understand the science and policy implications of climate change. Recognized as a leader within the state, and region overall, RISG helps decision makers at both the State and local level regarding vulnerability and risk reduction. Specifically, RISG has developed fact sheets to highlight impacts to the built environment, public health and welfare, and natural resources which include: *Precipitation and Storms in Rhode Island: Trends and Impacts*; and *Sea Level Rise in Rhode Island: Trends and Impacts*. RISG has also developed the climate change science summary, *Climate Change: Rhode Island's Coasts*, while also gathering additional climate data through two municipal projects in North Kingstown and Newport.

Adapting to Climate Change: A Planning Guide for State Coastal Managers, National Oceanographic and Atmospheric Administration
Federal resources such as the NOAA Office of Ocean and Coastal Resource Management and USGS continue to provide guidance on adaptation planning for states. NOAA's *Adapting to Climate Change: A Planning Guide for State Coastal Managers* is a valuable resource relative to the proximity of infrastructure adjacent to Rhode Island's coast.

Recommendations for Management of the Woonasquatucket River & Promenade District[48]
CRMC's Urban Coastal Greenway (UCG) policy applies to the Providence Harbor and broader Metro Bay Region. The leading goals of the UCG policy are to prevent further

[48] CRMC's Urban Coastal Greenway Policy.

degradation of coastal waters by treating stormwater (through vegetative means where possible), to protect and/or restore coastal habitats, and to ensure public access to the urban shoreline while preserving an aesthetically appealing view from both the water and the shore. In addition, the UCG policy offers a mechanism to encourage thoughtful economic development of the Metro Bay Region shoreline in a way that contributes to the CRMC's goals of enhancing the natural, recreational, and industrial history of the region.

CRMC encourages the use of effective, innovative techniques to achieve runoff reduction, pollutant abatement, and hazard mitigation. Accordingly, experimental technologies to achieve these goals may be implemented within the urban coastal greenway, at the discretion of the Council.

The UCG policy uses "managed landscape," defined as a vegetated area within a buffer zone or urban coastal greenway where limited landscaping practices are allowed. These practices may include the removal of non-native invasive plants, restorative plantings of native and sustainable plant species, and the pruning, trimming, and selective cutting of vegetation designed to manage habitat, maintain scenic view-sheds, and preserve shoreline access. Managed landscapes also provide for infiltration of stormwater and the minimization of erosion. The UCG policy encourages LID stormwater management techniques that improve water quality and enhance the developer's ability to maximally utilize an urban lot. Vegetated areas may include green roofs, bioretention areas, or other LID vegetation alternatives.

As noted earlier, all new development and redevelopment proposals in the city must meet stormwater regulations as specified in the most recent edition of the *Rhode Island Stormwater Design and Installation Standards Manual* (250-RICR-150-10-8) to control peak flow rates and volumes, maximize infiltration of runoff, and improve water quality. Critical for the Woonasquatucket River and Promenade District, using LID techniques such as filter strips, vegetated swales, vegetated detention ponds, bioretention areas, stormwater infiltration planters, green roofs, among others, should be incorporated into development and redevelopment projects. Permeable paving materials, vegetated buffers, and infiltration techniques are used wherever feasible to support infiltration and groundwater recharge. Applicants coordinate their stormwater management strategy with the CRMC, RIDEM, and the City of Providence. CRMC and RIDEM will coordinate for compliance with any required RIDEM Water Quality Certification or RIPDES permits.

City of Providence Harbor Management Plan

The Harbor Management Plan is a document which presents the City's goals, objectives, and recommendations for guiding public and private use of the land and water of its tidal waters, which extend inland on the Woonasquatucket River and establishes an implementation program to achieve the desired outcomes. The plan is designed to be useful to the City in determining its priorities for management of the harbor. As a policy document, the plan focuses on the following topics: water quality,

public access, mooring management, and shipping, navigation and multi-use of harbor waters, as well as storm preparedness.[49]

Goals of the Harbor Hazard Mitigation Plan include:

- To prevent the loss of life and property by:
  - Properly preparing for storm events,
  - Having a completed and enforceable response and recovery plan,
  - Working in cooperation with harbor and shoreline users to ensure that a coordinated approach is applied to hazard mitigation,
  - Integrating harbor hazard mitigation activities with other ongoing, local hazard mitigation programs, and
  - Identifying and completing long-term actions to redirect, interact with or avoid the hazard.

The Harbor Management Plan presents a Risk Assessment (Table 3.1) that includes flood/surge and wind threats. It also includes details of a three-level short-term preparedness, response, and recovery plan 72 hours prior to a storm event, or as necessary for unpredictable events. Several long-term mitigation projects were developed and incorporated into Section 4.0 Mitigation Strategy.

Table 3.1 Harbor Management Plan Risk Assessment

Threat	Marine Interest	Effect	Result: Level 1	Result: Level 2
Flood/Surge				
	Main harbor	Wide fetch	Poor holding	
	Moored boats	Decreased scope	Dragging	Threaten bridge
	Marina facility	Flooded facility	Floating debris	Threaten bridge
			Spills of hazardous materials	Threaten surrounding wetlands
		Docks topping pilings	Freed docks and boats	
	Private residences	Flooded property		
Wind				
	Moored boats	Windage	Dragging or pennant breakage	
	Marina facility	Windborne debris	Structural damage	

Source: City of Providence Harbor Management Plan, page 85.

[49] City of Providence Harbor Management Plan, page 2.

The following goals, objectives, and actions are included in the Harbor Management Plan:

Water Quality

Goal: Maintain and improve the water quality of Providence Harbor and rivers within and contributing to the harbor management area.

Objective 2: Support and enforce policies, designations, regulations, and initiatives that protect and improve water quality and critical habitat.

Action 8: Develop erosion mitigation strategies for shoreline areas including India Point, Richmond Square, and the Seekonk River along River Drive, and promote living shorelines along currently hardened shoreline where appropriate and feasible.

Objective 3: Promote water quality improvements through improved wastewater treatment, stormwater management, and investment in 'green' infrastructure projects.

Action 1: Support efforts to improve the stormwater system that drains into York Pond, just inland of the Seekonk River. Current conditions contribute to erosion of the riverbank, flooding, and water quality impacts.

Action 2: Support funding for citywide stormwater management programs, including the potential development and implementation of a stormwater enterprise fund.

Objective 4: Promote resiliency, protection of water quality, compatible mixed use, and economic vitality in the port area.

Action 2: Require all port area operators and businesses to comply with hazard mitigation and debris management regulations.

Action 3: Work with the Harbormaster and others to manage the cleanup of large debris after storms, including derelict vessels, damaged and derelict piers, and downed tree limbs.

Shipping, Navigation and Multi-Use of Harbor Water Policies and Implementation

Goal: Provide for safe and efficient navigation by all commercial and recreational users of City waters.

Objective 2: Develop regulations, policies and initiatives to address compatible and safe use of harbor waters by a variety of users.

Action 6: Incorporate sea level projections into the construction of bridges and other structures in flood zones and vulnerable waterfront areas.

State of Rhode Island

Office of Energy Resources[50]

The 2014 Resilient Rhode Island Act established the EC4. It also set specific greenhouse gas emissions reduction targets, established an advisory board and a science and technical advisory board to assist the Council, and incorporated

[50] http://www.energy.ri.gov/policies-programs/ri-energy-laws/resilient-rhode-island-act-2014.php

consideration of climate change impacts into the powers and duties of all state agencies. The EC_4 is charged with developing and tracking the implementation of a plan to achieve greenhouse gas emissions reductions below 1990 levels of: 10% by 2020; 45% by 2035; and 80% by 2050.

Coastal Resources Management Council (CRMC)[51]

The CRMC plans for and manages the coastal resources of the state. The Coastal Resources Management Program (CRMP) contains numerous policies and programs for the protection of coastal resources, including coastal wetlands and other shoreline features (e.g., beaches, and dunes). CRMC has statutory authority to restrict the alteration of coastal wetlands for preservation purposes, and to implement regulations requiring erosion setbacks, coastal buffer zones and to prohibit construction on beaches, in dunes, and on barrier spits that are identified as undeveloped or moderately-developed.

CRMC currently employs coastal policy analysts, a coastal geologist, and a marine resources specialist who are assigned to analyze climate change and SLR issues, shoreline change, beneficial re-use of sediment, and wetlands restoration. In addition, The CRMC Executive Director spends a significant amount of time in the development of coastal hazard analysis tools and engagement with stakeholders. Technical support is provided to other state agencies and municipalities related to CRMC programs, including SAMPs, stormwater design and installation, and coastal and estuarine land conservation. Additionally, CRMC provides technical assistance through membership of EC_4 and the EC_4 Science Subcommittee.

CRMC has several ongoing partnerships to reduce risks from coastal hazards and for public education and outreach. Some specific projects include:

- Working with federal, state and local agencies for post-hurricane Sandy recovery initiatives,
- Partnering with statewide and local planners, URI, GIS coordinators, and RISG to develop tools for determining vulnerability to present and future coastal flooding scenarios from storm surge and SRL. For example, STORMTOOLS, Coastal Environmental Risk Index (CERI) and Substantial Damage Estimation (SDE) Maps, and
- Coordinating the Rhode Island Habitat Restoration Team, comprised of partners from local, state, and federal governments as well as non-profit and educational organizations.

In addition, CRMC staff give numerous presentations to professional groups and the public on coastal hazards, climate change adaptation, coastal habitat restoration, and other topics.

[51] State of Rhode Island 2018 State Hazard Mitigation Plan, page 4-19.

The CRMC recently adopted a new Shoreline Change (Beach) SAMP to assess flood inundation coupled with SLR and shoreline erosion, to better inform planning efforts and decision-making to enhance community resilience. It also includes a Coastal Hazard Application Process that will be implemented by regulatory amendments to the CRMC's Red Book to address the coastal hazard issues detailed in the Beach SAMP chapters.

National Grid
Gas Infrastructure, Safety, and Reliability Plan (Gas ISR) FY 2020 Proposal
In consultation with the Rhode Island Division of Public Utilities and Carriers, National Grid has released the Gas ISR Plan to address capital spending on gas infrastructure and other costs related to maintaining the safety and reliability of the utility's gas distribution system, as per R.I. General laws §39-1-27.7.1.

3.3 Administrative and Technical Capabilities

City of Providence Municipal Administration and Staff
Warning Systems
Providence Metro Port Area Chemical Biological Radiological Nuclear Detection System
The purpose of Providence Metro Port Area Chemical Biological Radiological Nuclear (CBRN) Detection System is to provide continuous 24x7 MDA of the CBRN environment at, in and adjacent to the Port of Providence. Phase I detectors include Chemical Warfare Agent (CWA) and Toxic Industrial Chemical Detection (TIC) detection. There are three sensor suites for wide area CWA/TIC monitoring. These sensors will offer chemical protection system to include early warning and decision support. The system will be compatible with the currently operational Rhode Island Common Operating Picture (RICOP) and will integrate visual verification to sensor alerts for instant situational awareness. The system will integrate remote sensor data, produce dispersion models, send out alerts and initiate protective responses. The goal will be to substantially reduce the time it takes for the operator to understand and respond to a CBRN release.

Port of Providence Emergency Siren Warning System
The siren system is intended to alert workers and residents who are outside their residence or place of work that may not be able to receive a traditional notification. Examples of emergencies where the sirens would likely be activated include a Chemical Spill, Hostile Intruder, or Severe Weather Emergency. Each of the four strategically placed sirens emits a tone of 125 decibels, loud enough to cover a diameter of 5,400 feet. The activation will consist of an alert tone followed by a specific voice message regarding the nature of the emergency. This system operates on the City's legacy VHF Radio system.

NOAA Weather Radio
NOAA Weather Radio All Hazards is a network of radio stations broadcasting continuous weather information directly from a nearby NWS office. It is operated by the NWS, an agency of the NOAA within the U.S. Department of Commerce. NOAA Weather Radio broadcasts NWS warnings, watches, forecasts, and other hazard

information 24 hours a day. It also broadcasts alerts of non-weather emergencies such as national security, natural, environmental, and public through the Federal Communications Commission's (FCC) Emergency Alert System. Providence's NOAA Weather Radio transmitter is on 162.4 MHz. Tone activated receivers are owned by individual community members as well.

Notification Systems

Greater Providence Chamber of Commerce E-Alert

The Greater Providence Chamber of Commerce uses a business-based e-mail system E-Alert. Based on prior coordination with the Chamber approximately 2600 business can be reached in metropolitan Providence.

Providence Emergency Management Agency and Office of Homeland Security (PEMA)

PEMA is charged with protecting the community by coordinating and integrating all activities necessary to build, sustain and improve the capability to mitigate against, prepare for, respond to, and recover from threatened or actual natural disasters, acts of terrorism, or other man-made disasters. PEMA undertakes this mission with clear customer-focus and recognition that people are the most valuable asset. PEMA values the contributions and dedication of the personnel who staff the emergency response and management systems and employs/deploys the best available technologies in support of this mission.

PEMA maintains a wide variety of Memorandums of Understanding (MOUs) and Memorandums of Agreement (MOAs) that cover everything from first response, to non-profits for every emergency management function. PEMA conducts shelter exercises with various groups, coordinates with the Health Equity Zones looking at health issues in vulnerable neighborhoods and conducts public education and outreach programs in the schools. In 2014, PEMA expanded the Emergency Operations center (EOC) increasing capacity to host and share with a variety of partner organizations.

The City of Providence is also a StormReady-certified community. StormReady uses a grassroots approach to help communities develop plans to handle all types of severe weather—from tornadoes to tsunamis. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations.[52]

Emergency Operations Plan (EOP)

PEMA maintains an EOP) that addresses mitigation, preparedness, response, and recovery from a variety of natural, human, and technologic hazards. The Providence EOP is current as of February 15, 2015.

PEMA maintains both primary and secondary EOCs:

[52] https://www.weather.gov/StormReady

- Primary EOC:
    - Providence Emergency Management Agency
- Alternate EOC:
    - Providence Public Safety Complex

The EOC provides a central location where the Mayor, Emergency Support Function (ESF) lead agency representatives, and senior decision makers will gather to provide a coordinated response.

Fox Point Hurricane Barrier Coordination Guide
This Coordination Guide outlines activating and operating the FPHB located in the City of Providence and serves as the focal point for ensuring coordination of the FPHB during a major hurricane or coastal storm between multiple federal, state and local partners. The Coordination Guide has six main objectives:

- Minimize injury and loss of life,
- Minimize property damage and adverse economic impact,
- Minimize adverse environmental impact,
- Engage multiple federal, state and local partners in order to coordinate the operation of the FPHB during severe weather scenarios, abnormal tides/surge and special events,
- Provide awareness for federal, state and local partners about critical areas that are essential and indispensable to the operation of the FPHB, and
- Provide a deliberative coordination tool that facilitates the operation of the FPHB in order to improve operational speed and effectiveness.

All Hazards Debris Management Plan
The *All Hazards Debris Management Plan* ("The Debris Plan") is designed to provide policies, guidance, and lists of resources to the City of Providence for the removal and disposition of debris caused by a major disaster in order to facilitate and coordinate the management of debris to:

- Mitigate against any potential threat to the lives, health, safety, and welfare of the impacted community members in the City of Providence
- Expedite the recovery efforts in the impacted area and to maximize cost recovery for the City of Providence under a Stafford Act Declaration
- Address any threat of significant damage to improved public or private property

CodeRED Notification System
The City of Providence utilizes the CodeRED Emergency Notification System to alert residents, commuters, and businesses in emergency situations. CodeRED allows emergency officials to notify residents and businesses by telephone, cell phone, text message, email, and social media regarding time-sensitive emergency information. Types of emergency messages that people may be alerted to could be Amber Alerts, notifications of hazardous incidents, boil water advisories, evacuation notices, parking

bans, and severe weather alerts. The service is free and easy to sign up for, simply visit the City of Providence website www.providenceri.com or the PEMA website www.readyprov.com and click on the CodeRED feature.

Voluntary Organizations Active in Disasters (VOAD)
In 1970, seven national disaster response organizations convened for the first time to find a way to better coordinate responses and more effectively serve disaster survivors and their communities. As an outcome, National VOAD was formed as a forum for sharing knowledge and coordinating resources, money, materials and manpower throughout the disaster cycle: preparation, response and recovery. PEMA builds mitigation activities with faith-based groups, including the RI ARC and Salvation Army.

Citizens Emergency Response Team (CERT)
The CERT program educates community members about disaster preparedness for hazards that may affect the City of Providence and trains them in basic disaster response skills such as fire safety, light search and rescue, team organization and disaster medical operations. Using the training learned in the classroom and during exercises, CERT members can assist others following an event when professional responders are not immediately available to help, or by taking a more active role in emergency preparedness projects in the community.

Emergency Alert System
The Emergency Alert System (EAS) is a national public warning system that requires broadcasters, cable television systems, wireless cable systems, Satellite Digital Audio Radio Service (SDARS) providers, and Direct Broadcast Satellite (DBS) providers to provide the communications capability to the President to address the American public during a national emergency. The system also may be used by state and local authorities to deliver important emergency information, such as AMBER alerts and weather Emergency Management State Radio System (EMSTARS). When appropriate, Providence can send a short 30 second message directed to the residents of Providence. From the EOC in Providence, Emergency Management can send Civil Emergency Messages (CEM) to the NWS, the State Warning Point (SWP) via the State Warning System (SWS).

Emergency Notification System
The PEMA Emergency Notification System (ENS) enables immediate information dissemination of updates, reminders, and emergencies to the public safety community via various contact methods. The system enables appointed personnel to quickly and easily contact one, several or all individuals via web or telephone interface and distributes notifications via multiple media, including telephones, cell phones, email, pager, and text messaging. The system is capable of recorded voice and text-to-speech notifications, multilingual text-to-speech conversion, pre-defined messages, and recipient acknowledgement.

Sheltering
As noted earlier, the City of Providence uses a co-sheltering strategy that brings together the general population, which includes individuals with non-medical special needs and unattended children in each facility. The proper agencies will be present at each facility to provide their services; these include the ARC-RI, Aramark, Salvation Army, CFSA for unattended children, and other special needs services.[53]

PEMA Emergency Support Function (ESF) Annexes
PEMA maintains several ESF Annexes that provide the structure for coordinating federal interagency support for a local response to an incident. They are mechanisms for grouping functions most frequently used to provide local support during times of disaster or emergency and are in-line with State and Federal support. The ICS provides for the flexibility to assign ESF and other stakeholder resources according to their capabilities, taskings, and requirements to augment and support the other sections of the Providence EOC in order to respond to incidents in a more collaborative and cross-cutting manner. While ESFs are typically assigned to a specific section at the EOC for management purposes, resources may be assigned anywhere within the Unified Command structure. Regardless of the section in which an ESF may reside, that entity works in conjunction with other sections to ensure that appropriate planning and execution of missions occur.

ESF 1 – Transportation: Maintains and re-establishes multi-modal transportation within the City of Providence. It will also coordinate all available and attainable resources needed to address transportation infrastructure concerns. Providence utilizes the principles of the ICS.

ESF 2 – Communications: Provides the City of Providence with provisions for communications support before, during, and after an emergency/disaster situation. ESF 2 coordinates communications assets (both equipment and services) that may be available from a variety of sources (i.e., Providence agencies, volunteer groups, the telecommunications industry, state government agencies, and the National Guard), and communications systems procedures.

ESF 3 - Public Works and Engineering: Provides in a coordinated manner, the resources of ESF 3 agencies to support emergency public works and engineering needs during an emergency or a disaster in the City of Providence.

ESF 4 – Firefighting and Emergency Medical Services: Coordinates all firefighting and emergency medical resources to prepare for, respond to, recover from and mitigate emergency situations. The City of Providence has compiled, identified, and typed all resources available to emergency operations in an appendix to the Providence Resource Management Plan.

[53] Providence Shelter data and Red Cross standards taken from City of Providence all Hazard Gap Analysis Plan September 9, 2010 (not available for public distribution). The numbers associated with the tables were derived using FEMA's Gap Analysis Tool.

ESF 5 - Emergency Management: Ensures that there is a coordinated response to emergency events within Providence. ESF 5 will work with the various Providence departments to ensure that field operations have the necessary resources to complete their mission. Also, ESF 5 will coordinate the acquisition of state and federal resources, as required, through the state EOC.

ESF 6 - Mass Care, Emergency Assistance, Housing, and Human Services: Coordinates local and state assistance in support of local efforts to meet mass care needs of victims and disaster workers involved in a disaster in the City of Providence. This ESF does not command resources, but rather works in cooperation with the governmental and non-governmental organizations that provide mass care to disaster victims and disaster workers.

ESF 7 – Logistics Management and Resource Support: Provides direct and active support to emergency response and recovery efforts during and following a disaster. ESF 7 support includes the locating, procuring, and issuing of resources, including but not limited to, supplies, office space, staging areas, media areas, office equipment, fuels, contracting services, personnel, heavy equipment, generators, and transportation. ESF 7 provides equipment, materials, supplies, emergency relief supplies, space, office equipment, office supplies, telecommunications, contracting services, transportation services, and personnel to the Providence entities for emergency operations. It sets the stage for Providence to continue operations even in the event of an emergency, while being self-sufficient from the local stocks, private sector, and other Providence jurisdictions for up to 72 hours.

ESF 8 – Public Health and Medical Services: Addresses the activities associated with mobilizing and managing public health services in the City of Providence under emergency or disaster conditions. Responsibility for health and medical services is shared between RIDOH, licensed doctors, health care workers, and local Emergency Medical Technicians (EMT) throughout Providence.

ESF 9 – Urban Search and Rescue: Coordinates the use of municipal search and rescue resources in response to actual or potential emergency/disaster events. Because of limited capabilities of the City of Providence in search and rescue, the primary responsibility of ESF 9 is to act as a liaison with cooperating state agencies including Rhode Island Urban Search and Rescue, Rhode Island State Police, and the RIEMA.

ESF 10 – Oil and Hazardous Materials: Responsible for safety measures and precautions that protect the public until a hazardous situation has been corrected by returning the hazardous material to a controlled environment. Providence is responsible for hazardous materials response until resources are unavailable, exhausted, or not within the capabilities of local government. Resources available in response to an oil and hazardous materials incident are referenced in an annex to the Providence Resource Management Plan.

ESF 11 – Agriculture and Natural Resources: Prioritizes and coordinates the response to protect natural resources and agriculture in the City of Providence, including but not limited to, the water supply, parks, and cultural and historic property resources. Providence will support the coordination of agencies pertaining to service animals, household pets, other animals, pests, and food supply management. Specialized resources, especially those from state and federal government will be coordinated through the RIEMA in a large-scale emergency event.

ESF 12 – Energy: Involves close coordination with the utilities operating in the City of Providence to ensure that the integrity of the power supply systems is maintained during emergency situations and that any damages that may be incurred are repaired and services restored in an efficient and expedient manner afterward. ESF 12 is also responsible for notifying state ESF 12 of any power outages or downed wires within Providence.

ESF 13 – Public Safety and Security: Establishes actions and responsibilities for command, control, and coordination of all law enforcement personnel and equipment in response to an emergency or disaster. ESF 13 coordinates with state ESF 13 to procure additional resources as needed. ESF 13 assists in the development, maintenance, and planning of security force responses to disasters and emergencies including terrorist incidents or incidents involving weapons of mass destruction.

ESF 14 – Long-Term Community Recovery: Responsible for planning and coordinating all issues regarding long-term recovery from a disaster, including but not limited to federal assistance programs and post-disaster mitigation. This ESF will work closely with state and federal counterparts to ensure the City of Providence maximizes the assistance it will receive and allows for a quick and complete recovery from an emergency event.

ESF 15 – External Affairs: Coordinates the dissemination of emergency public information and warning notifications (across multiple systems and media) to control the spread of misinformation. ESF 15 will not be activated in all disasters but only in response to a verifiable need in conjunction with the operation of a Joint Information Center (JIC), if necessary. Furthermore, ESF 15 also coordinates the local public-private sector partnership ensuring that private sectors assets are brought to bear in the best possible matter.

ESF 16 – Volunteer and Donation Management: Provides guidance for the engagement and coordination of volunteers, volunteer services, and donations management in an emergency and establishes a consistent framework for coordinating with volunteer organizations supporting a response. This plan does not conflict with the established procedures of voluntary agencies regarding their respective procedures for soliciting goods and services or mobilizing their trained

volunteers. This plan outlines logistical and resource support following an emergency and establishes lines of communication between the primary and supporting ESF 16 agencies and other ESF agencies for an emergency or disaster that impacts the City of Providence. However, in a Providence emergency, voluntary agencies are expected to abide by this document.

Municipal Website
The City's Emergency Management Agency Office of Homeland Security maintains a municipal webpage hosted on the City's website that includes a variety of local, state, and regional emergency program information for residents, business owners, and tourists, including:

- Preparedness Page
  - Emergency Supply Kit Checklist
  - Emergency Pet Preparedness Checklist
  - Family Communications Plan
  - City's Evacuation Plan
  - Business Continuity Planning
  - Pets and Animals Emergency Planning
  - High-Rise Building Safety
  - How to get Involved/Volunteer, various Training Opportunities
  - Warming Centers locations and hours of operations
- Mitigation Page
  - Multi-Hazard Mitigation Plan Update 2019 information
  - Risk Management Assessment Form
  - Special Event Incident Action Plan Template (with examples)
- Recovery Page
  - FEMA Public Assistance Model
- Receive Alerts
  - CodeRED.
  - Social Media. Facebook Page: https://www.facebook.com/MayorJorgeElorza/, and Twitter Feed: https://twitter.com/Jorge_Elorza.

Various Drills and Exercises
The PEMA has developed and executed many drills and exercises since the 2013 Plan.

FEMA defines a drill as: A type of *operations-based* exercise that is a coordinated, supervised activity usually employed to test a single specific operation or function in a single agency. Drills are commonly used to provide training on new equipment, develop or test new policies or procedures, or practice and maintain current skills.

FEMA defines an exercise as: An instrument to train for, assess, practice, and improve performance in *prevention, protection, response,* and *recovery capabilities* in a risk-free environment. Exercises can be used for: testing and validating policies, plans,

procedures, training, equipment, and interagency agreements; clarifying and training personnel in roles and responsibilities; improving interagency coordination and communications; identifying gaps in resources; improving individual performance; and identifying opportunities for improvement.[54]

Drills and Exercises 2013-2018:

- Tin Can 2 TTX (30 Jan 2013)
- Tin Can 2 (13 March 2013)
- FEMA/State/City IEMC Course (May 13 -16 2013)
- Port Evacuation Drill (5 June 2013)
- COMEX – AARL Field Day, RACES Club (JUN 2013)
- Rhode Island School of Design TTX (30 July 2013)
- AMTRAK/MMRS Terrorist Attack and Mass Casualty Mini-TTX, (25 Sep 2013)
- AMTRAK/MMRS Terrorist Attack and Mass Casualty Full Scale Exercise, (5 Oct 2013)
- National Grid Drill – Gas Disruption, (9 Oct 2013)
- RIH MCI Exercise, (31 Oct 2013)
- DDRI TTX, (13 Dec 2013)
- Lifespan Functional Exercise (29 Jan 2014)
- RWP Zoo, Active Shooter Summit, (12 Feb 2014)
- Port Evacuation Drill (29 May 2014)
- COMEX – AARL Field Day, RACES Club (JUN 2014)
- Commodities Distribution Tabletop (AUG 2014)
- Household Pet Shelter tabletop (NOV 2014)
- Communications Drill TIN CAN (JUL 2014)
- 444 Evacuation Drill (JUL 2014)
- Hurricane Barrier Tabletop (MAY2015)
- Port of Providence Evacuation Drill (JUN 2015)
- COMEX – AARL Field Day, RACES Club (JUN 2015)
- MED-PODS Exercise (Feb 2016)
- COMEX – AARL Field Day, RACES Club (Jun 25-26, 2016)
- DHS Active Shooter Workshop (Jul 27, 2016)
- Hurricane TTX (Aug 6, 2016)
- City Hall Evacuation Drill (Sep 27, 2016)
- Statewide Cyber Exercise – Quantum Breach (Mar 8, 2017)
- RIDOH MED-PODS – DelSesto MS (Apr 19, 2017)
- RIDOH MEDS Functional Exercise (May 17, 2017)
- Port Evacuation Drill (May 25, 2017)

[54] FEMA Acronyms, Abbreviations, and Terms factbook.

- Statewide Hurricane Exercise – Operation Rhody (Jun 22, 2017)
- COMEX – AARL Field Day, RACES Club (Jun 24-25, 2017)
- Operation Downpour w/ URI (Aug 3, 2017)
- RISD Annual Table Top (Oct 13, 2017)
- Dialysis Center Table Top (Nov 9, 2017)
- Valley Falls Emergency Action Plan Workshop (Feb 15, 2018)
- Active Threat Exercise w/ VAMC (Feb 26, 2018)
- Healthcare Coalition of RI Preparedness Workshop (Apr 5, 2018)
- Emergency Medical Distribution Drill (Apr 18, 2018)
- Mall Active Shooter Table Top (Apr 24, 2018)
- DOH Ebola Response Table Top (May 15, 2018)
- Statewide CERT Exercise (May 20, 2018)
- Valley Falls Full Scale Exercise (Jun 13, 2018)
- COMEX – AARL Field Day, RACES Club (Jun 23-24, 2018)
- Emergency Commodities Distribution Drill (Jun 26, 2018)
- RISD Annual Table Top (Oct 12, 2018)
- Port Shelter-in-Place Drill (Nov 26, 2018)

Office of Sustainability

The Office of Sustainability works to provide a better quality of life for all residents while maintaining nature's ability to function over time by minimizing waste, preventing pollution, promoting efficiency, and developing local resources to revitalize the local economy. This office is also tasked with reducing energy consumption in city-owned facilities to cost-effectively lower utility operating costs and ensure occupant comfort and safety in city facilities.

The Office of Sustainability has conducted several charrettes over the years to talk about the city's issues of resiliency and to bring community members together to discuss issues and offer recommendations to emerging trends. A Racial and Environmental Justice Committee (REJC), comprised of frontline community members, was created to focus on equity in environmental issues such as climate change and SRL. The REJC is working together to integrate voices and concerns of low-income communities into city decision-making through the Office of Sustainability. This initiative comes from the desire to shift the structures that have contributed to inequities based on race in Providence. Since the 2013 plan, the Office has leveraged $500,000 in grants for sustainability education throughout the city. The Department also utilizes CRMC's STORMTOOLS data mapping and future SRL scenarios throughout their work to educate residents and business owners.

The City of Providence has also assembled the Environmental Sustainability Task Force with responsibilities defined by city ordinance as follows:

- Work with the Office of Sustainability, the Mayor, the City Council and other city departments to coordinate the City's environmental agenda and provide a level of accountability for the environmental initiatives the City is currently implementing or planning to implement.
- Communicate with the public important developments in the City's environmental agenda. This will bring an extra level of transparency and accessibility to the City's progress on important environmental goals.
- Include experts from the City and from the community to discuss and propose innovative, yet achievable, environmental initiatives which the City could adopt to further green the City of Providence.

Game of Floods
A new education tool 'Game of Floods' is an interactive game-based training to help decision-makers, community members, and other interested stakeholders better understand how Providence can prepare for current and future flooding, especially flooding related to SLR, heavy precipitation, and storm surge. The game takes participants through the process of prioritizing assets, conducting a vulnerability assessment, and identifying strategies to protect those assets. It is played in a series of steps and requires collaboration and thoughtful decision-making. Participants are assigned a specific role in the community such as Public Works Director or Neighborhood Association Chair, and then use real-world examples selected specifically for Providence to play the game. The training has been customized for Providence by the Office of Sustainability and embeds equity and climate justice principles throughout. Participants gain a deeper understanding of the local threats associated with climate change and how collective problem-solving can help address these tough issues.

Analyzing Coastal Flood Protection Strategies for Providence
The City of Providence continues to investigate the impacts of climate change on the frequency of flood events within the city. Collaborating with outside experts from the Center for Climate and Energy Solutions (C2ES) and Johns Hopkins University, in 2016, an analysis of the costs of different strategies for coastal flood protection with a focus on the FPHB was conducted to provide guidance for decision-making among city leaders. This analysis quantitatively assessed risks and potential economic losses due to SLR as well as informing the timing of decisions for future climate resilience investments.

Two key points emerged from this study:[55]
- Whether the barrier will continue to protect against future storm surge is very sensitive to the SLR projection used. If a low-probability, high SLR projection is used, then the optimal strategy is to build a new, taller barrier by the end of the century. However, under the highest-probability, lower SLR projections, the existing barrier is expected to be cost effective in protecting the city from storm

[55] Analyzing Coastal Flood Protection Strategies for Providence, RI, Center for Climate and Energy Solutions (C2ES) and Johns Hopkins University, page 1.

surge well into the 22nd century (assuming it can be maintained past its design lifetime).

  - *The analysis suggests that a decision about any future hurricane barrier must be made by around 2050, giving city leaders time to focus on other climate challenges.*

- A key emerging challenge is the increase in the frequency of tidal flooding (so-called nuisance flooding). Tide heights that prompt a precautionary closing of the barrier occur about 10 times a year today, but they would occur more than weekly by 2050 and twice daily by 2100. While the FPHB can be used to mitigate nuisance flooding through 2100, questions remain about whether the barrier can withstand near-constant use.
  - *To defray much of these operating costs, construction of sea walls to prevent nuisance flooding in low-lying areas of the city (the examined alternative) should optimally begin between 2040 and 2050.*

In September 2016, C2ES facilitated a public-private collaboration workshop on climate resilience planning. With representatives from multiple city departments, local universities, businesses, hospitals, state government, and others to conduct a baseline assessment of Providence's preparedness for climate risks. The following priorities for investigating coastal flood protection strategies include:[56]

- City government should take a *holistic look at climate resilience planning*, understanding that inland, tidal, and storm surge flooding can interact to impact the downtown and riverfront areas.
- A public engagement process should be undertaken to determine the community's tolerance for flooding along the Riverwalk. Such a process should focus on whether the community wants to invest in sea walls (and accept the resulting change in character of low-lying waterfront areas) or maintain current views and character and accept periodic flooding. This question comes from the model's finding that *the cheapest way to address tidal flooding is to raise the threshold at which Fox Point Hurricane Barrier is shut and prepare the waterfront to be periodically flooded* instead of investing in infrastructure to stop water.
- Stakeholders supported other targeted actions like *data collection, addressing some climate resilience questions in the Hazard Mitigation Plan, and investigating incentives the city could provide to encourage resilience investments on private property.*

Exploring Regional Solutions to Regional Problems Upper Narragansett Bay Regional Stormwater Utility Feasibility Study - Phase I Final Report

In 2013, the Upper Narragansett Bay Regional Stormwater Management (UNBRSM) Initiative (Central Falls, Cranston, East Providence, North Providence, Providence, Pawtucket, and Warwick) was convened to explore the creation of a regional stormwater utility that would provide a long term, sustainable solution to stormwater

[56] Ibid.

management. Shared challenges across all seven communities include flooding, pollution, and degraded infrastructure Phase I resulted in five major conclusions:[57]

1. The upper Narragansett Bay region has real, growing, shared, and unresolved challenges in managing stormwater.
2. With adequate resources, the expertise is available to address these challenges and the solutions would provide tangible benefits to each municipality.
3. The solutions will cost more than municipalities are now spending on stormwater management.
4. A regional approach will be more efficient and effective than an individual approach.
5. A stormwater user fee, based on how much a property contributes to stormwater run-off, is the best and fairest way to pay for the improvements.

City staff identified several concerns about a stormwater utility within the city, including aging infrastructure, flooding problems (local streets), Municipal Separate Storm Sewer System (MS4) permit compliance, water quality concerns, and limited public awareness. City staff also indicated a significant gap in funding for routine maintenance of the Combined Sewer System (CSS) and MS4 systems, as well as capital improvements to address water quality and expressed interest in regionalizing operations and maintenance of both by a private entity.

Resilient PVD Lab Report
In February 2016, the Office of Sustainability welcomed a Design and Resilience Team (DART) comprising architects, designers, and city planners from around the country to host the Resilient PVD Lab. The experts, along with city leadership and roughly 200 community participants, gathered for three days to identify strategies for making Providence more resilient to the impacts of climate change.

Community Toolkit Strategies include:

- Connect - Create connections between community hubs that can be traversed on foot or by bike. During an extreme weather event vehicular transportation might be hindered or impossible.
- Gather - Create places for people to gather for use year-round that are also sufficiently equipped to house people in the event of an extreme weather event. This allows people to be in a familiar place for safety.
- Cool - Combat the heat island effect. During a major storm, air conditioning capabilities might be lost. Retrofit existing buildings with techniques that will cool them naturally. Think of children and elderly community members who the heat effects more drastically.
- Absorb - Capture stormwater in more frequent, smaller amounts and let it infiltrate through pervious materials. This will allow pollutants to the be pulled out of the water and increase the health of ground water.

[57] Ibid.

- Adapt - Equip community members of Providence with the tool kit that is necessary to adapt and prepare for climate change.
- Link - Give people the means to communicate before and during major storms. Equip community centers with means of communication to other community centers in case of failure of usual communication lines.

Department of Public Works (DPW)
DPW provides efficient, cost-effective, high-quality services relative to the operations, maintenance, planning, construction and engineering of public works infrastructure, and waste management for the City of Providence. DPW staff consists of 105 employees. The Department is comprised of seven divisions that include Administration; Engineering, Traffic, Parking, Highway, Sewer, and Environmental.

A new DPW facility has been incorporated into the City's Capital Improvement Plan (CIP) projected over the next five years. The existing facility dates to 1927 and has flooding issues. Also, a snow/ice control plan in under development.

Department of Public Safety
The Commissioner's Office of the Department of Public Safety is committed to informing the residents of Providence about key public safety initiatives and encourages the public to work with PEMA to ensure the safety and welfare of all who visit, work, and live in Providence.

The Department has been successful over the last five years obtaining grant funds for operational improvements, including:

- Acquired a new ladder truck through Assistance to Firefighters' (AFG) grant from FEMA,
- Modernized rescue boat and conducted marine-related trainings, and
- Received $15 million to fund 90 firefighters.

The Department has also continued scenario-based training exercises with various groups at the Port, including Marine Strike Force Team, Flammable Liquids Task Force, and Special Hazards Division Task Force. And, effective July 1, 2018, the City was awarded a Class 1 Insurance Services Office (ISO) Rating – the highest achievable utilizing the Public Protection Classification (PPCTM) program.

Police Department
The Providence Police Department united with all community members, is committed to improving the quality of life in our city by aggressively resolving problems, preserving the peace, protecting human rights, and apprehending criminals consistent with the law.

Operational improvements since 2013 include the development of Operations Plans (OPS) for every event, establishment of a Special Response Unit, and a more holistic, comprehensive approach to policing (building partnerships with the business

community, cross-training, and improved communications. The Department also maintains a Continuity of Operations Plan (COOP), has assigned a staff member to the Joint terror Task Force, and meets weekly to review planned events and potential threats.

Fire Department

The Providence Fire Department provides for the protection of human life and property from fire and other disasters, either natural or man-made, through fire safety education, the development, and enforcement of fire codes, provision of emergency medical services and suppression of fire.

Department of Information Technology

The mission of the Information Technology Department is to support the network, applications and electronic hardware throughout the city which employees and the public use to conduct daily business. Using cost-effective and proven technology, these systems support municipal finance, operations, property management and public outreach for the city, and advance the Administration's goals of ensuring city government is efficient, transparent, and accessible for staff, residents, and visitors.

Since 2013, the Department has lost networks to power outages. Although not all offices have power backup, primary systems have two levels of backup. Improvement plans include a transition to the cloud service model. This will not only change the response process, it could be an additional layer of risk, having more components out of the City's control.

State of Rhode Island

Warning Systems

Emergency Management State Radio System (EMSTARS)

The Rhode Island EMSTARS is a Simplex (non-repeated) radio system that links local EOCs to the Rhode Island State EOC. This is an encrypted radio system that is located and kept secure in each EOC. It has been designed to afford communities a redundant mode of secure communications to the state EOC. EMSTARS is designed to be a base-to-base system only. There are no other talk groups on the VHF system. The Providence EMSTARS site is located at the EOC.

National Warning System (NAWAS)

NAWAS system used to convey warnings to United States-based Federal, State and local governments, as well as the military and civilian population. NAWAS has proven invaluable to local emergency managers responding to or coping with natural disasters. The Providence NAWAS site is located at the Department of Telecommunications located on West Exchange Street, Providence.

Notification Systems

Rhode Island Broadcasters Association's (RIBA) Cancellation System

The RIBA has a unified cancellation/delay notification system that transmits weather-related class cancellations throughout Rhode Island and bordering communities. The

City submits notices through RIBA's secure automated telephone or web-based system. The data is then available in real-time to all participating radio and television stations as well as on their websites. The TV and radio stations broadcast this information as they have in years past. RIBA has modified its system to include more than just weather-related closings and they have initiated a program to send alert messages to cell phones, email addresses, or home phone numbers of individuals who "subscribe" on the websites of any of their member stations.

Rhode Island Red Cross Emergency Notification System (ENS)
The Rhode Island Red Cross ENS enables immediate information dissemination of updates, reminders and emergencies to ARC-RI Volunteers via various contact methods. The system enables appointed personnel to quickly and easily contact one, several or all individuals via web or telephone interface and distributes notifications via multiple media, including telephones, cell phones, email, pager, text messaging. The system is capable of recorded voice and text-to-speech notifications, multilingual text-to-speech conversion, pre-defined messages, and recipient acknowledgement.

Amber Alert System
The State of Rhode Island Department of Public Safety's AMBER Alert Program is a voluntary partnership between law-enforcement agencies, broadcasters, transportation agencies, and the wireless industry, to activate an urgent bulletin in the most serious child-abduction cases. The goal of an AMBER Alert is to instantly galvanize the entire community to assist in the search for and the safe recovery of the child.

Executive Climate Change Coordinating Council (EC_4)
Resilient Rhody[58]
Resilient Rhody is a statewide climate resilience action strategy that responds to changing weather and environmental conditions in Rhode Island caused by climate change and proposes bold yet implementable actions to better prepare the state for these impacts. Under the leadership of Governor Gina M. Raimondo, steps have been taken to begin the hard work necessary to address the effects of climate change. Now is the time to invest in priority projects, continue to work collaboratively across agencies, and reinforce the strong partnerships between the state and municipalities to empower and prepare communities for a new climate reality. To accelerate actions and investments, Governor Raimondo signed an Executive Order on September 15, 2017, calling for the development of the state's first comprehensive climate preparedness strategy. *Resilient Rhody* lays the groundwork for collective action, involving state agencies, municipalities, and statewide organizations. This strategy will focus the state's attention on catalytic climate resilience actions both within government and together with business, academic, and nonprofit partners. Building on the climate leadership of state government, municipalities, and organizations, it leverages existing studies and reports to identify critical actions that move from planning to implementation.

Rhode Island Department of Environmental Management (RIDEM)[59]

[58] http://climatechange.ri.gov/documents/resilientrhody18.pdf

Implications of Climate Change for Rhode Island Wastewater Collection & Treatment Infrastructure
RIDEM, in collaboration with the state's Office of Housing and Community Development, recognized the need to begin integrating climate change considerations into wastewater system planning and design. This study is a planning tool intended to help Rhode Islanders understand the projected implications of climate change on the state's 19 public wastewater treatment systems. It focused on the municipal treatment plants and the major pump stations that help bring flow to those treatment plants. It did not include wastewater infrastructure owned by private entities or onsite systems with subsurface disposal. The study includes recommendation for adaptive strategies.

Rhode Island Department of Health (RIDOH)
SafeWater RI: Ensuring Safe Water for Rhode Island's Future
To help address the implications of climate change to drinking water utilities, RIDOH, Office of Drinking Water Quality launched *Safe*Water RI: *Ensuring Safe Water for Rhode Island's Future.* The objective is to assess changing conditions including, temperature, precipitation patterns, SRL and storm surge and their potential impacts to drinking water infrastructure in Rhode Island. The project includes a desktop literature review of the following issues: the state of knowledge regarding climate change trends for the Northeast and specifically Rhode Island, potential climate change impacts of drinking water utilities, and best practices used in adaptation strategies for drinking water utilities.

Rhode Island Special Needs Emergency Registry[60]
This registry allows police, fire, and other first responders in the community better prepare for and respond to community needs during a hurricane, storm, or other emergency.

Many people may need extra help during a time of emergency, including people who:

- Use life support systems such as oxygen, respirator, ventilator, dialysis, pacemaker, or are insulin dependent,
- Have mobility disabilities and use a wheelchair, scooter, walker, cane, or other mobility device,
- Are visually impaired, blind, hard of hearing, or deaf,
- Have speech, cognitive, developmental or mental health disabilities, or
- Use assistive animals or a prosthesis.

Rhode Island Department of Transportation (RIDOT)
As mentioned earlier, through RhodeWorks, RIDOT initiated work on the reconstruction of structurally deficient bridges as well as preventative approaches to prevent others from also becoming deficient. . A number of these structures are in Providence, scheduled for rehabilitation or preservation through the TIP projected through 2027 (Table 3.2).

[59] http://www.dem.ri.gov/programs/water/wwtf/wwtf-climate.php
[60] http://www.health.ri.gov/emergency/about/specialneedsregistry/

Table 3.2 Providence Area Bridge Improvements Schedule – RIDOT TIP

Location	State #	Owner	SRL Concern (TIP)	Bridge Group # (TIP)	Anticipated Completion Date: (TIP) Improvements	Description of Work
Harbor Junction	13101	State		57E	Aug-18	Major Rehabilitation
Reservoir Ave RR	32701	City		59C	2021	Major Rehabilitation
Glenbridge Ave	34801	City		16A	5/22/2017	Preservation
Delaine Street	40201	City		20B	2025	Preservation
Wanskuck	42801	State		13B	2023	Major Rehabilitation
Hawkins Street	42901	State		13B	2023	Preservation
Branch Ave. Culvert	43701	State		21	2021	Preservation
Frankfort Street*	45401	State		22	2024	Major Rehabilitation
Huntington Ave Viaduct*	50401	State			2024	Major Rehabilitation
Westminster St UP #1*	50501	State			2024	Major Rehabilitation
Westminster St UP #2*	50601	State			2024	Major Rehabilitation
Broadway Overpass*	50701	State			2024	Major Rehabilitation
Broadway Underpass*	50801	State			2024	Major Rehabilitation
Broadway Ramp Overpass*	50901	State			2024	Major Rehabilitation
Harris Ave RR*	51001	State			2024	Major Rehabilitation
Valley Street	51101	City		20B	2025	Preservation
Tar Bridge	51301	City		40	2026	
Eddy Street	53701	State		1	2020	Preservation
Blackstone Street	53901	State		77	2021	Major Rehabilitation
Broad Street	57101	State		1	2020	Preservation
Westminster Street	57201	State		1	2020	Preservation
Washington Street	57301	State		1	2020	Preservation
Broadway	57401	State		1	2020	Preservation
Atwells Ave	57501	State		20B	2025	Preservation
Atwells Ave Ramp East	57601	State		75T 5B	2027	Major Rehabilitation
Atwells Ave Ramp West	57701	State		75T 5B	2027	Major Rehabilitation

Location	State #	Owner	SRL Concern (TIP)	Bridge Group # (TIP)	Anticipated Completion Date: (TIP) Improvements	Description of Work
Providence Viaduct	57801	State		75T 5B	7/18/2017	Major Rehabilitation
Ramp CB-2 Civic Center	58201	State	X	75T 5B	2027	Major Rehabilitation
Ramp DB Civic Center	58301	State	X	75T 5B	2027	Major Rehabilitation
Ramp DA Civic Center	58401	State		2	2024	Preservation
Ramp CA Civic Center	58501	State		2	2024	Preservation
Hartford Ave. East*	60201	State			2024	Major Rehabilitation
Woonasquatucket River	60401	State		16T	2018	Preservation
Merino Pond	60501	State		16B	2022	Preservation
Killingly Street	60701	State		16B	2022	Preservation
Public Street (NB)	65101	State		2	2024	Preservation
O'Connell Street	65201	State		2	2024	Preservation
Oxford Street	65301	State		02T D	Jun-20	Preservation
Allens Ave Ramp	65401	State		2	2024	Preservation
Thurbers Ave.	65501	State		2	2024	Preservation
Eddy Street South	65601	State		2	2024	Preservation
Broad Street South	65701	State		30	Dec-20	Major Rehabilitation
Narragansett Electric Co	65801	State		2	2024	Preservation
Elmwood Ave.	65901	State		30	Dec-20	Major Rehabilitation
West Elmwood RR	66001	State			6/17/2016	
Elmwood Ave. South	66701	State		22	2026	Preservation
Hamlin	67401	State		22	2026	Preservation
Smith Street	70101	State		75T 5B	2027	Major Rehabilitation
Louisquisset Pike	70301	State		75	Jun-21	Preservation
Park Street	70401	City	X	75T 5B	2027	Major Rehabilitation
Chalkstone RR	70601	State		75T 5B	2027	Major Rehabilitation
Ashburton Street	70701	State		75T 5B	2027	Major Rehabilitation
Industrial Drive	70901	State		6	2021	Preservation
Moshassuck South	71001	State		6	2021	Preservation

Location	State #	Owner	SRL Concern (TIP)	Bridge Group # (TIP)	Anticipated Completion Date: (TIP) Improvements	Description of Work
Branch Ave.	71201	State		6	2021	Preservation
Smithfield Ave.	71301	State		6	2021	Preservation
Concord Street	71401	State		13A	2022	Preservation
Culvert A	71501	State		6	2021	Preservation
Culvert BC	71601	State		6	2021	Preservation
Dean Street	77601	State		20A	2021	Preservation
Pleasant Valley Parkway	77701	State			11/20/2017	
Bath Street East	77801	State	X	40	2026	
Ramp BC Civic Center	84801	State		19	2026	Preservation
Ramp BD Civic Center	84901	State		6	2021	Preservation
Memorial Blvd Ped UP	86401	City		19	2026	Preservation
Francis Street (North)	86501	City		19	2026	Preservation
Francis Street (South)	86521	City	X	19	2026	Preservation
Park ROW	86601	City	X	19	2026	Preservation
Steeple Street West	86701	City	X	20B	2025	Preservation
Steeple Street East	86721	City	X	20B	2025	Preservation
Washington Street	86801	City	X	19	2026	Preservation
College Street	87001	City	X	19	2026	Preservation
Crawford Street	87201	City	X	19	2026	Preservation
Exchange Street	87401	City	X	40	2026	Major Rehabilitation
Stevens Street	88101	City		20B	2025	Preservation
Industrial Drive	88201	City		20B	2025	Preservation
West River Street	88301	City		21	2021	Preservation
Magnan Road RR	88401	City		21	2021	Preservation
CAUNOUNICUS	88501	Local Park, Forest, or Reservation Agency		40	2026	Major Rehabilitation
MIANTUNNOMU	88601	Local Park, Forest, or Reservation Agency		40	2026	Major Rehabilitation

Location	State #	Owner	SRL Concern (TIP)	Bridge Group # (TIP)	Anticipated Completion Date: (TIP) Improvements	Description of Work
Cladrastis Ave	88701	Local Park, Forest, or Reservation Agency		22	2026	Preservation
Memorial Boulevard	88801	Local Park, Forest, or Reservation Agency		22	2026	Preservation
Memorial Boulevard	88901	Local Park, Forest, or Reservation Agency		22	2026	Preservation
Veazie Street	89001	City		21	2021	Preservation
Roger Williams Ave. RR	92301	City				
Union Ave. RR	92501	City		21	2021	Preservation
Westminster RR	92601	City		21	2021	Preservation
Westminster RR Utility Br	92621	City				
Broadway RR	92701	City		21	2021	Preservation
Smith Street RR	92801	State		16B	2022	
Orms Street RR	92901	City		17		
Charles Street RR	93001	State		21	2021	Preservation
Branch Ave. RR	93101	City		21	2021	Preservation
Smithfield Ave. RR	93201	State		13A	2022	Preservation
Eagle Street	97201	City	X	20B		Preservation
Atwells Ave	97501	City			5/17/2016	
Geneva Pond	97701	City		38A	Aug-20	Major Rehabilitation
Point Street	98001	City	X	19	2026	Preservation
Memorial Blvd South	98101	City	X	19	2026	Preservation
Memorial Blvd North	98121	City	X	19	2026	Preservation
Park Row C – East	98201	State	X	19	2026	Preservation
Park Row A – West	98301	State		19	2026	Preservation
Park Row B - Exchange St	98901	State		19	2026	Preservation
Harris Ave.	102701	State		20B	2025	Preservation
Woonasquatucket River	106501	State			Dec-20	

Location	State #	Owner	SRL Concern (TIP)	Bridge Group # (TIP)	Anticipated Completion Date: (TIP) Improvements	Description of Work
Clifford Street Bridge	108001	State			11/20/2017	
South Main Street Bridge	108201	State			11/20/2017	
Ramp EI	108301	State			6/20/2017	

Source: RIDOT.

Rhode Island Department of Administration (RIDOA)[61]

Technical Paper 167 - Vulnerability of Transportation Assets to Sea Level Rise and Storm Surge

RIDOA plays a role in hazard mitigation and risk reduction in the state. RIDOA manages the Rhode Island Climate Change website as well as other online resources that provide information regarding plans, programs, and policies related to resilience in Rhode Island. Technical assistance is provided by RIDOA divisions that have hazard mitigation and risk reduction capabilities, including the Office of Management and Budget and Division of Planning.

As previously mentioned, Technical Paper 167 assessed transportation assets under state jurisdiction and is a resource for the state and affected communities to incorporate SRL data into informed decision-making regarding spending, planning, goal setting, communication and capacity building, and for additional analysis.

Rhode Island Department of Public Safety

Reverse 911

Reverse 911 is a communication system that allows emergency services to quickly contact members of a community or organization with information. This system allows emergency services to do the "reverse" and inform the public of a known hazard. Reverse 911 is designed to provide map– or list-based communications with key audiences. Geographic calling zones are created based on immediate circumstances or ahead of time based on anticipated needs.

StormSmart Coasts Rhode Island

A web resource, the StormSmart Coasts Network is dedicated to helping decision makers in coastal communities address the challenges of storms, flooding, SRL, and climate change by providing a place to find and share the best resilience-related resources available and provides tools for collaboration.

[61] State of Rhode Island 2018 State Hazard Mitigation Plan, page 4-21.

North American Marine Industry Environmental Certification Program
Green Marine
The Green Marine program is a voluntary initiative to surpass regulatory requirements within the maritime industry. Established in 2007, the Green Marine environmental program offers a detailed framework for maritime companies to first establish and then reduce their environmental footprint. It provides a step-by-step template for port authorities, terminal operators, shipping lines and shipyard managers to voluntarily and measurably reduce their environmental footprint using 12 performance indicators that include lowering air emissions, minimizing community impacts, and demonstrating environmental leadership. In December 2018, Waterson Terminal Services joined the Green Marine environmental certification program for its stevedoring and terminal operations at ProvPort.[62]

Coordination with Neighboring Municipalities
The City of Providence (PEMA) coordinates with neighboring communities regarding vulnerabilities from shared risks, as well as municipal evacuation plans. The City will continue to coordinate with these communities on multi-hazard mitigation planning, specifically evacuation plans.

Coordination with Area Colleges and Universities
The City (PEMA) regularly coordinates with area colleges and universities as primary stakeholders and populations at-risk in Providence through participation on the LHMC and various drills throughout the year. The City will continue these coordination efforts regarding future development/expansion plans and multi-hazard mitigation planning.

Coordination with Area Hospitals and Health Care Centers
The City (PEMA) also regularly coordinates with area hospitals and health care centers as primary stakeholders and populations at-risk in Providence through participation on the LHMC and various drills throughout the year. The City will continue these coordination efforts regarding future development/expansion plans and multi-hazard mitigation planning.

3.4 Financial Capabilities

Federal/State Grant Opportunities
The City, across all municipal departments, considers and pursues all applicable federal, state, and local grant opportunities to assist in implementing hazard mitigation programs:

> FEMA – has several programs including Hazard Mitigation Assistance (HMA) Guidance, Hazard Mitigation Grant Program (HMGP), PDM Program, and Flood Mitigation Assistance Program (FMAP)- Over the past several years, FEMA has provided the City of Providence with approximately $998,201.00 in grant assistance from various projects (see Section 2.5 for additional details).

[62] https://green-marine.org/about-us/

U.S. Housing and Urban Development Community Development Block Grant Program - a flexible program that provides communities with resources to address a wide range of unique community development needs, particularly the Disaster Recovery Assistance Program which provides grants to help cities, counties, and states recover from Presidentially-declared disasters, especially in low-income areas, subject to availability of supplemental appropriations.

U.S. Department of Agriculture Natural Resources Conservation Service – provides Conservation Technical Assistance, Financial Assistance, and Conservation Innovation Grant programs.

U.S. Economic Development Administration - empowers distressed communities to revitalize, expand, and upgrade their physical infrastructure to attract new industry, encourage business expansion, diversify local economies, and generate or retain long-term, private sector jobs and investment.

RIDEM – provides up to 50% matching funds to municipalities, land trusts and non-profit land conservation organizations to preserve valuable open space in Rhode Island.

Capital Improvement Plan (CIP)
The City regularly plans and budgets for both short- and long-term capital improvement projects through its CIP. The updated list of projects for the City's CIP Fiscal Years 2018 – 2022 includes[63]:

Department of Public Works:

- Sanitary Sewers and Stormwater Management, citywide - $2, 200,000 each year over the next five years
- Fox Point Hurricane Barrier sewer gate valve - $500,000/2018
- Hawkins Street Bridge - $1,100,000/2019
- Tar Bridge - $1,900,000/2020
- Canada Dam repair - $750,000/2018, $1,750,000/2019, $1,500,000/2020

Department of Public Property:

- New DPW Complex - $15,000,000/2020, $15,000,000/2021
- Brook St. Fire Station alarm upgrade, roof, kitchen - $108,389/2022
- Branch Ave. Fire Station alarm upgrade and repairs - $160,415/2019
- Allens Ave. Fire Station - $50,000/2022
- Atwells Ave. Fire Station alarm upgrades - $43,356/2019
- Admiral St. Fire Station – 86,711/2019
- Messer Fire Station fire alarm upgrades - $43,356/2019
- North Main Fire Station - $95,383/2022
- Broad St. Fire Station - $134,402/2019

[63] City of Providence Capital Improvement Plan, Fiscal Years 2018 – 2022 Amended Appendix A, July 13, 2017.

- Fire Department Repair Garage roof repairs - $52,207/2019
- Mt. Pleasant Fire Station alarm upgrade, structural repair, heating - $196,000/2019
- Mello Communications Dispatch fire alarm and halon upgrade - $70,000/2022
- Hartford Ave. Fire Station upgrades - $151,744/2010
- Reservoir Ave. Fire Station upgrades, painting, and roof repairs - $82,376/2019
- Police Training Fire Alarm upgrade - $86,711/2022

Department of Parks and Recreation:

- India Pt. Park Seawall replacement – East End/Community Boating Center $335,000/2018

Additional, smaller stormwater management and green infrastructure projects are also funded in part through the CIP.

3.5 National Flood Insurance Program

Providence implements and enforces the state building code and is fully participates in the NFIP. Providence has been active in protecting valuable natural open space, which can help minimize flood damage. The City has also adopted and incorporated the requirements from FEMA regarding development in the floodplain into the Zoning Ordinance and has updated the Subdivision and Development Review Regulations to address drainage and properties in the floodplain.

Table 3-3 Actions for Continued Compliance with NFIP below lists those actions that the City has done and will continue to do and those actions that will be done within the next five years for continued compliance with the NFIP. The "To Be Done actions" listed in the table that follows are listed in order of priority.

Table 3-3 Actions for Continued Compliance with NFIP

Actions (Listed in order of priority)	Done/Ongoing	To be Done
Join the NFIP.	X	
Participate in NFIP training by State and/or FEMA. Bristol is also a member of the RI Flood Mitigation Association and attends the annual conference.	X	
Establish mutual aid agreements with neighboring communities to address administering the NFIP following a major storm event.		X
Address NFIP monitoring and compliance activities.	X	
Revise/adopt subdivision regulations and erosion control regulations to improve floodplain management in the community.		X
Participate in the CRS.	X [1]	
Prepare, distribute, or make available NFIP, insurance and building code explanatory pamphlets or booklets.	X	

Actions (Listed in order of priority)	Done/Ongoing	To be Done
Identify and become knowledgeable on non-compliant structures in the community.	X	
Identify and become knowledgeable of submit to rate structures.	N/A	
Identify cause of submit to rate structure and analyze how to prevent non-compliant structures in the future.	N/A	
Inspect foundations at time of completion before framing to determine if lowest floor is at or above BFE.	X	
Require use of elevation certificates.	X	
Report any changes in the Special Flood hazard Area to FEMA within 180 days of change.	X	
Identify and keep track of LOMA/LOMR in the community.	X	
Gain familiarity with community's Flood Insurance Rate Maps.	X	
Address repetitive loss structures.	X	

1. CRS has been explored two times in Providence, not considered cost-beneficial
Source: City of Providence Planning and Development

3.6 Existing Protection Matrix

A summary of the main identified existing and future protection measures presented above are summarized on Table 3-4. These measures constitute the baseline protection that was further evaluated by the Providence LHMC to determine gaps in the City's protection from natural, human-caused, and technologic disasters. Goal statements and specific actions were then developed to mitigate the identified gaps in the existing protection. These identified protection measures facilitate the City of Providence to implement various hazard mitigation programs, and ultimately making the community more resilient.

Table 3-4 Existing Protection Matrix Providence, RI

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Planning and Regulatory				
Providence Tomorrow: The Comprehensive Plan				
	The 2014 Plan includes many of the mitigation actions included in the 2010 Hazard Mitigation Plan, still relevant for this 2019 Update. Moving forward, the City will integrate new mitigation actions from this 2019 Update in the next Comprehensive Plan Update.	Citywide	Effectiveness: Very Good Enforcement: Managed by City Council and Mayor	Update concurrently with Hazard Mitigation Plan
Flood Zone Management				
	As requested, the Building Official and/or Inspection and Standards Department provide residents and business owners with information regarding properties located within the Special Flood Hazard area, flood insurance/Flood Insurance rate Maps (DFIRMs), and elevation certificates.	Properties located within Special Flood Hazard areas	Effectiveness: Good Enforcement: Regulated and enforced by Department Inspection and Standards	Continue to Enforce
Floodplain/Special Flood Hazard Areas				
	Special flood hazard areas are established as a floodplain overlay district.	Properties located within Special Flood Hazard areas	Effectiveness: Very Good Enforcement: Regulated and enforced by Department Inspection and Standards	Continue to Enforce
Article VII Soil Erosion and Sediment Control Ordinance				
	To prevent soil erosion and sedimentation from occurring as a result of non-agricultural development within the city by requiring proper provisions for water disposal, construction waste disposal and the protection of soil surfaces during and after construction, in order to promote the safety, public health and general welfare of the city.	Citywide	Effectiveness: Very Good Enforcement: Managed by City of Providence Engineering Division	Continue to Enforce

Table 3-4 Existing Protection Matrix Providence, RI

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Stormwater Management				
	Staff enforce the City's Stormwater Management Plan in conformance with the requirements of Rhode Island Pollutant Discharge Elimination System (RIPDES).	Properties located within Special Flood Hazard areas	Effectiveness: Very Good Enforcement: Managed by City of Providence Engineering Division	Continue to Enforce
Zoning Ordinance				
	Regulates the use of land in the city.	Citywide	Effectiveness: Good Enforcement: Managed by Inspection and Standards	Continue to Enforce
R.I. Climate Change Commission				
	Commission has released its summary report of the risks of climate change to the state, including points of weakness in infrastructure.	Coastal and inland areas subject to inundation	Effectiveness: Good Enforcement: Across municipal officials/departments	Continue to Utilize
Planning for Climate Change				
	Municipal staff participate regularly in conferences and workshops on Climate Change and Sea Level Rise (SLR), continues to amend the comprehensive plan to improve public and private practices, and has given presentations on planning for climate change.	Citywide	Effectiveness: Very Good Enforcement: Office of Sustainability, Department of Planning and Development	Continue to Utilize
Historic Preservation				
	The protection and preservation of historic resources citywide through the use of design standards, historic district zoning and other tools, uncovering distinct cultural values in the neighborhoods and taking steps to honor their significance, and supporting efforts to educate Providence residents on the importance of historic preservation.	Citywide	Effectiveness: Good Enforcement: Department of Planning and Development	Continue to Enforce

Table 3-4 Existing Protection Matrix Providence, RI

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Narragansett Bay Commission: Emergency Operations Plan				
	Includes a number of alternatives to ensure the facility's resilience such as hardening of the shoreline, protection of power supply, and reducing recovery time.	Wastewater Treatment Facilities	Effectiveness: Very Good Enforcement: NBC	Continue to Utilize
Providence Water: Water Supply System Management Plan - Emergency Response Plan				
	Emergency Response Plan that identifies vulnerability, criticality, and response.	Citywide	Effectiveness: Very Good Enforcement: Providence Water	Continue to Utilize
Waterson Terminal Services				
	During hazard events, port assets are made available to the City (heavy machinery, crane equipment, rail access, access to trucks, etc.).	Citywide	Effectiveness: Very Good Enforcement: Waterson Terminal Services	Continue to Utilize
R.I. Sea Grant Fact Sheets/Climate Change Science Summary				
	Highlights impacts to the built environment, public health and welfare, and natural resources.	Coastal and inland areas subject to inundation	Effectiveness: Good Enforcement: Across municipal officials/departments	Continue to Utilize
Adapting to Climate Change: A Planning Guide for State Coastal Managers, NOAA				
	Highlights guidance on adaptation planning to the built environment, public health and welfare, and natural resources.	Coastal and inland areas subject to inundation	Effectiveness: Good Enforcement: Across municipal officials/departments	Continue to Utilize
Recommendations for Management of the Woonasquatucket River & Promenade District				
	Goals of the UCG policy are to prevent further degradation of coastal waters by treating stormwater (through vegetative means where possible), to protect and/or restore coastal habitats, and to ensure public access to the urban shoreline while preserving an aesthetically appealing view from both the water and the shore.	Woonasquatucket River & Promenade District	Effectiveness: Good Enforcement: Across municipal officials/departments	Continue to Utilize

Table 3-4 Existing Protection Matrix Providence, RI

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Harbor Management Plan				
	Document which presents the community's goals and objectives for guiding public and private use of the land and water of its harbor areas, and establishes an implementation program to achieve the desired outcomes.	Waterfront/harbor areas	Effectiveness: Very Good Enforcement: Harbormaster and Department of Planning and Development	Continue to Enforce
Resilient Rhode Island Act 2014 - Executive Climate Change Coordinating Council				
	Set specific greenhouse gas emissions reduction targets; established an advisory board and a science and technical advisory board to assist the Council; and incorporated consideration of climate change impacts into the powers and duties of all state agencies.	Citywide	Effectiveness: Very Good Enforcement: EC_4	Continue to Enforce
Coastal Resources Management Council (CRMC)				
	The CRMC plans for and manages the coastal resources of the State. Technical support is provided to other state agencies and municipalities related to CRMC programs, including SAMP, stormwater design and installation, Shoreline Change (Beach) SAMP and coastal and estuarine land conservation.	Waterfront/coastal areas	Effectiveness: Very Good Enforcement: CRMC	Continue to Enforce/Utilize
Gas Infrastructure, Safety, and Reliability Plan (Gas ISR) FY 2020 Proposal				
	The Gas ISR Plan which addresses capital spending on gas infrastructure and other costs related to maintaining the safety and reliability of the Company's gas distribution system.	Citywide	Effectiveness: Good Enforcement: National Grid	Continue to Utilize
Administrative and Technical				
Municipal Administration and Staff				
	Providence Metro Port Area Chemical Biological Radiological Nuclear Detection System. Phase I detectors include Chemical Warfare Agent (CWA) and Toxic Industrial Chemical Detection (TIC) detection.	Port area	Effectiveness: Very Good Enforcement: Port Managers	Continue to Utilize

Table 3-4 Existing Protection Matrix Providence, RI

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Administrative and Technical				
Municipal Administration and Staff				
	Port of Providence Emergency Siren Warning System. The siren system is intended to alert workers and residents who are outside their residence or place of work that may not be able to receive a traditional notification.	Port area	Effectiveness: Good Enforcement: PEMA	Continue to Utilize
	National Oceanic and Atmospheric Administration (NOAA) Weather Radio.	Citywide	Effectiveness: Very Good Enforcement: Providence's NOAA Weather Radio transmitter	Continue to Utilize
	Greater Providence Chamber of Commerce E-Alert. A business-based e-mail system E-Alert.	Citywide	Effectiveness: Very Good Enforcement: Managed by Greater Providence Chamber of Commerce	Continue to Utilize
	Comprehensive Emergency Management Plan PEMA maintains a Comprehensive Emergency Management Plan (CEMP) which addresses mitigation, preparedness, response, and recovery from a variety of natural, human, and technologic hazards.	Citywide	Effectiveness: Very Good Enforcement: Managed by PEMA	Continue to Utilize
	Fox Point Hurricane Barrier Coordination Guide This Coordination Guide outlines activating and operating the Fox Point Hurricane Barrier (FPHB) located in the City of Providence and serves as the focal point for ensuring coordination of the FPHB during a major hurricane or coastal storm between multiple federal, state and local partners.	Citywide	Effectiveness: Very Good Enforcement: Managed by PEMA	Continue to Utilize
	All Hazards Debris Management Plan The All Hazards Debris Management Plan ("The Debris Plan") is designed to provide policies, guidance, and lists of resources to the City of Providence for the removal and disposition of debris caused by a major disaster.	Citywide	Effectiveness: Very Good Enforcement: Managed by PEMA	Continue to Utilize

Table 3-4 Existing Protection Matrix Providence, RI

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Administrative and Technical				
Municipal Administration and Staff				
	CodeRED Notification System The City of Providence utilizes the CodeRED Emergency Notification System to alert residents, commuters, and businesses in emergency situations.	Citywide	Effectiveness: Very Good Enforcement: Managed by PEMA	Continue to Utilize
	Voluntary Organizations Active in Disasters (VOAD) A forum for sharing knowledge and coordinating resources — money, materials and manpower – throughout the disaster cycle: preparation, response and recovery.	Citywide	Effectiveness: Very Good Enforcement: Managed by PEMA	Continue to Utilize
	Citizens Emergency Response Team (CERT) The CERT program educates citizens about disaster preparedness for hazards that may affect the City of Providence and trains them in basic disaster response skills such as fire safety, light search and rescue, team organization and disaster medical operations.	Citywide	Effectiveness: Very Good Enforcement: Managed by PEMA	Continue to Utilize
	Emergency Alert System The EAS is a national public warning system that requires broadcasters, cable television systems, wireless cable systems, satellite digital audio radio service (SDARS) providers, and direct broadcast satellite (DBS) providers to provide the communications capability to the President to address the American public during a national emergency.	Citywide	Effectiveness: Very Good Enforcement: Managed by PEMA	Continue to Utilize
	Emergency Notification System Enables immediate information dissemination of updates, reminders and emergencies to the Public Safety community via various contact methods.	Citywide	Effectiveness: Very Good Enforcement: Managed by PEMA	Continue to Utilize

Table 3-4 Existing Protection Matrix Providence, RI

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Administrative and Technical				
Municipal Administration and Staff				
	Sheltering The City of Providence uses a co-sheltering strategy that brings together the general population. Which includes individuals with non-medical special needs and unattended children in each facility.	Citywide	Effectiveness: Very Good Enforcement: Managed by PEMA	Continue to Utilize
	PEMA Emergency Support Function Annexes PEMA maintains a number of Emergency Support Function (ESF) Annexes that provide the structure for coordinating Federal interagency support for a local response to an incident.	Citywide	Effectiveness: Very Good Enforcement: Managed by PEMA	Continue to Utilize
	Municipal Website The City's Emergency Management Agency + Office of Homeland Security maintains a municipal webpage hosted on the City's website that includes a variety of local, state and regional emergency program information for residents, business owners and tourists.	Citywide	Effectiveness: Very Good Enforcement: Managed by PEMA	Continue to Utilize
	Various Drills and Exercises *The PEMA has developed and executed many drills and exercises with a range of stakeholders.*	Citywide	Effectiveness: Very Good Enforcement: Managed by PEMA	Continue to Implement
	Game of Floods A new education tool 'Game of Floods' is an interactive game-based training to help decision-makers, community members, and other interested stakeholders better understand how Providence can prepare for current and future flooding, especially flooding related to sea-level rise, heavy precipitation, and storm surge.	Citywide	Effectiveness: Very Good Enforcement: Managed by Office of Sustainability	Continue to Utilize

Table 3-4 Existing Protection Matrix Providence, RI

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Administrative and Technical				
Municipal Administration and Staff				
	Exploring Regional Solutions to Regional Problems Upper Narragansett Bay Regional Stormwater Utility Feasibility Study - Phase I Final Report In 2013, the Upper Narragansett Bay Regional Stormwater Management (UNBRSM) Initiative (Central Falls, Cranston, East Providence, North Providence, Providence, Pawtucket, and Warwick) was convened to explore the creation of a regional stormwater utility that would provide a long term, sustainable solution to stormwater management.	Citywide	Effectiveness: Very Good Enforcement: Managed by Office of Sustainability	Continue to Assess Feasibility
	Resilient PVD Lab Report In February 2016, the Office of Sustainability welcomed a Design and Resilience Team (DART) comprising of architects, designers, and city planners from around the country to host the Resilient PVD Lab. The experts, along with City leadership and roughly 200 community participants, gathered for three days to identify strategies for making Providence more resilient to the impacts of climate change.	Citywide	Effectiveness: Very Good Enforcement: Managed by Office of Sustainability	Continue to Utilize
	Department of Public Works Provides efficient, cost-effective, high-quality services relative to the operations, maintenance, planning, construction and engineering of public works infrastructure and waste management for the City of Providence.	Citywide	Effectiveness: Very Good Enforcement: Managed by DPW	Continue to Utilize
	Department of Public Safety The Commissioner's Office is committed to informing the residents of Providence about key public safety initiatives and encourages the public to work with us to ensure the safety and welfare of all who visit, work and live in our great city.	Citywide	Effectiveness: Very Good Enforcement: Managed by Department of Public Safety	Continue to Utilize

Table 3-4 Existing Protection Matrix Providence, RI

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Administrative and Technical				
Municipal Administration and Staff				
	Police Department Operations include the development of Operations Plans (OPS) for every event, establishment of a Special Response Unit, and a more holistic, comprehensive approach to policing (building partnerships with the business community, cross-training, and improved communications.	Citywide	Effectiveness: Very Good Enforcement: Managed by Police Department	Continue to Utilize
	Fire Department Provides for the protection of human life and property from fire and other disasters, either natural or man-made, through fire safety education, the development, and enforcement of fire codes, provision of emergency medical services and suppression of fire.	Citywide	Effectiveness: Very Good Enforcement: Managed by Fire Department	Continue to Utilize
	Department of Information Technology Supports the network, applications and electronic hardware throughout the City which employees and the public use to conduct daily business.	Citywide	Effectiveness: Very Good Enforcement: Managed by Department of Information Technology	Continue to Utilize
State of Rhode Island				
	Emergency Management State Radio System The EMSTARS is a Simplex (non-repeated) radio system that links local EOCs to the Rhode Island State EOC.	Citywide	Effectiveness: Very Good Enforcement: Managed by PEMA	Continue to Utilize
	National Warning System (NAWAS) NAWAS system used to convey warnings to United States-based Federal, State and local governments, as well as the military and civilian population.	Citywide	Effectiveness: Very Good Enforcement: Department of Telecommunications	Continue to Utilize
	Rhode Island Broadcasters Association's (RIBA) Cancellation System Has a unified cancellation/delay notification system that transmits weather-related class cancellations throughout Rhode Island and bordering communities.	Citywide	Effectiveness: Very Good Enforcement: RIBA	Continue to Utilize

Table 3-4 Existing Protection Matrix Providence, RI

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Administrative and Technical				
State of Rhode Island				
	RI Red Cross Emergency Notification System Enables immediate information dissemination of updates, reminders and emergencies to Rhode Island Red Cross Volunteers via various contact methods.	Citywide	Effectiveness: Very Good Enforcement: RI Red Cross	Continue to Utilize
	Amber Alert System The State of Rhode Island Department of Public Safety's AMBER Alert Program is a voluntary partnership between law-enforcement agencies, broadcasters, transportation agencies, and the wireless industry, to activate an urgent bulletin in the most serious child-abduction cases.	Citywide	Effectiveness: Very Good Enforcement: Dept. of Public Safety	Continue to Utilize
	Resilient Rhody This Statewide Climate Resilience Action Strategy responds to changing weather and environmental conditions in Rhode Island caused by climate change and proposes bold yet implementable actions to better prepare the state for these impacts.	Citywide	Effectiveness: Very Good Enforcement: Executive Climate Change Coordinating Council	Continue to Implement
	Implications of Climate Change for Rhode Island Wastewater Collection & Treatment Infrastructure Integrates climate change considerations into wastewater system planning and design. This study is a planning tool intended to help Rhode Islanders understand the projected implications of climate change on the state's nineteen public wastewater treatment systems.	NBC's WWTFs	Effectiveness: Very Good Enforcement: RIDEM	Continue to Assess Vulnerability
	SafeWater RI: Ensuring Safe Water for Rhode Island's Future *Assess changing conditions including, temperature, precipitation patterns, sea level rise and storm surge and their potential impacts to drinking water infrastructure in Rhode Island.*	Citywide	Effectiveness: Very Good Enforcement: RIDOH	Continue to Utilize

Table 3-4 Existing Protection Matrix Providence, RI

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Administrative and Technical				
State of Rhode Island				
	Rhode Island Special Needs Emergency Registry Allows police, fire, and other first responders in the community better prepare for and respond to community needs during a hurricane, storm, or other emergency.	Citywide	Effectiveness: Very Good Enforcement: RIDOH	Continue to Utilize
	RhodeWorks The reconstruction of structurally deficient bridges and has acted on others to prevent them from becoming structurally deficient.	Citywide	Effectiveness: Very Good Enforcement: RIDOT	Continue to Implement
	Technical Paper 167 - Vulnerability of Transportation Assets to Sea Level Rise and Storm Surge Utilizes a GIS-based methodology to assess transportation assets under state jurisdiction (including Roadways, Rail, RIPTA, Passenger Intermodal Hubs, Ports and Harbors, Bridges, Bicycle Infrastructure) at risk.	Citywide	Effectiveness: Very Good Enforcement: RIDOA	Continue to Utilize
	Reverse 911 A communication system that allows emergency services to quickly contact members of a community or organization with information. This system allows emergency services to do the "reverse" and inform the public of a known hazard.	Citywide	Effectiveness: Very Good Enforcement: RI Dept. of Public Safety	Continue to Utilize
	StormSmart Coasts A web resource dedicated to helping decision makers in coastal communities address the challenges of storms, flooding, sea level rise, and climate change by providing a place to find and share the best resilience-related resources available.	Coastal areas	Effectiveness: Very Good Enforcement: Mayor, City Council, Planning Commission	Continue to Utilize

Table 3-4 Existing Protection Matrix Providence, RI

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Administrative and Technical				
North American Marine Industry Environmental Certification				
	Green Marine Provides a step-by-step template for port authorities, terminal operators, shipping lines and shipyard managers to voluntarily and measurably reduce their environmental footprint using 12 performance indicators that include lowering air emissions, minimizing community impacts and demonstrating environmental leadership.	ProvPort	Effectiveness: too early to determine Enforcement: Green Marine Management Corporation	Continue to Utilize
Coordination with Neighboring Municipalities				
	Coordination to identify applicable efficiencies (resource-sharing and Mutual Aid agreements).	Regional context	Effectiveness: Very Good Enforcement: PEMA	Maintain
Coordination with Area Colleges and Universities				
	Coordination to understand future development/expansion plans, energy disruptions, and evacuation of at-risk population.	Area Colleges/Universities	Effectiveness: Good Enforcement: PEMA	Maintain
Coordination with Area Hospitals and Health Care Centers				
	Coordination to understand future development/expansion plans, energy disruptions, and evacuation of at-risk population.	Area Hospitals/Health Care Centers	Effectiveness: Good Enforcement: PEMA	Maintain
Financial				
Federal/State Funding Opportunities				
	FEMA 2013 Hazard Mitigation Guidance, HMA Guidance, FEMA requirements regarding HMGP, PDM and FMA grants. http://www.fema.gov/media-library/assets/documents/33634?id=7851	Townwide		Continue to utilize
	HUD CDBG Disaster Recovery Assistance: http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/drsi	Low-income areas.		Continue to utilize

Table 3-4 Existing Protection Matrix Providence, RI

Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Financial				
Federal/State Funding Opportunities				
	USDA, Natural Resources Conservation Service (NRCS) Conservation Technical Assistance: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/cta Financial Assistance: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/ Conservation Innovation Grant Programs:	Citywide		Continue to utilize
	R.I. State Hazard Mitigation Officer (SHMO) and State Mitigation Planners	Citywide		Continue to utilize
	2018 Rhode Island State Hazard Mitigation Plan	Citywide		Continue to utilize
Local/Municipal Funding Opportunities				
	Capital Improvement Plan Provides for both short- and long-term capital improvement projects through its CIP.	Citywide		Continue to utilize

Section 4 Mitigation Strategy

4.1 Introduction

Removing and precluding development from hazardous areas is the best method of mitigation. However, this cannot be the sole focus of hazard mitigation in the City of Providence. The city's character and functionality require a level of intimacy with the areas of greatest risk – wind-related, winter-related, and flood-related hazards.

4.2 Mitigation Activities

In completing the risk and vulnerability analyses, the LHMC considered projects and actions that would reduce Providence's vulnerability to the identified hazards. The updated 2019 Risk Assessment Matrix (Table 2-1) is the basis for the mitigation actions presented in Section 4.3.

4.3 Mitigation Action Plan

The LHMC considered the goals of this plan and re-prioritized the matrix and the associated actions based on historical damage, safety of the population, property protection, and consistency with citywide goals and objectives. After the 'Priority Score' for each mitigation action, the '2013 Plan Score' has been included to reflect any changes in the prioritization of actions for this 2019 Update by the LHMC. Issues and objectives were aligned to public health risks, evacuation and mass care considerations, disruption of essential services, and potential economic losses to the city.

The LHMC determined that the identified objectives could be met by considering actions aligned to the following Mitigation Categories:

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

The LHMC has worked to set goals and objectives that are bounded by a time frame and are compatible and consistent with state hazard mitigation goals. Upon submittal of this plan to RIEMA, the State Hazard Mitigation Committee (SHMC) is expected to review and approve these goals and objectives to ensure consistency with the statewide goals and objectives. The time frames used for this strategy are as follows:

- Short Term = Less than six months
- Medium Term = six to 24 months
- Long Term = more than 24 months

The following actions use the Risk Assessment Matrix (Table 2-1) to identify areas at risk, offer mitigation strategies, and consider benefits. Each action offers a discussion of the project and if applicable, includes the options considered. Multiple actions associated with a vulnerable area reflect city priorities and are simply prioritized high, medium or low. If known, the actions include cost estimations and assign responsible parties to lead the efforts to complete the action. The cost ranges used for this strategy are as follows:

- Staff Time – Municipal staff time
- Minimal – less than $5,000
- Moderate – between $5,000 and $25,000
- Significant – over $25,000

Other relevant departments/agencies that can offer support to the project are also listed. Finally, possible finance options are offered. Once the 2019 Update receives FEMA's 'Approved Pending Adoption', the mitigation strategy will be put into motion. (The source for the mitigation action is included below each action in red font).

Evaluation/Selection of Mitigation Actions

After reviewing the City's identified risks and vulnerabilities to natural, human-caused, and technologic hazards, the input/feedback from the public workshops and recommendations from the City, and the local Capability Assessment, the LHMC selected mitigation actions to incorporate into the 2019 update.

Prioritization of Actions

Due to budgetary constraints and other limitations, it is often impossible to implement all mitigation actions. The LHMC needed to select the most cost-effective actions for implementation first to use resources efficiently and develop a realistic approach toward mitigation risks. The Disaster Mitigation Act 2000 (DMA) supports this principle of cost-effectiveness by requiring action plans to follow a prioritization process that emphasizes benefits over costs. DMA 2000 states:

> *"The mitigation strategy section shall include an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs."*

Part 1: Review Benefits and Costs

As part of the planning process, the LHMC utilized Review Tools 1, 2, and 3 associated with each action identified.

Part 2 Prioritize Actions – Qualitative Method, Relative Score

The LHMC utilized Method B: Prioritization using the Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLEE) criterion Relative Scores, suggested in FEMA's Hazard Mitigation Planning How-to-Guide Series (Table 4.2).

Table 4.1 STAPLEE Review and Selection Criteria

Category	Criteria
Social	Is the proposed action socially acceptable to the community?
	Are there equity issues involved that would mean that one segment of the community is treated unfairly?
	Will the action cause social disruption?
Technical	Will the proposed action work?
	Will it create more problems than it solves?
	Does it solve a problem or only a symptom?
	Is it the most useful action in light of other community goals?
Administrative	Can the community implement the action?
	Is there someone to coordinate and lead the effort?
	Is there sufficient funding, staff, and technical support available?
	Are there ongoing administrative requirements that need to be met?
Political	Is the action politically acceptable?
	Is there public support both to implement and to maintain the project?
Legal	Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity?
	Are there legal side effects? Could the activity be construed as a taking?
	Is the proposed action allowed by a comprehensive plan, or must a comprehensive plan be amended to allow the proposed action?
	Will the community be liable for action or lack of action?
	Will the activity be challenged?
Environmental	How will the action affect the environment?
	Will the action need environmental regulatory approvals?
	Will it meet local and state regulatory requirements?
	Are endangered or threatened species likely to be affected?
Economic	What are the costs and benefits of this action?
	Do the benefits exceed the costs?
	Are initial, maintenance, and administrative costs taken into account?
	Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private)?
	How will this action affect the fiscal capability of the community?
	What burden will this action place on the tax base of the local economy?
	What are the budget and revenue effects of this activity?
	Does the action contribute to other community goals, such as capital improvements or economic development?
	What benefits will the action provide?

Part 3 Documentation of the Process

Each of the mitigation actions were scored against each of the STAPLEE criteria with a numerical score. These numbers were then totaled to reach an overall priority score (Table 4-2). The ranking of the priority score is a guideline for when the City should begin acting on the identified strategies or actions.

The STAPLEE method includes a cost-benefit review as part of the prioritizing mitigation actions. A more detailed cost-benefit analysis will be done at the time of application for those proposed mitigation actions that the City applies for funding under the PDM HMGP.

Table 4.2 STAPLEE Analysis

2019 Action Number	Title	Cost/ Benefit	Social	Technical	Administrative	Political	Legal	Environmental	Economic	Total	Prioritization
PUBLIC EDUCATION AND AWARENESS											
2019 - 1	Stormwater Learning Center	Cost	2	1	1	2	2	1	2	11	23
		Benefit	2	2	2	2	2	0	2	12	
2019 - 2	Mitigation Education/Incentive Program	Cost	2	2	2	2	2	2	2	14	28
		Benefit	2	2	2	2	2	2	2	14	
2019 - 3	Municipal Certified Floodplain Manager	Cost	2	2	2	2	2	2	2	14	28
		Benefit	2	2	2	2	2	2	2	14	
2019 - 4	Outreach campaign evacuation routes/bridges/roads	Cost	2	2	1	2	2	1	0	10	22
		Benefit	2	2	2	2	2	2	0	12	
2019 - 5	Port resilience through partnerships/planning	Cost	2	1	-1	1	2	1	2	8	20
		Benefit	2	2	2	1	2	1	2	12	
2019 - 6	Outreach program floodplain compliance	Cost	2	2	1	2	2	1	2	12	23
		Benefit	2	2	1	1	2	1	2	11	
2019 - 7	Periodic CRS Feasibility	Cost	2	2	1	1	2	2	2	12	25
		Benefit	2	2	1	2	2	2	2	13	
2019 - 8	Exercise to test RI's MEDS at PODs	Cost	2	2	2	2	2	2	2	14	28
		Benefit	2	2	2	2	2	2	2	14	
2019 - 9	Develop climate resilience checklist new construction	Cost	2	2	2	2	2	2	2	14	28
		Benefit	2	2	2	2	2	2	2	14	
2019 - 10	Develop report to reflect long-term monitoring of hurricane barrier efficacy	Cost	2	2	2	2	2	2	2	14	28
		Benefit	2	2	2	2	2	2	2	14	

2019 Action Number	Title	Cost/ Benefit	Social	Technical	Administrative	Political	Legal	Environmental	Economic	Total	Prioritization
PLANNING AND PREVENTION											
2019 - 11	Encourage port-area businesses participate in Green Marine	Cost	2	1	0	2	0	1	2	8	**19**
		Benefit	2	2	2	2	0	1	2	11	
2019 - 12	Develop stakeholder committee to execute Phase III of UNBRSM (Stormwater Utility)	Cost	2	2	2	2	2	2	2	14	**28**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 13	Support green infrastructure techniques/applications	Cost	2	2	1	2	2	1	2	12	**28**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 14	Develop flood resiliency plan for Woonasquatucket River	Cost	2	2	2	2	2	2	2	14	**28**
		Benefit	2	2	2	2	2	2	2	14	
PROPERTY PROTECTION											
2019 - 15	New location vital municipal documents	Cost	2	2	2	1	2	2	2	13	**27**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 16	Retro-fit older buildings for code compliance	Cost	2	-1	2	1	2	-1	2	7	**21**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 17	Develop dam safety notification system	Cost	2	2	2	2	2	2	2	14	**28**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 18	Conduct risk assessment of coastal/riverine flooding and stormwater infrastructure	Cost	2	-1	-1	1	2	-1	2	4	**18**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 19	Facilitate water supply redundancy across districts	Cost	2	2	2	2	2	2	2	14	**28**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 20	Ensure spillway management/coordination with suppliers/municipalities	Cost	2	2	2	2	2	2	2	14	**28**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 21	Minimize impervious surface coverage	Cost	2	2	2	2	2	2	2	14	**28**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 22	Develop erosion mitigation strategies for shoreline areas	Cost	2	1	1	2	2	1	2	11	**25**
		Benefit	2	2	2	2	2	2	2	14	

2019 Action Number	Title	Cost/ Benefit	Social	Technical	Administrative	Political	Legal	Environmental	Economic	Total	Prioritization
STRUCTURAL PROJECTS											
2019 - 23	Support resilient strategies for NBC's facilities	Cost	2	2	2	2	2	2	2	14	**28**
		Benefit	2	2	2	2	2	2	2	14	
EMERGENCY SERVICES											
2019 - 24	Develop partnerships for Business Continuity Plans	Cost	2	2	2	2	2	2	2	14	**28**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 25	Evaluate long-term solution for flooding at Atwells Ave. Fire Station	Cost	2	-1	-1	2	2	2	0	6	**18**
		Benefit	2	2	2	2	2	2	0	12	
2019 - 26	Enhance coordination between City/wireless providers	Cost	2	2	2	2	2	2	0	12	**23**
		Benefit	2	2	2	2	2	1	0	11	
PLANNING AND PREVENTION											
2019 - 27	Work with RIDOT to prioritize transportation asset improvements	Cost	2	1	2	2	2	1	1	12	**26**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 28	Ensure agency/municipality data consistency	Cost	2	2	2	2	2	2	2	14	**28**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 29	Develop/maintain database of technologic/human-caused hazards	Cost	2	1	2	2	2	2	2	14	**28**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 30	Consider acquisition of repetitive flood loss properties	Cost	1	1	1	1	1	1	2	8	**16**
		Benefit	1	1	1	1	1	1	2	8	
2019 - 31	Develop education/outreach campaign to mitigate cyber threats	Cost	2	1	2	2	2	2	0	11	**23**
		Benefit	2	2	2	2	2	2	0	12	
2019 - 32	Design/Implement targeted strategy for energy security	Cost	2	1	1	2	2	2	0	10	**22**
		Benefit	2	2	2	2	2	2	0	12	
2019 - 33	Update Fox Point Hurricane Barrier coordination guidebook	Cost	2	2	2	2	2	2	2	14	**28**
		Benefit	2	2	2	2	2	2	2	14	
2019 - 34	Host annual workshop/tabletop exercise on climate change projections	Cost	2	2	2	2	2	2	0	12	**22**
		Benefit	1	2	2	2	2	1	0	10	

PUBLIC EDUCATION AND AWARENESS

Action #1

Create a Stormwater Learning Center in Roger Williams Park
Staff/Agency/Organization Interviews

Partner with academic institutions, government agencies, and nonprofits to create a living laboratory for green infrastructure. The primary functions are to 1) provide opportunities for learning best practices for project design, construction and maintenance, 2) scientific research and analysis to measure water quality impacts of stormwater management practices, and 3) training, outreach and education to build the community of practice and foster broad public engagement in sustainable environmental practices.

- Action Type: Planning, Pre-Disaster
- Priority Score: 23
- Lead: Office of Sustainability
- Supporting: Community institutions/agencies/non-profits
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City budget
- Cost Estimate: Staff time
- Benefit: Institutional awareness of hazards, impacts on stormwater system and water quality
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #2

Implement Mitigation Education and Incentive Program.
Rhode Island 2018 State Hazard Mitigation Plan

The Inspection and Standards Department will provide information to contractors and homeowners on risks of building in hazard-prone areas and inform builders and homeowners of the benefits of building and renovating structures to current standards. The City will use FEMA's *Home Builder's Guide to Coastal Construction* (Publication #499), FEMA's *Coastal Construction Manual*, (Publication #55CD Third Edition), *No Adverse Impact (NAI) Coastal Land Management Guidelines* developed by the Association of State Floodplain Managers, *R.I. Coastal Properties Guide*, and other FEMA publications, as applicable.

In addition, the City will promote and support enforcement of the latest policy revisions relative to climate change and SRL and distribute literature related to mitigation techniques including information from the Institute of Business and Home Safety, retrofit methodology (FEMA's library of Technical Bulletins), grant/loan sources, and insurance options.

Consider developing public/private partnership incentives to implement mitigation measures in coordination with local, state, and federal funding opportunities. Incentives could include tax incentives, cost-sharing, and regulatory streamlining or acceleration of the permit process for those who implement mitigation activities.

- Action Type: Planning, Pre-Disaster
- Priority Score: 28
- Lead: Inspection and Standards Department
- Supporting: Department of Planning and Development
- Time Frame: 0 – 6 months (Short-term)
- Financing Options: City budget
- Cost Estimate: Staff Time
- Benefit: Institutional awareness of hazards for contractors/homeowners, increased property protection/improved resiliency
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #3
Identify municipal personnel to become a Certified Floodplain Manager.
LHMC

Personnel from the Inspection and Standards Department should become a Certified Floodplain Manager (CFM) through the Association of State Floodplain Managers and serve as the City's Floodplain Coordinator. In addition to providing floodplain coordination information to the public, a CFM can assist with floodplain mapping, elevation certificates and floodplain mitigation alternatives.

- Action Type: Planning, Pre-Disaster
- Priority Score: 28
- Lead: Inspection and Standards Department
- Supporting: Department of Planning and Development
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City budget
- Cost Estimate: Staff time
- Benefit: Institutional awareness of hazards for contractors/homeowners, increased property protection/improved resiliency
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #4
Implement a public outreach campaign to inform community members about evacuation routes and which bridges and roads are subject to periodic flooding.
Rhode Island 2018 State Hazard Mitigation Plan

Steps should be taken to inform residents about which bridges, and roads are subject to flooding, as well as about indicators to begin evacuation. Principles of the Emergency Response Plan that are pertinent to given neighborhoods or the population in general should be summarized and distributed. Hazardous locations and warning signs, along with critical phone numbers and evacuation routes, could be conveyed on a calendar, a refrigerator magnet, or some other item commonly displayed in households. Outreach to residents could also be in the form of an annual mailing prior to hurricane season to give information on property protection and preparedness. Public service messages in the newspaper, on the radio, or during public forums may be alternatives.

Incorporate education/awareness for out of town/state visitors/tourists. Visitors/tourists may not be familiar with local authorities, evacuation routes, or know what to expect if police-enforced evacuation becomes necessary. Distribute information on city evacuation routes and emergency services to hotels, Bed and Breakfasts, real estate agencies dealing with seasonal rentals, and other facilities and events hosting tourists.

This action should include the annual update on the vulnerability of these critical infrastructure components in relation to climate change and SRL, with revisions made accordingly.

- Action Type: Planning, Pre-Disaster
- Priority Score: 22
- Lead: PEMA
- Supporting: DPW/RIDOT
- Time Frame: 0 – 6 months (Short-term)
- Financing Options: City budget
- Cost Estimate: Staff Time
- Benefit: Protection of life, institutional awareness of hazards, accelerated evacuation
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #5

Strengthen storm resilience at the port through strategic partnerships and planning.

City of Providence Harbor Management Plan
Resilient Rhody

Shipping lines will turn to ports that rapidly resume normal operations after hurricanes. The City of Providence should approach storm resilience and climate change as a business opportunity through inclusion of resilience planning such as, developing pre-contracts for debris removal after an event, or businesses could implement data backup mechanisms to help the port resume operations more quickly after an event. Encourage the establishment of a new collaborative partnership between the state and port community to better understand the economic implications of severe weather events and benefits of resiliency planning.

Prior to the start of hurricane season (June 1st), PEMA will:

- Develop and implement an annual Disaster Mitigation Workshop for businesses, industries, and shoreline users
- Develop and implement an education/training program for harbor and shorefront users that includes the distribution of the Harbor Hazard Mitigation Plan and a storm readiness checklist for boaters
- Update accurate lists of principal marine interests and pumpout facilities including marinas, waterfront businesses, neighboring Harbormasters, Coast Guard, Towing and Salvage Companies, Environmental teams, Key vessel operators, and fishing cooperatives

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: 20
- Lead: Harbor Management Commission/Office of Strategic Partnerships and Economic Advancement
- Supporting: RIEMA/Department of Planning and Development
- Time Frame: 6 – 24 months (Medium- term)
- Financing Options: City budget
- Cost Estimate: Staff time and materials cost
- Benefit: Reduced losses/damages, improved resiliency, accelerated recovery
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #6

Develop and implement a public outreach program to notify property owners in A- and V-zones of the requirements to comply with new floodplain standards.

Strategy for Reducing Risks from Natural & Human-Caused Hazards in Providence, Rhode Island: A Multi-Hazard Mitigation Plan 2013

The Inspection and Standards Department enforce compliance of building permits with floodplain standards. A public outreach program would inform residents/contractors in in the application process.

- Action Type: Planning, Pre-Disaster
- Priority Score: 23 (2013 Score: High)
- Lead: Inspection and Standards
- Supporting: Department of Planning and Development
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: FEMA Flood Mitigation Assistance Program
- Cost Estimate: Staff time and materials cost
- Benefit: Reduced damage, improved resiliency
- Vulnerable Area: A-V Zone properties

Action #7

Conduct periodic review on the feasibility of enrolling in the NFIP's Community Rating System (CRS) as a means to soften the likely increase in many flood insurance policy rates resulting from new reforms to the NFIP.

Rhode Island 2018 State Hazard Mitigation Plan

Strategy for Reducing Risks from Natural & Human-Caused Hazards in Providence, Rhode Island: A Multi-Hazard Mitigation Plan 2013

CRS is a voluntary program that recognizes and encourages a community's efforts that exceed the NFIP minimum requirements for floodplain management. The CRS program emphasizes three goals:

- the reduction of flood losses
- facilitating accurate insurance rating
- promoting the awareness of flood insurance

By participating in the CRS program, communities can earn a 5-45% discount for flood insurance premiums based upon the activities that reduce the risk of flooding within the community.

The City evaluated the feasibility of enrolling in the CRS program in 2013 and again in 2015. In both instances, it was determined as not cost-beneficial to pursue enrolling given the limited number of existing policies and limited capacity of staff to complete.

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: 25 (2013 Score: Medium)
- Lead: Inspection and Standards/Department of Planning and Development
- Supporting: RIEMA
- Time Frame: >24 months (Long-term)
- Financing Options: FEMA Flood Mitigation Assistance Program
- Cost Estimate: Staff time
- Benefit: Reduced flood insurance policy premiums
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

PLANNING AND PREVENTION

Action #8

Conduct a full-scale exercise to test RI's Medical Emergency Distribution System (MEDS) and its ability to rapidly dispense medical countermeasures to the general public at PODs and to predefined populations in hospitals and nursing homes within the City of Providence.

Rhode Island 2018 State Hazard Mitigation Plan

MEDS is intended to mitigate the spread of morbidity and mortality during public health emergencies (such as large-scale disease outbreak or bioterrorism attack) through the timely provision of countermeasures.

The City of Providence should:

- Prepare to receive and dispense medical countermeasures to their entire population within 48 hours of the decision to do so as part of the federal Cities Readiness Initiative
- Conduct annual exercises of POD
- Utilize POD for: Flu vaccine and Tdap/Seasonal flu vaccinations
- Train staff, volunteers, and medical professionals

  - Action Type: Planning, Pre/Post-Disaster
  - Priority Score: 28
  - Lead: PEMA
  - Supporting: RIDOH/Healthcare Coalition of RI
  - Time Frame: 6 – 24 months (Medium-term)
  - Financing Options: RIDOH MEDS Budget, FEMA HMA/EMPG
  - Cost Estimate: RIDOH MEDS budget/PEMA Staff time
  - Benefit: Protection of life
  - Vulnerable Area: City of Providence

Action #9

Develop a climate resilience checklist for new construction and large renovations.

LHMC

Boston, MA (https://www.boston.gov/departments/public-works/climate-resilient-design-standards-and-guidelines)

Checklist to inform the design of all new construction and major rehabilitation projects to be evaluated based on climate change variables, including temperature, precipitation, and SRL. This checklist will inform future policy decisions, as well as help guide developers to consider long-term climate impacts.

  - Action Type: Planning, Pre-Disaster
  - Priority Score: 28
  - Lead: Office of Sustainability, Department of Planning and Development
  - Supporting: Inspection and Standards
  - Time Frame: 6 – 24 Months (Medium-term)
  - Financing Options: City budget
  - Cost Estimate: Staff time
  - Benefit: Protection of life/property, reduced losses/damages, improved resiliency,
  - Vulnerable Area: City of Providence

Action #10

Develop a report to reflect the long-term monitoring of climate change projections for Rhode Island/City of Providence that evaluates the efficacy of the hurricane barrier to protect the City of Providence.

Analyzing Coastal Flood Protection Strategies for Providence, Rhode Island

The City of Providence continues to investigate the impacts of climate change on the frequency of flood events within the city, more recently with a focus on the Fox Point Hurricane Barrier. A 2016 analysis quantitatively assessed risks and potential economic losses due to SRL, as well as informing the timing of decisions for future climate resilience investments. The primary concern is whether the hurricane barrier will continue to protect against future storm surge due to sensitivity of the SRL projection used in the long-term. Results of this analysis indicate if a low-probability, high SRL projection is used, then the optimal strategy is to build a new, taller barrier by the end of the century. However, under the highest-probability, lower SRL projections, the existing barrier is expected to be cost effective in protecting the city from storm surge well into the 22nd century (assuming it can be maintained past its design lifetime).

Prior to development of this report, the City should implement a public engagement process to inform community members and other stakeholders of the long-term impacts of climate change on the City's waterfront (north of the hurricane barrier) and to create guiding principles and values for how to manage these impacts going forward.

Due to the increase in the frequency of tidal flooding (so-called nuisance flooding), tide heights that prompt a precautionary closing of the hurricane barrier occur about 10 times a year today. However, they would occur more than weekly by 2050 and twice daily by 2100. While it is anticipated the hurricane barrier will continue to mitigate nuisance flooding through 2100, questions remain about whether it can withstand near-constant use, as projected by 2050.

A 2016 analysis determined the most cost-effective approach to address tidal flooding is to raise the threshold at which the hurricane barrier is shut and prepare the waterfront to be periodically flooded, rather than invest in infrastructure to stop the infiltration of water. The construction of sea walls to prevent nuisance flooding was also an examined alternative of this analysis.

A public engagement process should focus on whether the community wants to invest in sea walls (and accept the resulting change in character of low-lying waterfront areas) or maintain current views and character and accept periodic flooding. If the construction of sea walls was determined to be the preferred alternative, the 2016 analysis suggested construction begin in 2040 – 2050.

This report (every five years, and in advance of the next hazard mitigation plan update) should include findings from federal, state and local agencies and leaders who will continue to monitor climate change projections in order to inform the timing of decisions

about the future of the hurricane barrier (current analysis suggests a decision be made by 2050).

- Action Type: Planning, Pre-Disaster
- Priority Score: 28
- Lead: Office of Sustainability/Operations Department
- Supporting: Army Corps, PEMA, RIEMA, DPW, NBC, CRMC
- Time Frame: >24 months (Long-term)
- Financing Options: City budget
- Cost Estimate: Staff time
- Benefit: Protection of life/property, reduced damage, improved resiliency, accelerated recovery
- Vulnerable Area: A-V Zone properties, Hurricane Barrier, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #11

Promote resiliency, protection and improvement of water and air quality, compatible uses, port/community relations and economic vitality in the port area by encouraging port-area businesses to participate in certification programs such as Green Marine.

City of Providence Harbor Management Plan

Support development of green port initiatives designed to encourage port operators to adopt best practices in areas such as stormwater management, green infrastructure, renewable energy, energy conservation, air quality, habitat protection, living shorelines, public access, and future climate change considerations for operations and expansion plans. Enforce compliance with hazard mitigation and debris management regulations and work with the Harbormaster and others to manage the cleanup of large debris after storms, including derelict vessels, damaged and derelict piers, and downed tree limbs.

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: 19
- Lead: Department of Planning and Development/office of Sustainability
- Supporting: EPA/RI DEM/Harbor Management Commission, Strategic Partnerships
- Time Frame: Medium-term
- Financing Options: City budget
- Cost Estimate: Staff time
- Benefit: Continuity of services, improved resiliency, accelerated recovery
- Vulnerable Area: Port area (industrial sites)

Action #12

Develop a stakeholder committee to execute Phase III of the Upper Narragansett Bay Regional Stormwater Management (UNBRSM) Initiative to develop a regional stormwater utility.

Exploring Regional Solutions to Regional Problems Upper Narragansett Bay Regional Stormwater Utility Feasibility Study - Phase I Final Report
Resilient Rhody
City of Providence Harbor Management Plan

A long term, sustainable solution to stormwater management is needed in the Upper Narragansett Bay region due to real, growing, shared and unresolved challenges in managing stormwater. City staff identified several concerns regarding limited public awareness about a stormwater utility within the city, including aging infrastructure, flooding problems (local streets), MS4 permit compliance, and water quality concerns. City staff also indicated a significant gap in funding for routine maintenance of the CSS and MS4 systems, as well as capital improvements to address water quality. A public education/awareness campaign perhaps hosted on the City's website could provide the information necessary for the City to make more informed decisions on the topic.

- Action Type: Planning, Pre-Disaster
- Priority Score: 28
- Lead: Office of Sustainability/Operations Department
- Supporting: Stakeholder Committee
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City budget
- Cost Estimate: Significant
- Benefit: Public awareness regarding minimized flood losses/damages, improved water quality
- Vulnerable Area: A-V Zone properties

Action #13

Support green infrastructure techniques/applications to reduce flooding, ease the burden on traditional stormwater systems, and improve and protect water quality.

Rhode Island 2018 State Hazard Mitigation Plan
Resilient Rhody
City of Providence Harbor Management Plan

The City already encourages the use of green infrastructure techniques/applications in development/redevelopment proposals. This is a continuation of standard operating procedures to reduce flooding, minimize impacts on stormwater systems, and improve/protect water quality.

- Action Type: Planning, Pre-Disaster
- Priority Score: 26
- Lead: Department of Planning and Development, Office of Sustainability, DPW

- Supporting: RI Department of Environmental Management/RIDOT
- Time Frame: >24 months (Long-term)
- Financing Options: FEMA HMGP/PDM funds
- Cost Estimate: Significant
- Benefit: Reduced losses/damages and improved resiliency
- Vulnerable Area: A-V Zone properties

Action #14
Develop a flood resiliency plan for the Woonasquatucket River to both account for existing flooding as well as make it more resilient to future change.
Woonasquatucket River Watershed Council

The Woonasquatucket River corridor is a recreational and natural resource amenity for residents, workers and businesses in Providence. The corridor floods periodically jeopardizing public access, recreation opportunities and habitat for wildlife.

- Action Type: Planning, Pre-Disaster
- Priority Score: 28
- Lead: PEMA, Office of Sustainability
- Supporting: Woonasquatucket River Watershed Council
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: Federal grants, Woonasquatucket River Watershed Council
- Cost Estimate: Significant
- Benefit: Reduced losses/damages, improved access, minimized disturbance to wildlife habitat and improved resiliency
- Vulnerable Area: Woonasquatucket River Watershed Council

PROPERTY PROTECTION

Action #15
Identify new location for vital municipal documents.
Strategy for Reducing Risks from Natural & Human-Caused Hazards in Providence, Rhode Island: A Multi-Hazard Mitigation Plan 2013

For the most part, City Hall is protected from serious flooding by the Hurricane Barrier. In the unlikely event that the barrier should fail, the City's Department of Public Property must insure that vital documents are stored in upper stories or in flood-proof cabinets or located outside of a flood zone.

- Action Type: Planning, Pre-Disaster
- Priority Score: 27 (2013 Score: Low)
- Lead: Department of Public Property, City Archives, Public Records
- Supporting: Department of Planning and Development
- Time Frame: 6 – 24 months (Medium-term)

- Financing Options: City budget, FEMA, FMAP
- Cost Estimate: Significant
- Benefit: Minimized losses/damages, protection of vital documents
- Vulnerable Area: City Hall and Other Public Properties

Action #16

Retrofit older buildings to comply with current code requirements.

Strategy for Reducing Risks from Natural & Human-Caused Hazards in Providence, Rhode Island: A Multi-Hazard Mitigation Plan 2013

Like City Hall, Downtown Providence is protected from serious flooding by the Hurricane Barrier. Moreover, most new buildings are earthquake resistant. Some buildings both in and out of downtown would require some retrofitting. Buildings constructed after the end of the World War II would have been designed according to then- accepted structural engineering practice, resembling current code requirements, to withstand hurricane force winds. Some pre-war buildings may not have utilized structural engineering criteria resembling current code requirements. Structural analysis should be provided by property owners to determine which buildings are structurally consistent with current code requirements and currently accepted engineering practice.

- Action Type: Planning, Pre-Disaster
- Priority Score: 21 (2013 Score: High)
- Lead: Department of Public Property
- Supporting: Inspection and Standards
- Time Frame: >24 months (Long-term)
- Financing Options: City budget/private funds
- Cost Estimate: Significant
- Benefit: Minimized damage, improved resiliency
- Vulnerable Area: Buildings with Archaic Structural Systems

Action #17

Develop a dam safety notification system to coordinate the actions of officials at the federal, state, and local levels.

Resilient Rhody

Establish a notification system for dam safety to coordinate the actions of officials at the federal, state, and local levels. The system should use the process developed by the National Weather Service for severe weather, including a dam advisory, a dam watch, and a dam warning.

- Action Type: Planning, Pre-Disaster
- Priority Score: 28
- Lead: RI Department of Environmental Management
- Supporting: RIEMA
- Time Frame: 6 – 24 months (Medium-term)

- Financing Options: RIDEM
- Cost Estimate: Staff time
- Benefit: Minimized flood losses/damages
- Vulnerable Area: A-V Zone properties

Action #18
Mitigate impacts of coastal and riverine flooding on stormwater infrastructure and its performance by conducting a risk assessment.
Rhode Island 2018 State Hazard Mitigation Plan
Resilient Rhody

Identify at-risk structures, then develop projects and/or policies to address risks and establish process for maintenance of stormwater ponds.

- Action Type: Planning, Pre-Disaster
- Priority Score: 18
- Lead: DPW/NBC
- Supporting: RI Department of Environmental Management
- Time Frame: >24 months (Long-term)
- Financing Options: Pre-Disaster Mitigation/Hazard Mitigation Grant Program funds
- Cost Estimate: Moderate
- Benefit: Reduced losses/damages, improved resiliency
- Vulnerable Area: A-V Zone properties

NATURAL RESOURCE PROTECTON

Action #19
Facilitate redundancy of supply across water supply districts throughout the state.
Rhode Island 2018 State Hazard Mitigation Plan
Resilient Rhody

Assist water suppliers in developing local Emergency Interconnection Programs. Emergency water system interconnections provide redundancy of supply and the ability to address water emergencies rapidly and efficiently across water supply districts particularly in small systems throughout the state.

- Action Type: Planning, Pre-Disaster
- Priority Score: 28
- Lead: RI Water Resources Board
- Supporting: RI Department of Health
- Time Frame: >24 months (Long term)
- Financing Options: Drinking Water State Revolving Fund
- Cost Estimate: Staff time
- Benefit: Continuity of services

- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #20
Ensure spillway management and coordination between water suppliers and downstream municipalities.
Rhode Island 2018 State Hazard Mitigation Plan
Resilient Rhody

Advance common goal setting and communication between water suppliers that manage reservoirs and downstream municipalities. Ensure downstream flood mitigation via proactive spillway management without adverse impacts on safe yield.

- Action Type: Planning, Pre-Disaster
- Priority Score: 28
- Lead: Providence Water Supply Board
- Supporting: RIDOH/RIEMA/NOAA/NWS
- Time Frame: 0 – 6 months (Short -erm)
- Financing Options: Drinking Water State Revolving Fund
- Cost Estimate: Staff time
- Benefit: Reduced losses/damages, improved resiliency
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #21
Use Total Maximum Daily Loads (TMDLs), watershed plans and local land use analysis and planning to identify areas of existing impervious surface that can be removed/minimized.
Resilient Rhody

There may be opportunities to include drainage and/or Low Impact Development techniques, such as infiltration strips and reduced pavement, in existing commercial and municipal parking lots that are being resurfaced. As the City continues to assess the feasibility of a Stormwater Management Utility District, provisions should be made to incorporate the development of 'criteria' relative to incentive credits for stormwater improvements across three typologies: retrofit of existing paved surfaces (reductions); new/expansion of parking for commercial sites; and, residential conversions. The City should also consult the Urban Forest Management Plan.

- Action Type: Mitigation, Pre-Disaster
- Priority Score: 28
- Lead: Department of Planning and Development
- Supporting: Office of Sustainability
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City Budget, FEMA grants, private funds
- Cost Estimate: Staff time

- Benefit: Reduced flow/loading to the WWTF, increased infiltration onsite, increased property protection/resiliency
- Vulnerable Area: A-V Zone properties

Action #22
Develop erosion mitigation strategies for shoreline areas including India Point, Richmond Square, and the Seekonk River along River Drive, and promote living shorelines along currently hardened shoreline where appropriate and feasible.
City of Providence Harbor Management Plan
Resilient PVD Lab Report

- Action Type: Mitigation, Pre-Disaster
- Priority Score: 25
- Lead: Parks Department, Department of Planning and Development, DPW
- Supporting: CRMC
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City Budget, FEMA grants, private funds
- Cost Estimate: Moderate
- Benefit: Improved water quality, improved resilience
- Vulnerable Area: A-V Zone properties

STRUCTURAL PROJECTS

Action #23
Support implementation of Resilience Strategies for the NBC's Bucklin Point and Field's Point Wastewater Collection and Treatment Facility.
Implications of Climate Change for RI Wastewater Collection and Treatment Infrastructure
Resilient Rhody

NBC is currently developing a climate resiliency plan to ensure the continuity of their operations based on SRL and climate change projections anticipated for Providence/Rhode Island.

- Action Type: Planning, Pre-Disaster
- Priority Score: 28
- Lead: Narragansett Bay Commission
- Supporting: DPW, Office of Sustainability
- Time Frame: >24 months (Long-term)
- Financing Options: NBC
- Cost Estimate: Significant
- Benefit: Minimized flood losses/damages, continuity of operations, improved resiliency
- Vulnerable Area: NBC WWTF

EMERGENCY SERVICES

Action #24

Develop partnerships with businesses to provide public/private collaboration for coordinated mitigation, preparedness, response and recovery (Business Continuity Plans).
Rhode Island 2018 State Hazard Mitigation Plan

PEMA, in coordination with the RI Alliance for Business will develop strategies to help local businesses in flood prone areas recover from the effects of a natural disaster. These strategies will include organizing business owners for collective clean-up of their properties after a disaster and the creation of a list of businesses and the people connected with those businesses that are authorized to enter the businesses in the period immediately following a disaster. This list would be used by the Police Dept. in their role of guarding properties after a disaster. The Police Dept. will develop criteria for determining when safety considerations outweigh the rights of a given business owner to access their property.

- Action Type: Planning, Pre-Disaster
- Priority Score: 28
- Lead: PEMA
- Supporting: RI Alliance for Business
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: Private businesses
- Cost Estimate: Staff time
- Benefit: Accelerated clean-up and recovery
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #25

Evaluate options to determine the best long-term solution to protect the City's Fire Station on Atwells Avenue from flooding.
Strategy for Reducing Risks from Natural & Human-Caused Hazards in Providence, Rhode Island: A Multi-Hazard Mitigation Plan 2013

The City's Fire Station on Atwells Avenue at Valley Street is in a floodplain and floods periodically.

- Action Type: Planning, Pre-Disaster
- Priority Score: 18 (2013 Score: High)
- Lead: Fire Department
- Supporting: PEMA
- Time Frame: 6 – 24 Months (Medium-term)
- Financing Options: City budget, FEMA grants, Army Corps, Bonds
- Cost Estimate: Staff time
- Benefit: Minimized flood losses/damages, continuity of operations
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #26
Enhance the coordination and capabilities between the City and all wireless providers.
Staff/Agency/Organization Interviews

Wireless providers have capabilities during emergencies that could be coordinated with various municipal departments for enhanced emergency services and recovery citywide, including:

- Establish a virtual bridge with PEMA
  - Presence/communication line to EOC
  - Primary Point of Contact/direct line for more proactive coordination
- Provide priority access to emergency personnel
- Share 24/7 monitoring of coverage/internal plans during emergencies
- Consider linking network assets to shelters/gathering locations
- Share deployable assets during emergencies such as mobile cell towers and generators

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: 23
- Lead: PEMA
- Supporting: Wireless providers
- Time Frame: 6 – 24 Months (Medium-term)
- Financing Options: City/Wireless provider budgets
- Cost Estimate: Staff time
- Benefit: Expedited recovery, continuity of operations
- Vulnerable Area: Public Buildings and Critical Infrastructure

PLANNING AND PREVENTION

Action #27
Work collaboratively with RIDOT to prioritize improvements for transportation assets evaluated under various SRL scenarios throughout the city.
Technical Paper 167 – Vulnerability of Municipal Transportation Assets to SRL and Storm Surge
RIDOT Resiliency Pilot

RIDOT has conducted several studies over the past few years evaluating impacts to transportation assets impacted by various SRL scenarios. Most recently, RIDOT adopted NOAA's 'High Model' SRL projection which anticipates an increase of 8.99 feet by 2100.

The study is intended to be a resource for the state and affected communities to incorporate SRL data into informed decision-making regarding spending, planning, goal setting, communication and capacity building, and for additional analysis. This High Model should be the baseline for planning purposed regarding improvements to transportation assets throughout the city.

- Action Type: Planning, Pre-Disaster
- Priority Score: 26
- Lead: RIDOT
- Supporting: DPW/Department of Planning and Development
- Time Frame: >24 Months (Long-term)
- Financing Options: Transportation Improvement Program (TIP)
- Cost Estimate: Staff time
- Benefit: Minimized losses/damages disruption to transportation assets, improved resiliency
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #28

Ensure agency and municipality data consistency.

Rhode Island 2018 State Hazard Mitigation Plan

Updating, coordinating, and standardizing foundational resilience data including GIS layers (e.g. STORMTOOLS, critical infrastructure, precipitation projections) and related metadata should be centralized. Hosting coordinated data will provide support for municipal/agency decision-making on infrastructure/public facility investments.

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: 28
- Lead: GIS Department/Information Technology Department/PEMA
- Supporting: State Agencies
- Time Frame: 0 – 6 months (Short-term)
- Financing Options: City budget
- Cost Estimate: Staff time
- Benefit: Improved resiliency
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #29

Develop and maintain a database of technological and human-caused vulnerabilities.

Rhode Island 2018 State Hazard Mitigation Plan

Work with the state to include how technological and human-caused threats and hazards impact communities, in addition to documenting frequency and intensity of past threats and future probabilities.

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: 28
- Lead: RIEMA
- Supporting: PEMA
- Time Frame: >24 months (Medium-term)

- Financing Options: RIEMA
- Cost Estimate: Staff time
- Benefit: Improved resiliency
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #30
Consider the acquisition of properties in the Special Flood Hazard and Repetitive Flood Loss Areas.
Rhode Island 2018 State Hazard Mitigation Plan

Providence now includes 24 (8 residential and 16 non-residential) repetitive flood loss properties, as well as properties subject to periodic flooding. The City will work with private property owners in these areas and FEMA to identify an acquisition project (s), obtain approval by the State and FEMA, and seek funding to purchase the property. By purchasing these residential properties, the City is utilizing an effective program designed to move people and property away from high-risk areas to reduce disaster losses. The buildings are either demolished or relocated, and the land is then restricted to open space, recreation, or wetlands in perpetuity.

- Action Type: Mitigation, Pre/Post-Disaster
- Priority Score: 16
- Lead: Operations/Law Department
- Supporting: Department of Planning and Development/RIEMA/FEMA
- Time Frame: >24 Months (Long -term)
- Financing Options: City Budget, State/FEMA/Open Space grants
- Cost Estimate: Significant
- Benefit: Reduced losses/damages, improved resiliency, also satisfies other community objectives of additional open space, parks/recreation sites and/or scenic areas
- Vulnerable Area: A – V Zone properties, Woonasquatucket River

Action #31
Work with the state to develop an education/outreach campaign for the public and private sector on ways to mitigate cyber threats affecting personal, private, municipal, and state agency security and other sensitive information.
Rhode Island 2018 State Hazard Mitigation Plan
Providence Healthcare and Higher Education Cluster

- Action Type: Planning, Pre-Disaster
- Priority Score: 23
- Lead: RIEMA
- Supporting: PEMA
- Time Frame: >24 Months (Long -term)
- Financing Options: City Budget
- Cost Estimate: Staff/Personnel time

- Benefit: Improved resiliency
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #32
Design and implement a comprehensive, targeted strategy addressing energy security vulnerabilities at the municipal and/or facility level, based on findings of the Energy Assurance Plan.
Resilient Rhody

This strategy should address risks specific to discrete critical infrastructure assets, including hospitals, police and fire, water and wastewater infrastructure, nursing homes, shelters, fueling stations, and grocery stores. Smart energy security investments at these locations and energy resilience solutions could alleviate the impacts of power outages and fuel supply disruptions in energy emergencies (i.e. backup generation, fuel reserves, distributed generation, combined heat and power, energy storage, and microgrids).

- Action Type: Planning, Pre-Disaster
- Priority Score: 22
- Lead: Department of Planning and Development
- Supporting: Utility providers
- Time Frame: >24 Months (Long -term)
- Financing Options: City Budget, FEMA PDM/FMA/HMGP funds
- Cost Estimate: Staff time
- Benefit: Reduced disruption of services, improved resiliency
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #33
Update the Fox Point Hurricane Barrier Coordination Guidebook to include the Narragansett Bay Commission in the communication flow for operations.
Staff/Agency/Organization Interviews

The NBC will be included in the communication protocol outlined in the Fox Point Hurricane Barrier Coordination Guidebook since the operation of the hurricane barrier can have a significant impact on the Fields Point Wastewater Treatment Facility and large portions of the sewerage collection system.

- Action Type: Planning, Pre-Disaster
- Priority Score: 28
- Lead: PEMA
- Supporting: NBC
- Time Frame: 0 – 6 months (Short-term)
- Financing Options: City/NBC budgets
- Cost Estimate: Staff time
- Benefit: Protection of property, improved resiliency

- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #34
Host annual interactive workshop/tabletop exercise with key City officials, community members, and other stakeholders.
Staff/Agency/Organization Interviews

This workshop/tabletop exercise is an evolution of the "Game of Floods" event hosted in 2018 in Providence with great success. It is an engaging way for decision-makers to understand long-term climate risks, conduct vulnerability assessments, prioritize assets, and mitigate impacts.

- Action Type: Planning, Pre-Disaster
- Priority Score: 22
- Lead: Office of Sustainability
- Supporting: Department of Planning and Development
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City budget
- Cost Estimate: Staff time
- Benefit: Protection of property, improved resiliency
- Vulnerable Area: Public Buildings and Critical Infrastructure

Section 5 Plan Implementation and Maintenance

5.1 Implementation, Evaluation, and Revision of Plan

"The success of the hazard mitigation plan is measured by the degree to which actions are accomplished. Without the implementation and maintenance of the plan, the previous components have merely been an effort in research void of any practical application." —Tennessee Emergency Management Agency

Implementation

The LHMC realized that assigning a time frame to each recommended mitigation action is important so that activities can be coordinated with other important governmental functions, such as committee meetings and budget hearings. Assigned time frames also provide inputs to a project plan used for tracking the progress of all activities. Once the 2019 Update receives FEMA's 'Approved Pending Adoption', the mitigation strategy will be put into motion and the City Council will adopt the Plan (within one year of FEMA's approval). It is recognized that progress on plan implementation may vary dependent upon available funding and capacity of staff to complete assigned tasks.

Evaluation

The LHMC will meet annually to review the status of the mitigation actions. Within two months of this meeting, a status report will be given to the City Plan Commission and City Council. Progress will be reviewed every two years at advertised public hearings held by the City Plan Commission. It is advantageous the review be conducted prior to the City's annual budget process so any locally funded projects can be considered in the budget process.

PEMA will be responsible for coordinating the review meeting with the Local Hazard Mitigation Committee. The group will reconvene in the first quarter of each year. Prior to the meeting, each of the participating jurisdictions will gather data to assess progress toward meeting plan objectives and goals. The evaluation will assess whether:

- Goals and objectives address current and expected conditions
- The nature or magnitude of the risks has changed
- Current resources are appropriate for implementing the plan and if different or additional resources are now available
- Actions are cost-effective
- Schedules and budgets are feasible
- Implementation problems, such as technical, political, legal or coordination issues with other agencies are present
- Outcomes have occurred as expected
- Changes in City resources impacted plan implementation (e.g., funding, personnel, and equipment)
- Changes in programming or government structures warrant changes to the plan
- New agencies/departments/staff should be included

Specifically, the LHMC will review the mitigation goals, objectives, and activities using performance-based indicators, including:

- Project completion
- Percent complete versus percent of resources allocated
- Under/over spending
- Achievement of the goals and objectives
- Resource allocation (e.g., If there had been more money would the activity have been more successful)

Additionally, the group will review the mitigation implementation strategy using performance-based indicators including:

- Timeframes
- Budgets
- Lead/support agency commitment
- Resources (funding, personnel)
- Feasibility (Is it still an appropriate measure)

Finally, they will evaluate how other programs and policies have conflicted, or augmented, planned or implemented measures. Other programs and policies can include those that address:

- Sustainability
- Economic development
- Water quality management
- Environmental protection
- Historic preservation
- Redevelopment
- Health and/or safety
- Recreation
- Land use/current and comprehensive planning
- Transportation
- Public education and outreach

Revision

As per 44 CFR S 201.6(d)(3), the Plan will be reviewed and revised to reflect progress in local mitigation efforts and changes in priorities and resubmitted for approval within 5 years in order to continue to be eligible for mitigation project grant funding. In order to ensure that the Plan remains current, the LHMC, which consists of representatives from the Department of Planning and Development, Office of Sustainability, EMA, Public Works, Zoning and Code Enforcement, Fire Department, Police Department, and Utility providers/distributors will meet annually. The Plan will also be evaluated and updated after a disaster, or as funding opportunities arise for the actions and projects identified

in the plan. Any updates will be reviewed and submitted to RIEMA upon local approval to ensure that the state hazard mitigation strategy remains current.

The City of Providence Multi-Hazard Mitigation Plan will be incorporated into the City's Comprehensive Plan, CEMP for consistency and CIP for potential funding of projects, as appendices.

5.2 Continued Public Involvement

The City of Providence will continue public involvement in the plan maintenance process by:

- The approved/adopted plan will be posted on the City's website.
- The annual meeting of the LHMC to review the implementation of the Plan will be posted/advertised as a public meeting as per City guidelines.
- The LHMC will include the public in the preparation of the five-year update using the same public participation process as in the development of this update.

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Appendix A

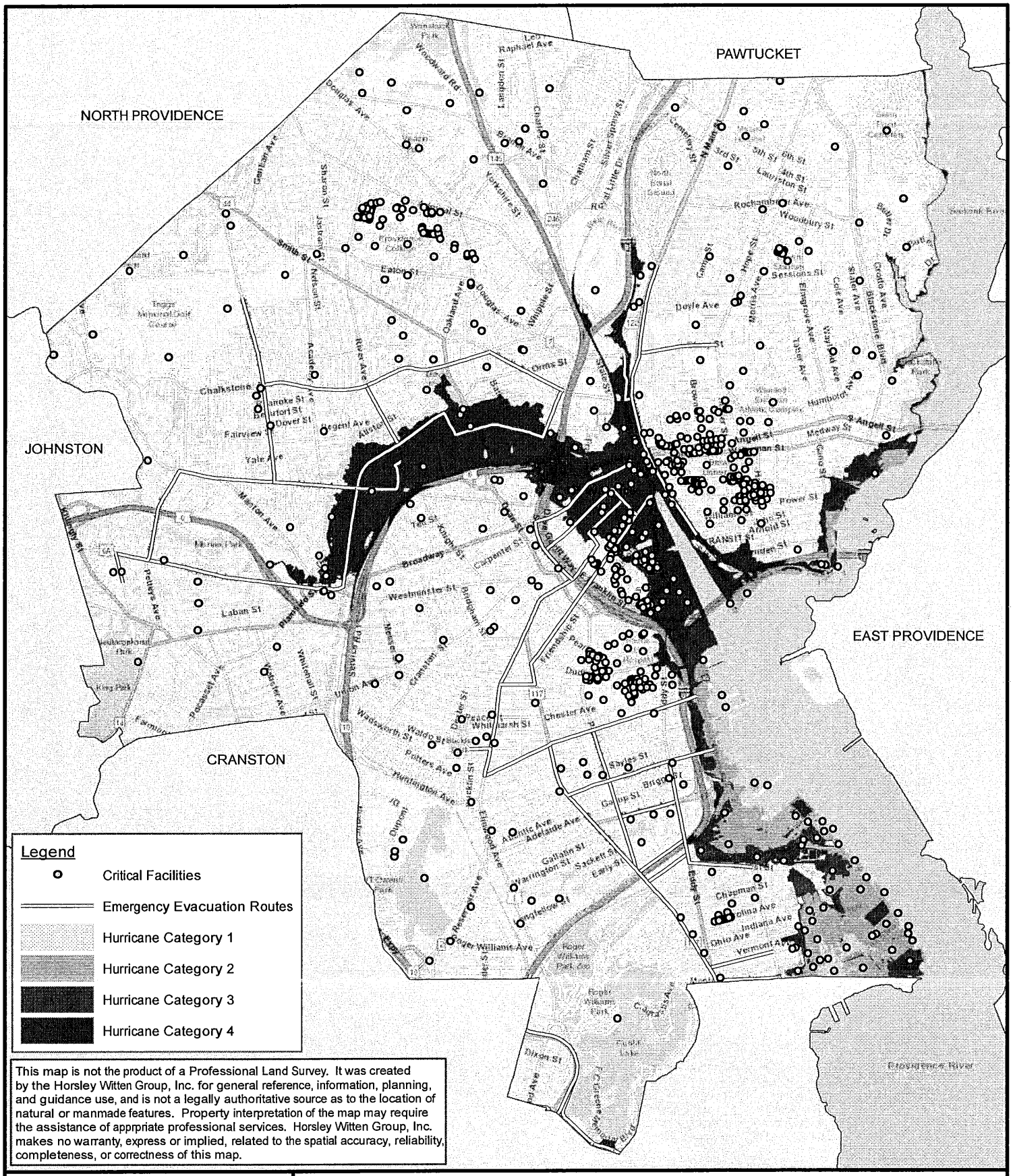
Map 2.1 Hurricane Surge Inundation Areas

Map 2.2 FEMA Flood Zones

Map 2.3 Mean Higher High Water

Map 2.4 Mean Higher High Water Plus One-Foot SLR

Map 2.5 Mean Higher High Water Plus Seven Feet SLR



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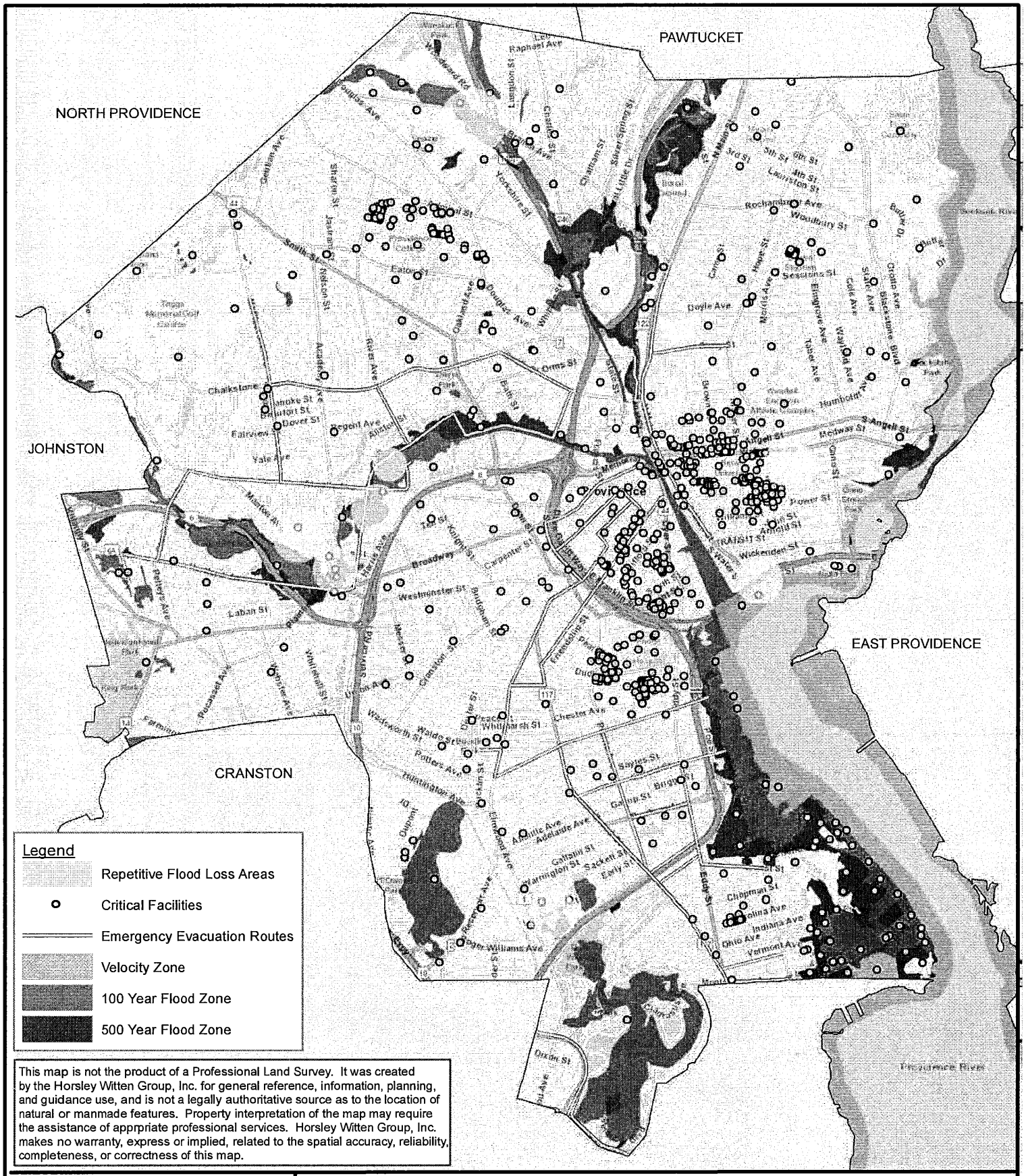
N

Mile
0 0.5 1

Map 2.1
Hurricane Surge Inundation Areas Providence, RI

Date: February 20, 2019
Source: RIGIS, City of Providence, State of R.I.



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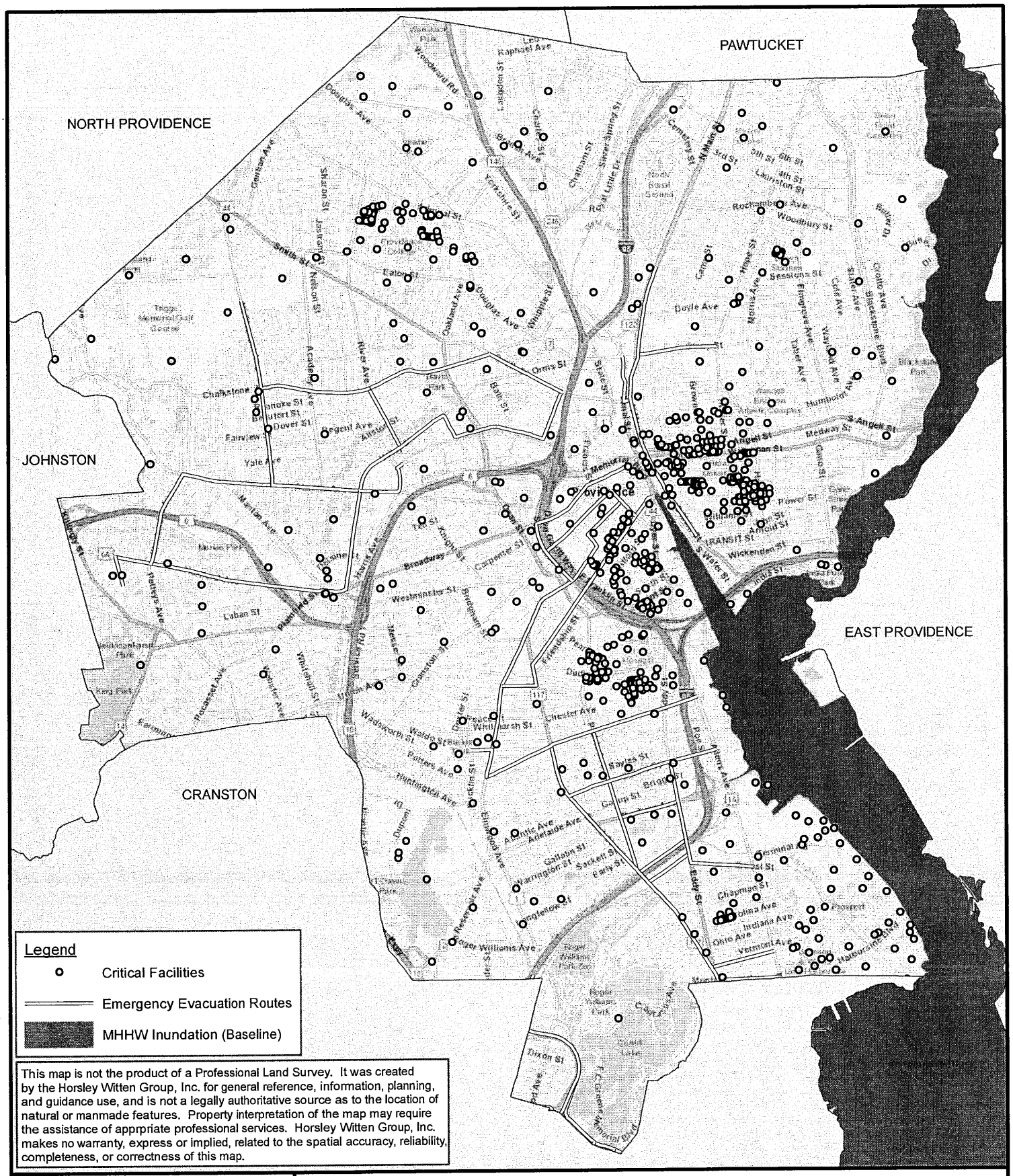
N

Mile

0 0.5 1

Map 2.2
FEMA Flood Zones
Providence, RI

Date: February 20, 2019
Source: RIGIS, City of Providence, State of RI.



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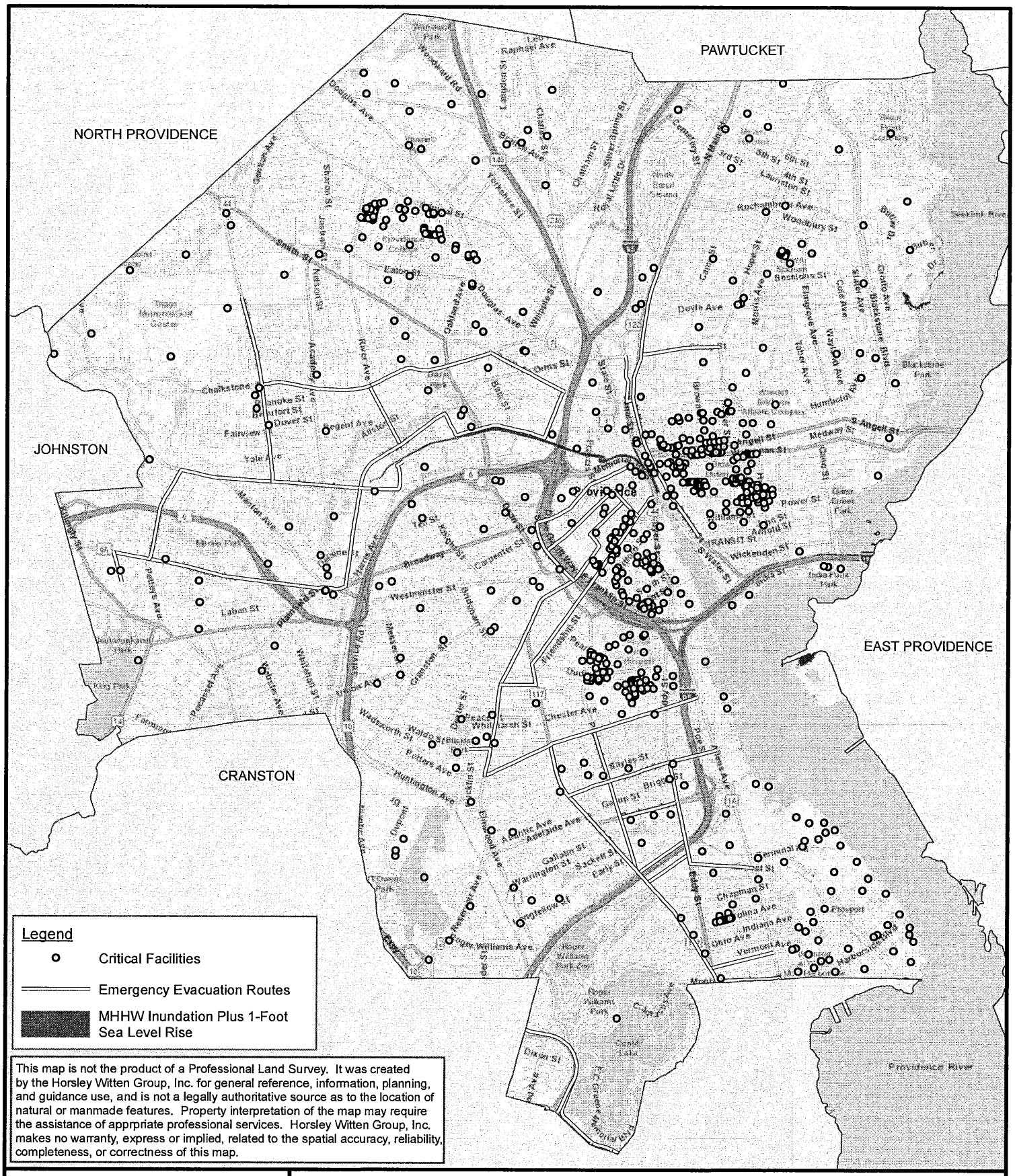
Horsley Witten Group

Date: February 20, 2019
Source: RIGIS, City of Providence, State of RI.

N

0 0.5 1 Mile

Map 2.3
Mean Higher High Water
Providence, RI



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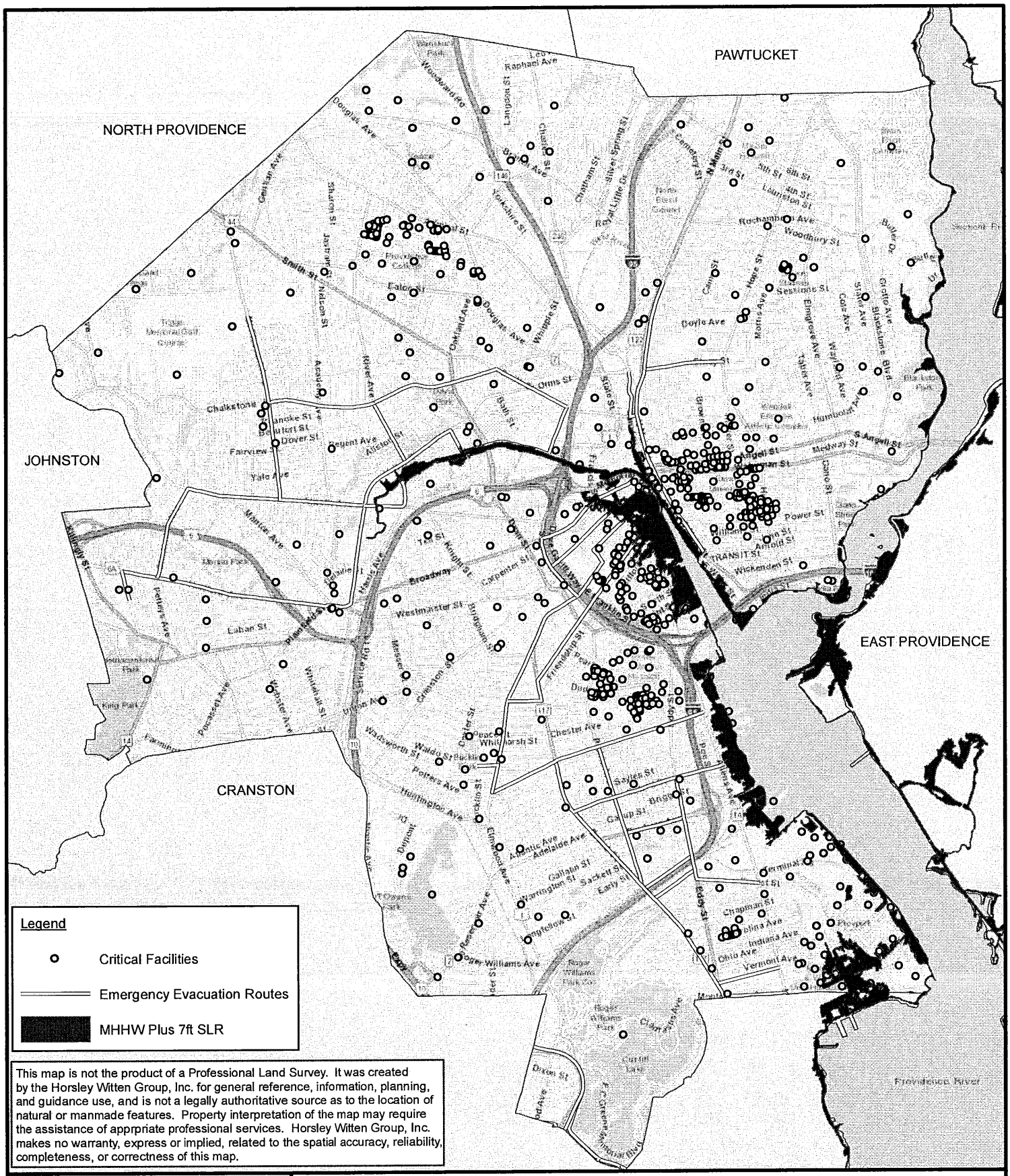
Date: February 20, 2019
Source: RIGIS, City of Providence, State of RI.

N

0 0.5 1 Mile

Map 2.4
Mean Higher High Water Plus 1-Foot Sea Level Rise
Providence, RI



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Date: February 20, 2019
Source: RIGIS, City of Providence, State of R.I.

N

0 0.5 1 Mile

Map 2.5
Mean Higher High Water Plus 7 ft SLR
Providence, RI

Appendix B

Higher Education Annex

Overview

The Deputy Director from the Providence Emergency Management Agency (PEMA) worked with the Project Consultant to incorporate data-specific information regarding the development of a more robust Higher Education annex for this update. The PEMA Deputy Director attended a monthly area college/university coordination meeting to solicit participation. Four area colleges/universities agreed to participate, including:

- Rhode Island School of Design – Jennifer Howley
- University of Rhode Island – Sam Adams
- Johnson & Wales University – Christopher Harwood (also a member of the Providence LHMC)
- Brown University – Stephen Morin (also a member of the Providence LHMC)

Participants were asked to complete a survey utilizing the Providence (citywide) Risk Assessment Rubric previously developed, including:

- Confirming the hazard severity of impacts on their operations/management and population,
- Identifying top concerns, areas for improvement and potential mitigation strategies for consideration by the LHMC, and
- Suggesting steps to be taken to improve preparedness and response.

In addition, participants were asked to provide the following:

- Facility Profile
- Unique Characteristics
- Vulnerabilities
  - Physical
  - Social
  - Economic
- Recent/Future Development Trends/Plans
- Capabilities Assessment

Survey Findings

Respondents ranked natural hazards similarly to that of the City's Risk Assessment Rubric. The majority of human-caused hazard impacts were ranked low, with the exception of cyber-related hazard impacts which was ranked moderate to high. Technological/infrastructure failure-related events (communications, information technology, and/or power/energy sources) were also ranked moderate to high.

Top priority improvements included:

- Cyber threat assessment and response,
- Development of continuity plans to minimize interruption in services, and
- Development of mutual aid agreements with stakeholders/utility providers.

Measures to improve collective preparedness and response included:

- Periodic exercises/drills with the City of Providence,
- List of resources available through the City, and
- Continue to coordinate with the Rhode Island Association of Emergency Managers.

Hazard Analysis. The following hazards have been identified as the most likely to cause impacts, according to past history of the Providence area and threats unique to colleges and universities:

- Hurricane
- Severe Winter Storm
- Infectious Disease Outbreak
- Utility Failure
- Flooding
- Sea Level Rise
- Fire
- Active Shooter/Threat
- Chemical Spill
- Data Breach

Vulnerability Analysis

Physical Vulnerabilities. Due to multiple colleges/universities being located close to the Providence River and its tributaries, several campus buildings are vulnerable to flooding. These campuses are largely comprised of historic buildings constructed in the early 20th century. These historic buildings may be less able to withstand hazardous weather conditions than newer buildings. The universities and colleges also employ many faculty members who commute from New York City and the greater Boston area on a regular basis. Following a disaster that has damaged infrastructure in the greater New England region, many faculty may be unable to travel until transportation routes have been restored. The colleges and universities' geographical location also makes it vulnerable to certain weather conditions. The New England region regularly experiences cold and snowy winters. Additionally, the proximity to the coast makes the campuses vulnerable to hurricanes.

Economic Vulnerabilities. The main economic impacts from hazards are typically due to hurricanes and winter storms with associated power outages. Both hurricanes and winter storms can interrupt operations, cause cancellation of classes, activities, events, and athletic matches and practices. The longer the disruption, the more significant the impact to operations. This is exacerbated when a power outage happens. While the universities have some generators, both fixed and portable, they do not typically provide sufficient power to continue operations. Depending on which buildings are affected, this may result in moving classes, doubling up residence halls, or cancelling operations.

Some of the colleges and universities have worked with electrical power provider National Grid to better coordinate response to restore power as well as increase the priority for response.

Social Vulnerabilities. The colleges and universities have residential campuses and form close-knit communities. Many of our students live, study, and socialize on the campuses, and in the event of an emergency would rely on the colleges and universities for food and shelter. International students account for a portion of the student population and are potentially more vulnerable to disasters because of cultural differences and language barriers. The colleges and universities also draw a significant number of students from out-of-state. Both out-of-state and international students may lack an established support network in the Providence area and familiarity with disaster response, and therefore will require extra support from the colleges and universities during and after a hazard event.

Existing Capabilities: The colleges and universities have the capability to respond to winter and tropical storm events and mitigate damages, however, other than generators the universities relies on public utility providers and municipal and state response agencies for assistance in events with major impacts.

Appendix C

Healthcare/Hospital Annex

Overview

The Deputy Director from the Providence Emergency Management Agency (PEMA) worked with the Project Consultant to incorporate data-specific information regarding the development of a more robust Healthcare/Hospital annex for this plan update. The PEMA Deputy Director attended a monthly Hospital Coalition of Rhode Island (HCRI) coordination meeting to solicit participation. Several area healthcare/hospital facilities and representatives from the R.I. Department of Health agreed to participate, including:

- Ken Otis – Lifespan
- David Schnell – Women and Infants
- John O'Reilly – Women and Infants
- Dawn Lewis – HARI
- Connie Allen – HARI
- Alysia Mihalakos – DOH
- Philip Sheridan – DOH
- Joe Reppucci – DOH
- Nicholas Larmore – DOH

Participants were asked to complete a survey utilizing the Providence (Citywide) Risk Assessment Rubric previously developed, including:

- Confirming the hazard severity of impacts on the public health and health care delivery systems (projected impacts to be considered as increases/decreases in service demand or availability compared to a normal average day),
- Identifying top concerns, areas for improvement and potential mitigation strategies for consideration by the LHMC, and
- Suggesting steps to be taken to improve preparedness and response.

In addition, participants were asked to provide the following:

- Facility Profile
- Health Care Delivery in R.I.
- Unique Characteristics
- Vulnerabilities
  - Physical
  - Social
  - Economic
- Recent/Future Development Trends/Plans
- Capabilities Assessment

Survey Findings

Respondents ranked natural hazards on the higher end of the scale. The majority of human-caused hazard impacts were ranked moderate to very high, with civil disobedience/mass casualty ranked as moderate to high. Technological/infrastructure failure-related events (communications, information technology, and/or power/energy sources) were consistently ranked high.

Top priority improvements included:

- Cyber-attack/security,
- Utilities failure,
- Civil disturbance,
- An emphasis on training,
- A mutual aid agreement between home health agencies so that there is better coverage for patients at home or in shelters who require continuity of care after a disaster,
- Given the types of specialty (tertiary) care that are provided at hospitals within Providence, mutual aid agreements with neighboring states to ensure that plans are in place to move patients to appropriate levels of care during disasters, and
- Continuity of operations plans that cover a variety of scenarios and ensure the abilities to address all essential functions of RIDOH, including those of the State Health Laboratory and the Office of the State Medical Examiners, that are fully developed and tested.

Measures to improve collective preparedness and response included:

- Continue/increase exercises/drills with the City of Providence, especially those that pertain to healthcare facility evaluation,
- Currently engaged in Ebola planning/response capabilities,
- Continued engagement to ensure an efficient, effective group of points of dispensing (PODs) can be simultaneously executed in Providence (public PODs and closed PODs at healthcare facilities and colleges/universities), and
- Continued engagement in assessing the public health impacts to the City's infrastructure projects (e.g., new LNG tanks in the Port of Providence).

Healthcare in Providence

The entire spectrum of healthcare – from specialty prenatal and labor and delivery to advanced trauma care to skilled nursing facilities – is represented in the City of Providence. A breakdown of the number of healthcare facilities in Providence by type is as follows:

Hospitals	6
ESRD	3
Blood Center	1
Home Care	16
Long Term Care	12
Outpatient	17
Public Health	1

Over the past several years, especially with the release of the 2016 *Emergency Preparedness Requirements for Medicare and Medicaid Participating Providers and Suppliers* by the Centers for Medicare and Medicaid Services and the efforts of the

Healthcare Coalition of Rhode Island, healthcare organizations in Rhode Island have grown increasingly familiar with the principles of emergency management. The emergency management efforts -- including preparedness, response, recovery, and mitigation -- of healthcare organizations in Providence are supported by the Healthcare Coalition of Rhode Island, which is co-led by the Rhode Island Department of Health and the Hospital Association of Rhode Island.

The Healthcare Coalition of Rhode Island (HCRI)

The Healthcare Coalition of Rhode Island (also referred to as HCRI, or the Coalition), has been in place since 1999 and has grown over time to meet changing needs and guidance. While the Coalition has undergone several name changes over the years, its mission has remained fundamentally the same: to serve as a forum for cooperation among organizations to develop a networked plan for interaction and collaboration in disaster-related planning, mitigation, response, and recovery efforts that address Rhode Island's healthcare system. Since its inception, HCRI has been cited several times by the federal Hospital Preparedness Program as a best practice.

HCRI provides two main functions for its membership:

1. A forum to facilitate information sharing among its members. Information, such as best practices, lessons learned from exercises and real-world events, details on upcoming events of interest, intelligence on new or emerging threats, etc., is routinely shared in HCRI, both during scheduled meetings and on an ongoing basis through email and other means.
2. A mechanism to enhance coordination among its members and with response agencies outside the healthcare sector during emergency responses. The structure of HCRI, with its direct connection to RIDOH and HARI, provides external response agencies a single, unified means of interaction with the healthcare sector, thus ensuring an accurate and valid common operating picture for the overall response. The information sharing mechanisms within the Coalition also lend to enhanced coordination among its members during responses.

In general, all healthcare organizations in Rhode Island are considered stakeholders of HCRI, including those located in the City of Providence. Because RIDOH co-chairs HCRI and has responsibilities, both statutory and issued by grant guidance, to a broad host of healthcare organizations, any healthcare organization in Rhode Island may be eligible, pending approval from the Coalition's leadership, to participate in the Coalition. On an annual basis, the Coalition's membership convenes to identify threats and hazards, members' vulnerabilities, and best practices to mitigate risk during the annual HCRI Conference. Gaps identified through risk assessments, for instance the State's (Threat and) Hazard Identification and Risk Assessment (THIRA and HIRA) or findings from the Coalition's annual conference, will be addressed by HCRI leadership and its membership during regularly scheduled HCRI meetings. Depending on the gap, its mitigation or remediation may include planning, resource acquisition, training, and/or exercising.

HCRI currently conducts regular resource assessments of its healthcare organizations, including facility information (e.g., bed types, clinical capabilities, vendors, alternate care sites), equipment inventories (including all equipment previously purchased with preparedness funds, such as communications and IT equipment), and detailed electrical, generator, and other utility information. As circumstances dictate (e.g., the PPE required by the Ebola funding or specific medications when there are shortages), relevant healthcare partners are queried about resource availability and the collated information is shared among the Coalition's membership. When resource gaps are identified, HCRI will typically work to leverage group purchases of the lacking resource in order to reduce cost.

During emergency responses, HCRI leadership works to ensure situational awareness flows appropriately throughout the Coalition. This is achieved through the use of a number of interoperable communication systems and established processes to elicit essential elements of information from Coalition membership, including operating status, fuel levels, resource availability, etc. When gaps are identified, HCRI leadership will work to identify solutions both within the Coalition and from external sources, often through Emergency Support Function 8 at the State Emergency Operations Center. Following the resolution of incidents that involve significant Coalition participation, Coalition leadership will frequently facilitate after-action reviews to identify best practices and areas for improvement that can be incorporated into future Coalition preparedness initiatives in order to enhance the collective resilience of its members.

Appendix D Public Information/Outreach

Project Kickoff Meeting
Project Website
LHMC Meeting #1
LHMC Meeting #2
Public Workshop #1
Online Community Survey
PEMA/City/Project Team Meeting #2
PEMA/City/Project Team Meeting #3
LHMC Meeting #3
Public Workshop #2
Municipal/Agency/Organization Interviews
PEMA/City/Project Team Meeting #4
LHMC Meeting #4
Public Workshop #3
LHMC Meeting #5
Correspondences

Project Kickoff Meeting
April 6, 2018

Horsley Witten Group
Sustainable Environmental Solutions
55 Dorrance Street • Suite 403 • Providence, RI 02903
401-272-1717 • horsleywitten.com

Multi-Hazard Mitigation Plan Update – City of Providence

Project Kickoff Meeting

444 Westminster – 3rd Floor Conference Room
Providence, RI
April 6, 2018 1:00 PM – 2:00 PM

Agenda

1. Introductions

2. Project Coordination

    a. Schedule
    b. LHMC (Composition/Contacts)
    c. Project Protocol and Document/Data Exchange/Review
    d. Data Collection
    e. Communications
        i. Project Website
        ii. Press Release
        iii. Social Media
        iv. Interpreters
            1. Volunteer Corp
            2. Mayor's Office (Published Materials)
        v. Providence Healthcare Cluster Annex

3. Next Steps
    a. LHMC Meeting #1

Horsley Witten Group

Memorandum of Meeting

To: Kevin Kugel, CEM, Director - EMA City of Providence

From: Craig Pereira

Date: April 10, 2018

Re: Providence Emergency Management Agency/City of Providence Kickoff Meeting #1 – Hazard Mitigation Plan Update

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In attendance:
Kevin Kugel, CEM, Director - EMA City of Providence (PEMA)
Leah Bamberger, Director of Sustainability – City of Providence
Craig Pereira, Horsley Witten Group, Inc. (HW)

1. **Introductions.**
   - HW Team includes:
     - Woods Hole Group, Inc.
     - Boardman Ecological Services (WBE)
       Both will be involved in Hazard Identification, Critical research/Analysis, and Public Outreach.

2. **Project Coordination.**
   - Schedule
     - Craig presented a revised schedule that reflects a start date three months later than anticipated (estimated April 5, 2019 delivery of draft Update to RIEMA).
     - Performance period ends August 2019 which provides just about 5 months for RIEMA/FEMA review.
     - The Local Hazard Mitigation Committee (LHMC) meetings and public workshops are distributed throughout the schedule to reflect milestones in the Update.
     - Leah asked if residents could be offered incentives to participate…there are no funds for this, but we certainly plan to hold workshops and listening sessions throughout the City to reach varied demographics/neighborhoods. Leah suggested (and offered to assist with) partnering with community organizations to host workshops.
   - LHMC (Composition/Contacts)
     - Craig provided a list of LHMC members from the current plan for discussion.
     - Kevin has the participation request email for this list and will forward to this group to determine their continued participation on the LHMC. Following return of these emails, the group will determine who else should be invited to participate (to include representation from College/University personnel).
     - Craig will develop a spreadsheet of LHMC members for updating based on role/agency they represent.
   - Project Protocol and Document/Data Exchange/Review.
     - Craig suggested the use of Basecamp as a project management tool. HW already maintains an ongoing subscription, so there is no additional cost. Basecamp can be set up to provide levels of access…there will be an area for PEMA/City Team, and another for the LHMC.

- Craig will create a PEMA Project in Basecamp and send invitations to City, PEMA and HW Team.
- All materials will be forwarded to the PEMA Deputy Director (once hired) for approval. Kevin stated that all meeting notices, agendas and minutes need to be posted to the Secretary of State website.

- Data Collection
  - The following data/documents are needed by HW for review:
    - Storm Surge/Sea Level Rise Scenarios: HW to reach out to Sean O'Rourke.
    - City of Providence Multi-Hazard Mitigation Plan 2013: provided
    - 2016 Emergency Management Standard: provided.
    - PEMA Recovery Plan, June 14, 2010: provided.
    - PEMA and Office of Homeland Security Multi-Year Strategic Plan, Update April 30, 2012: provided.
    - City of Providence Emergency Operations Plan (and Annex's): provided.
    - City of Providence Emergency Support Functions: provided
    - Dam Emergency Action Plans:
      - Canada Pond 2014: provided.
      - Cunliff Pond 2014: provided.
    - Providence Dams Profiles 2017: provided.
    - Providence Stormwater Utility District Study: Leah to forward to HW.
    - Providence Resiliency 2015 Charrette (findings and participation list): Leah to forward to HW.
    - Institution/Business Scorecard Evaluation (findings): Leah to forward to HW.
    - Hurricane Barrier Evaluation (Providence Foundation): Leah to forward to HW.
    - Woonasquatucket Valley Vision Plan (Draft): available at: http://www.providenceri.gov/planning/woonasquatucket/
    - Johns Hopkins Sea Wall Barrier Model: Leah to forward to HW
    - URI Graduate Study - Hurricane Model (with graphics): Kevin to forward to HW.
    - Rainfall Event/Tidal Flooding with Storm Surge/High Tide Study: URI is working on this now.
    - GIS Data: Kevin stated that Jen Bonin (Rhode Island College Professor) assists the PEMA will GIS needs: contact information provided. Kevin also stated that inundation mapping is typically provided in advance of a hurricane event.
    - Weather events tables (NOAA Climatic Data website) for current plan: Kevin will search for these.

- Communications
  - Communications staff were unable to attend. Kevin and Craig will follow-up on this item regarding press release, social media, and interpreters.
  - Several discussion points included:
    - PEMA website could serve as repository for posting workshop materials and draft Updates. Could also utilize newsfeed for upcoming events, public comment opportunities. A webpage for the Update should be created, PEMA to handle this.
    - Kevin and Leah suggested setting up an area where the public can comment on the Update (with a dedicated email address), including a mapping area to input local knowledge: Craig to investigate mapping item via Wiki Maps.

- Due to current Budget climate, City News and Update Webpage will be developed by mid-May: PEMA to take care of this.
- Leah stated that the Sustainability Office also has social media capacity and can help out.
- Kevin mentioned there is the Volunteer Corp and Planning Dept. for interpreters, and the Mayor's Office for published materials.
- Providence Healthcare Cluster Annex: Kevin will provide membership list from current plan. PEMA staff are also represented on the Healthcare Coalition of RI.

2. **General Comments.**
   - Leah announced there will be a Sustainable Providence Fair on Saturday, May 19th at the Southside Cultural Center.

3. **Follow Up/Action Items.**
   - Required follow-up actions are highlighted in yellow throughout the memo.

Mulit-Hazard Mitigation Plan Update - City of Providence

Sign in Sheet

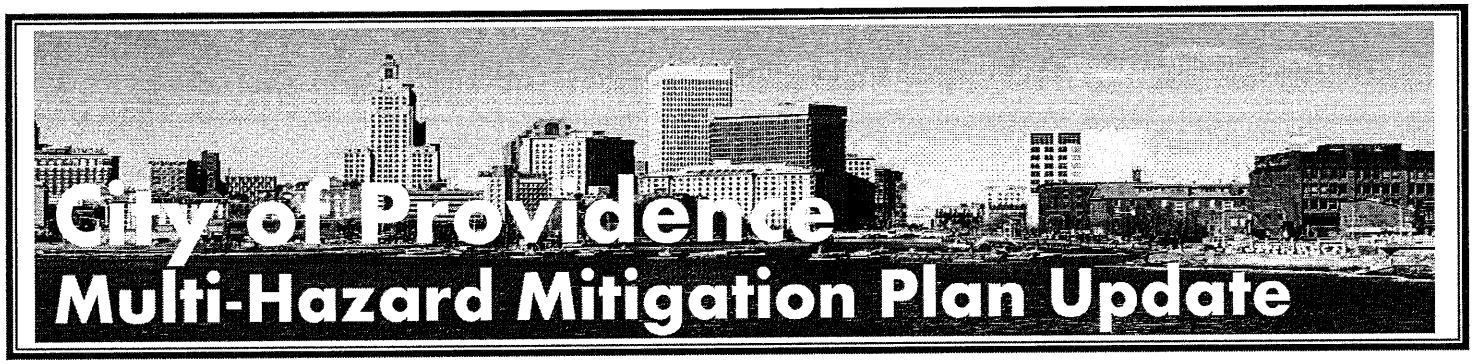
444 Westminster Street -3rd Floor Conference Room
Providence, RI

April 6, 2018 1:00 PM - 2:00 PM

Name	Email Address	Phone
CRAIG PEREIRA	cpereira@horsleywitten.com	
Kevin Kugel	kkugel@providenceri.gov	680-8091
Leah Bamberger	LBamberger@providenceRI.gov	680-5735

Horsley Witten Group
Sustainable Environmental Solutions
www.horsleywitten.com

Project Webpage



FEMA defines hazard mitigation as:

A series of actions and policies designed to reduce and/or eliminate the impacts of naturally occurring disasters on people and property.

About the Hazard Mitigation Plan Update

A hazard mitigation plan should be considered a living document that must grow and adapt, keeping pace with a community's growth and change. The Disaster Mitigation Act of 2000 (DMA) places high priority on the continuation of the planning process after the initial submittal, requiring communities to seek and receive re-approval from FEMA in order to remain eligible for assistance. The evaluation, revision and update process is also a means to create an increased institutional awareness and involvement in hazard mitigation as part of daily activities.

This Update will replace the existing June 6, 2013 Multi-Hazard Mitigation Plan. The approach for this Update is premised on four primary methods, all geared towards meeting the requirements of the DMA 2000 Public Law 106-390, October 10, 2000:

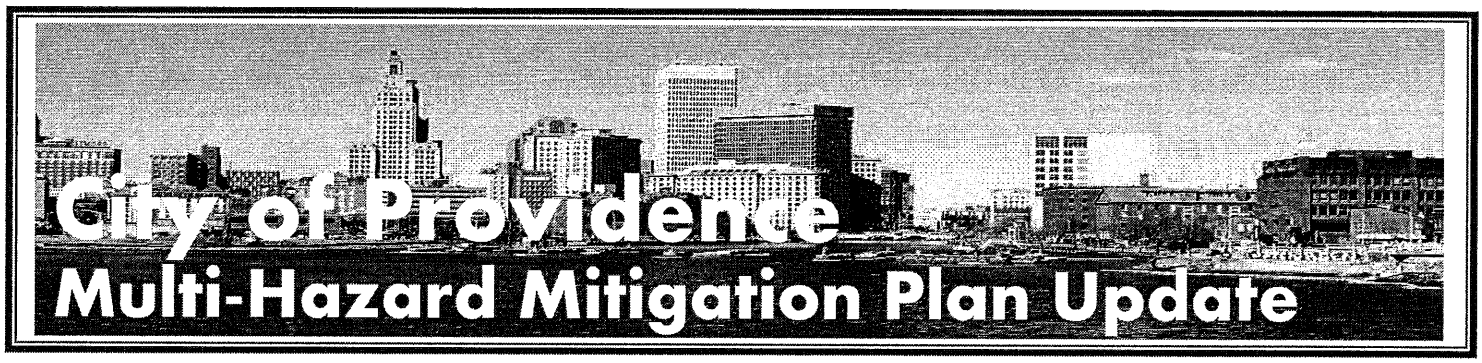
- Planning Process—Outreach and Stakeholder Coordination
- Risk Assessment—Identifying Hazards and Estimating Losses
- Mitigation Strategy— Identifying Mitigation Actions and Implementation Strategies
- Plan Maintenance—Implementation, Evaluation and Revision/Update

Stay tuned for more information on how to get involved!

Contacts

Clara Decerbo—Deputy Director
Providence Emergency Management Agency
591 Charles Street
Providence, RI 02904
cdecerbo@providenceri.gov
Phone: (401) 680-8092

Craig Pereira—Project Manager
Horsley Witten Group, Inc.
55 Dorrance St. Suite 200
Providence, RI 02903
cpereira@horsleywitten.com
Phone: (401)272-1717



2018 Local Hazard Mitigation Committee

Marisa Albanese	National Grid
Leah Bamberger	City of Providence, Sustainability Dept.
Michael Bates	City of Providence, Fire Dept.
Michael Borg	City of Providence, Public Works Dept.
James Boyd	RI Coastal Resources Management Council
Roger Choiniere	City of Providence, Emergency Management Agency
Manuel Cordero	Citizen of Providence
Steve Curtis	Waterson Terminal Services, LLC
Clara Decerbo	City of Providence, Emergency Management Agency
Margaret DeVos	Southside Community Land Trust
Jeffrey Emidy	RI Historical Preservation and Heritage Commission
David Everett	City of Providence, Planning Dept.
Janet Freedman	RI Coastal Resources Management Council
Chris Harwood	Johnson & Wales University
Melinda Hopkins	RI Emergency Management Agency
Kevin Kugel	City of Providence, Emergency Management Agency
Peter LePage	Providence Water Supply Board
Dawn Lewis	Hospital Association of RI
Jeffrey Lykins	City of Providence, Inspections and Standards Dept.
Stephen Morin	Brown University
Jared Rishel	Providence & Worcester Railroad
Philip Stocking	American Red Cross
Jeffrey Varone	City of Providence, Fire Dept.

Consultant Team

Craig Pereira	Horsley Witten Group, Inc.
Dorian Boardman	Boardman Ecological Services
Matt Shultz	Woods Hole Group, Inc.

Providence Local Hazard Mitigation Committee Meeting #1
May 25, 2018

City of Providence Multi-Hazard Mitigation Plan Update

Local Hazard Mitigation Committee Meeting

Providence Emergency Management Agency – Conference Room
591 Charles Street
Providence, RI 02904
May 25, 2018 1:00 PM – 3:00 PM

Agenda

1. Introductions

2. Project Coordination

    a. Scope/Schedule
    b. Update Layout
    c. Data Collection
        i. Existing Reports, Studies and Plans
            1. Data?
        ii. Report Card of Existing Plan
    d. Municipal Coordination
        i. Date for Municipal Interviews
    e. Public Outreach
        i. Press Release
        ii. Project Webpage
        iii. Social Media
        iv. Translation Services

3. Agenda/Logistics for Public Workshop

Horsley Witten Group

Memorandum of Meeting

To: Kevin Kugel, CEM, Director and Clara Decerbo, Deputy Director - EMA City of Providence

From: Craig Pereira

Date: May 29, 2018

Re: Providence Emergency Management Agency (PEMA)/City of Providence Local Hazard Mitigation Committee (LHMC) Meeting #1 – Hazard Mitigation Plan Update

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In attendance:

LHMC

Kevin Kugel, CEM, Director - PEMA
Clara Decerbo, Deputy Director – PEMA
Melinda Hopkins, Mitigation Planning Supervisor – RI EMA
Roger Choiniere, Recovery Coordinator, PEMA
Leah Bamberger, Director of Sustainability – City of Providence (telephone/conference line)
Gary Marino, Providence Water Supply Board
Michael Bates, Acting Chief – Providence Fire Dept.
Derek Jordan, American Red Cross
James Boyd, Coastal Policy Analyst, CRMC
Stephen Morin, Brown University
Jeffrey Varone, Battalion Chief – Providence Fire Dept.
William Kenyon, Batallion Chief - Providence Fire Dept.
Janet Freedman, Coastal Geologist, CRMC
Jeff Emidy, Project Review Coordinator – RI Historical Preservation & Heritage Commission
Dawn Lewis, Emergency Preparedness Coordinator, Hospital Association of RI
Margaret DeVos, Executive Director – Southside Community Land Trust (telephone/conference line)
Manuel Cordero, Resident – City of Providence (telephone/conference line)
Jeff Lykins, Director – Providence Dept. of Inspections/Standards (telephone/conference line)
Dave Everett, Principal Planner, City of Providence
Michael Borg, Director – Providence Dept. of Public Works

Consultant Team

Craig Pereira, Project Manager - Horsley Witten Group, Inc. (HW)
Matt Shultz, Coastal Engineer – Woods Hole Group, Inc.
Dori Boardman, Environmental Planner - Boardman Ecological Services

Note: Follow up items identified with yellow highlighting.

1. Introductions. In person and on the phone.
2. Project Coordination
   a. Scope/Schedule
      1. Revised Schedule to coincide with project milestones
      2. Mid-April 2019 for a draft (performance period ends August 2019). Extra time has been built into the schedule to allow for quality over pace.
   b. Update Layout
      1. Existing plan layout could use better organization so it flows logically.
      2. Provided previous example to Clara as an example (Cumberland, RI).
      3. Suggested new layout for consideration (attached).

a. Michael Borg suggested placing 'Capability Assessment' before 'Risk Assessment'.
b. Melinda Hopkins suggested the layout follow that of the state Plan for consistency. Melinda also requested the hazard identification profile/order matches the state format.
    i. Follow Up: Craig to confirm state Plan layout.
c. Dawn Lewis suggested an annex that summarizes hazards ranked according to loss of life (health), vs. loss of business (economic), vs. damage to infrastructure, etc. Dawn also asked if reflective costs will be incorporated into prioritization.
    i. Craig Pereira commented that the capabilities section is internal to the City and will include financial opportunities.

c. Data Collection
1. Basecamp…invited PEMA/CITY/Consultants to date as File Transfer/Review site, discussed options for review of draft materials.
    a. Google Docs also suggested…allows for edits to draft one at a time.
    b. Project protocol for document review? Suggested using one POC with assigned subject matter experts
        i. Follow Up: Clara/Craig to discuss hosting options/protocol.

ii. Existing Reports, Studies and Plans
1. Preliminary list…only posted plans publicly available (did not post: Dam EAPs/profiles, Emergency Support Functions, EOP).
    a. Follow Up: Dave Everett to provide list of regulations to add to data list.
    b. Army Corps of Engineers primary POC for Hurricane Barrier.
    c. Hurricanes/Blizzards are big hazards, followed by Civil Disturbance (Michael Borg).
    d. CRMC currently consolidating Metro Bay SAMP…Under preliminary review now. Beach SAMP will also have pertinent information (Jim Boyd).
        i. Follow Up: Craig to coordinate with Jim Boyd and Teresa Crean.
    e. DEM also working on hazards analysis including chemical/ hazardous material storage sites.
        i. Follow Up: Craig to coordinate with DEM.
2. GIS data…City database.
    a. Follow Up: Craig to coordinate with Dave Everett regarding City files.
3. Others?
    a. Follow Up: Craig to coordinate with CRMC for Metro Bay SAMP data.
4. Craig will provide LHMC HW's FTP site for uploading photos.
    a. Follow Up: Craig to include HW's FTP access for photo upload.

iii. Report Card of Existing Plan
1. Preliminary stab at this…
    a. Responsible parties correct?
    b. Date completed/staff/funding mechanism?

Actions 1 / 2: Bifurcated responsibility for management, operations, maintenance for hurricane barrier. The part in the water is jurisdiction of

Army Corps, the above water components are the responsibility of the City (Michael Borg).

Follow Up: Craig to coordinate with Army Corp and City.

Action 3: Not cost-efficient.

Follow Up: Melinda Hopkins for "what if" scenario information.

Action 4: Yes, it is a requirement, no there has not been a public outreach program, likely due to staffing constraints.

Action 5:Yes, there was an effort, but City unable to match 50/50 funding goal needed (no longer an item because the window has since closed)

Action 6: Unknown.

Follow Up: Craig to coordinate with Steve Curtis.

Action 7: Michael Borg indicated that the TIP list is dated, some work has been completed.

Follow Up: Craig to coordinate with Michael Borg.

Action 8: Start with City Clerk and Public Property.

Follow Up: Craig to coordinate with Caitlynn Ward at State Archives, Al Bucco at Public Property, Tom Campbell is Tier 2 facilities.

Action 9: Debris Management Plan update under review by Kevin Kugel.

Follow Up: Craig to coordinate with Kevin and Doug Still (City Forester).

Action 10: No cataloguing to date on deficient buildings. Suggested the City to consider elevation of critical utilities (like Boston) and Providence is going to need to consider that with SLR projections and potential for overtopping of hurricane barrier (including National Grid).

Follow Up: Craig to coordinate with Jeff Lykins and National Grid.

Action 11: No action to date due to limitations on funding, and that City doesn't own the site. Planning Department has plans and studies for the area around Atwells Ave station.

Follow Up: Craig to coordinate with Dave Everett for plans.

Action 12: Unknown.

Follow Up: Craig to coordinate with NBC/Dave Aucoin.

d. Municipal Coordination
   i. Date for Municipal Interviews
      1. Preference is for one or two half days, round-robin fashion for municipal and stakeholder interviews.
      2. Suggestion was made for one day at 591 Charles St, the second at 444 Westminster St.
         a. Follow Up: Craig Pereira/Clara Decerbo to identify dates, Craig to develop Doodle Poll for time slots.

e. Public Outreach.
   i. Press Release
      1. To be developed once project webpage is up and running
   ii. Project Webpage
      1. Bonnie Howland (Communications) to set up initial page on EMA webpage (until Clara gets trained)…once this is up and running…press release/social media to follow. ETA for webpage is week of 5/28.
         a. Follow Up: Clara Decerbo
      2. Discussion on Wikimaps area on webpage for conveyance of local knowledge…HW looking into ESRI Survey 123 also…TBD.
         a. Follow Up: Craig Pereira to research both.
   iii. Social Media

1. Lea Bamberger/Sustainability Dept. will initiate once webpage is ready

iv. Translation Services: Project Team will utilize:

1. City's Communications Dept.
2. Mayor's office
   a. Follow Up: Clara Decerbo to identify what each capacity is, timeline needed.

3. Agenda/Logistics for Public Workshop
   1. Logistics planning on-hold for now until closer to 2nd LHMC meeting.
   2. Anticipated to be held throughout the City. Craig asked for LHMC members to inform him/Clara if they have facilities available (minimum of 50 people). Public safety Complex was suggested.
      a. Follow Up: LHMC members to express facility availability.

4. Other
   1. Photos…PEMA Flikr site…Clara to confirm. MyCoast and SeaGrant Flikr also suggested. Craig will provide LHMC HW's FTP site for uploading photos.
      a. Follow Up: Craig to include HW's FTP access for photo upload.
   2. Healthcare Cluster/Higher Education Planning Groups…
      a. A separate, concurrent effort
      b. Healthcare Cluster:
         i. Ken Otis – Lifespan Continuity Planner
         ii. David Snell
         iii. Dawn Lewis – Hospital Assoc. of RI
      c. Education Cluster
         i. Chris Harwood (JWU)
         ii. Stephen Morin (Brown)
            1. Follow Up: Clara and Craig to confirm membership for both.

Horsley Witten Group
Sustainable Environmental Solutions
55 Dorrance Street • Suite 200 • Providence, RI 02903
401-272-1717 • horsleywitten.com

City of Providence Multi-Hazard Mitigation Plan Update

Local Hazard Mitigation Committee Meeting

Providence Emergency Management Agency - Conference Room
591 Charles Street

May 25, 2018 1:00 - 3:00 PM

Name	Email Address	Phone
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Roger Chouniere	RCHOUNIERE@MAILBOX.RI.GOV	401-680-8095
Kevin Kugel	kkugel@providenceri.gov	401-680-8091
Clara Decerbo	cdecerbo@providenceri.gov	401 648 1619
[illegible]	cperenin@horsleywitten.com	401 272 1717
Gary Marino	GMARINO@PROVIDENCE.COM	401-639-2984
Michael J Bates	MBATES@providence.RI.GOV	401-529-6833
Derek A Jordan	DEREK.JORDAN2@REDCROSS.ORG	401-663-0785
Matt Shultz	mshultz@wherp.com	508 495 6259
James Boyd	JBOYD@CRMC.RI.GOV	401.883.3370
Stephen Morin	Stephen_Morin@brown.edu	401 863 3353
Jeffrey Varone	JVarone@providenceri.gov	401 527-9353
William Kenyon	WKenyon@Providenceri.gov	401-257-9931
JANET FREEDMAN	jfreedman@crmc.ri.gov	401-783-3370
Jeff Emidy	Jeffrey.emidy@preservation.ri.gov	401 222-4134
Dawn Lewis	dawnl@hmi.ny	401-640-2320
MICHAEL BORG		
LEA BAMBERGER		
MARGARET DRIVOS	ON CONFERENCE LINE	
MANUEL CONDRINO		
JEFF LYKINS		
DAVE PAPARET		

Providence Local Hazard Mitigation Committee Meeting #2
July 13, 2018

City of Providence Multi-Hazard Mitigation Plan Update

Local Hazard Mitigation Committee Meeting #2

Providence Emergency Management Agency – Conference Room
591 Charles Street
Providence, RI 02904
July 13, 2018 10:00 AM – 12:00 PM

Agenda

1. Update: Public Outreach/Engagement
2. Update: 2013 Plan Report Card
3. Overview: Updated Risk Assessment/Hazard Index
4. Discussion: Technical Review Committee – Draft Approach
5. Update: Higher Education/Healthcare Cluster
6. Agenda/Logistics for Public Workshop

Horsley Witten Group
Sustainable Environmental Solutions
55 Dorrance Street • Suite 200 • Providence, RI 02903
401-272-1717 • horsleywitten.com

Horsley Witten Group

Memorandum of Meeting

To: Kevin Kugel, CEM, Director and Clara Decerbo, Deputy Director - EMA City of Providence

From: Craig Pereira

Date: July 13, 2018

Re: Providence Emergency Management Agency (PEMA)/City of Providence Local Hazard Mitigation Committee (LHMC) Meeting #2 – Hazard Mitigation Plan Update

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In attendance:

LHMC

Kevin Kugel, CEM, Director - PEMA
Clara Decerbo, Deputy Director – PEMA
Leah Bamberger, Director of Sustainability – City of Providence
Phil Stocking, American Red Cross
Marisa Albanese, Manager - National Grid
Chris Harwood, Johnson & Wales
Jeffrey Varone, Battalion Chief – Providence Fire Dept.
Janet Freedman, Coastal Geologist - CRMC
Manuel Cordero, Resident – City of Providence (telephone/conference line)
Jeff Lykins, Director – Providence Dept. of Inspections/Standards
Dave Everett, Principal Planner - City of Providence
Michael Borg, Director – Providence Dept. of Public Works
Peter LePage, Senior Manager - Providence Water Supply Board
Dave Aucoin, Narragansett Bay Commission
Jared Rishel, Director – Providence & Worcester Railroad (telephone/conference line)

Consultant Team

Craig Pereira, Project Manager - Horsley Witten Group, Inc. (HW)
Elise LeDuc, Coastal Engineer – Woods Hole Group, Inc.
Dori Boardman, Environmental Planner - Boardman Ecological Services

Note: Follow up items identified with yellow highlighting.

1. Update: Public Outreach and Engagement
    a. 2018 Plan Update announcement on PEMA Mitigation page
    b. Survey 123 ready for posting on PEMA Mitigation page
        i. Local Knowledge
            1. What hazard type reporting on
            2. Location (user can drop a pinpoint on property
            3. Description
            4. Upload photo
    c. Online Survey
        i. Survey is being translated into Spanish; both versions will be available starting at the Public Workshop. Hard copies will be available around the City, and links will be posted on PEMA Mitigation page
        ii. Public survey: will be pushed out starting at the public workshop on July 25 with versions in English and Spanish. Survey will be accessible for 1-2 months, hoping to

get 400-500 responses. Survey link will be sent out to LHMC, will be pushed out on social media and on PEMA website.

2. Update: 2013 Plan Report Card
   a. Report Card is primary document to be shared at the public workshop. Demonstrate accomplishments.
      i. Hurricane Barrier
         1. Michael Borg to provide summary of what has happened since 2013 Plan
      ii. Action #3…not completed, do not carry forward
      iii. Action #4…enforcement of regulations remains ongoing, public outreach campaign not completed. Carry this forward. Janet Freedman (CRMC) and RIFMA may be able to assist with education and outreach efforts to support this action item. Leah Bamberg (Sustainability) can assist with these outreach efforts too.
      iv. Action #5…not completed, City could not meet the funding match and grant opportunity has since passed. Do not carry forward.
      v. Action #6…Craig to follow up with Steve Curtis
      vi. Action #7…Craig provided an update to the deficient bridge list based on RIDOT's site and the current TIP. Michael Borg to confirm this data.
      vii. Action #8…Craig spoke with Caleb Hortin – City Archivist. Study has been completed, implementation not completed, carry forward. Plans to house under one state facility. In the meantime, existing vital documents have been backed up electronically.
      viii. Action #9…Debris Management Plan for the City is currently updated and under review. Doug Still…National Grid already does systematic pruning of trees near their circuits, on a 4-5 year schedule. The Providence Forestry Division has also implemented a "block pruning" program to prune all the City's street trees on a 10-year cycle. Marisa Albanese also indicated the Grid can do more coordination with the City.
      ix. Action #10…Cataloguing of deficient building not completed, carry forward…look to best practices elsewhere (elevation of utilities)
      x. Action #11…Not completed, revise and carry forward
      xi. Action #12…NBC's EOP updated 2013. Meg Goulet coordinates with the City. Craig to reach out to Meg for more information.
3. Overview: Updated Risk Assessment Matrix
   a. HW completed the natural hazards data research from NOAA's Climatic Data Website and utilized FEMA's Calculated Priority Risk Index to identify risk percentages (similar to existing 2013 Plan). Some of the data is limited (extreme cold, dam inundation, sea level rise, fire-related hazards, extreme heat, and epidemic) were not aligned with what is reported in the State's Plan. Coordination with Melinda Hopkins confirmed to use the data from state plan for Providence County.
   b. The City's 2013 Plan does not include data or a methodology for ranking man-made and technological hazards. Again, Melinda Hopkins confirmed we can use the State's data.
   c. There are several additional hazards from the City's 2013 Plan that are not consistent with the state plan, and no backup/methodology is provided in 2013 Plan. Craig to coordinate with Kevin/Clara/Melinda on how to proceed.
   d. Coastal Erosion needs to be added to the Risk Assessment…Craig to follow up
   e. Is the sea level rise score from the state plan only for current risks/hazards, or does it consider projections from future impacts? Craig to coordinate with Melinda.
   f. State Plan addresses climate change as its own hazard, while the state HIRA considers it as an amplifier. Craig to coordinate with Melinda.
   g. Elise Leduc provided an overview of climate change impacts on all natural hazards, as an amplifier. Confirmation of how this will be presented TBD with discussions with Melinda.

h. Although this is a 5-year update, we need to caution to look to accomplish 'baby steps' towards future actions…perhaps the longer term actions become action items to 'develop plan or 'establish committee'. Should some scores be weighted?

4. Discussion: Technical Review Committee
    a. Utilize Google Docs for review
    b. Includes (as a discussion point):
        i. State: Melinda Hopkins
        ii. City: Dave Everett
        iii. PEMA: Clara Decerbo
        iv. Coastal: Jim Boyd
        v. Healthcare/HARI: Dawn Lewis
        vi. Education: Steve Morin
5. Update: Higher Education/Healthcare Clusters
    a. Working on confirming membership, to date:
        i. Healthcare:
            1. Dawn Lewis (HARI)
            2. Ken Otis (Lifespan)
            3. David Schnell (Woman and Infants)
            4. Suggestion to include someone from RI DOH…Craig to follow up.
        ii. Education:
            1. Chris Harwood (JWU)
            2. Steve Morin (Brown)
            3. Sam Adams (URI)
            4. Suggestion to include Bill Patenaude (DEM and PC)…Craig to follow up
6. Agenda/Logistics for Public Workshop
    a. July 25, 2018 at PEMA headquarters…5:30 – 6:30 PM informal drop-in session, formal presentation 7:00 – 8:30 PM.
    b. Flyer for public workshop in English and Spanish is being pushed out via City social media, posting in public areas (libraries/rec centers), on PEMA website, through other City Departments social media
    c. PEMA to provide translators
    d. Agenda:
        i. Project Overview (PEMA)
        ii. Why hazard mitigation planning? (Craig)
        iii. 2013 Plan Report Card (Craig)
        iv. Q & A
        v. Map Exercise: identify local knowledge on maps
        vi. Hard copies of the Survey will be available

City of Providence Multi-Hazard Mitigation Plan Update

Local Hazard Mitigation Committee Meeting

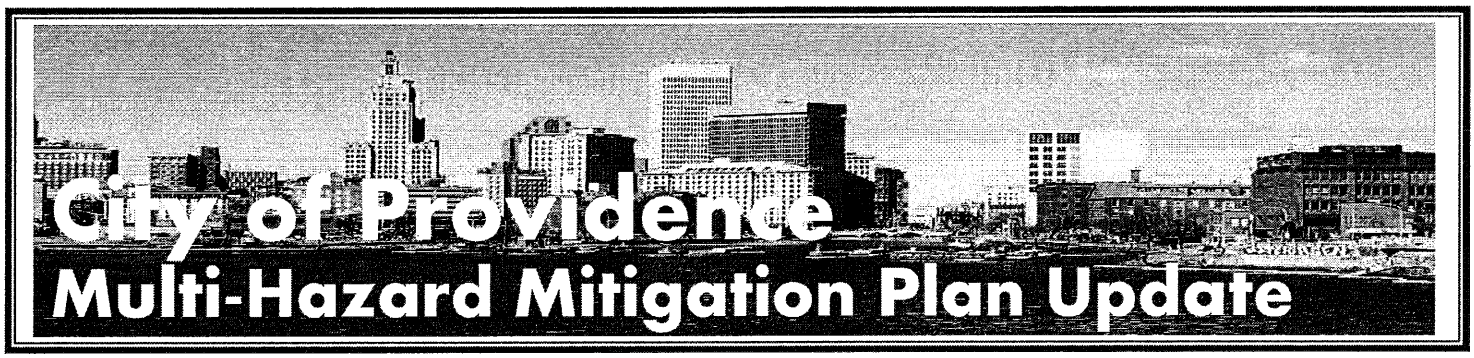
Providence Emergency Management Agency - Conference Room
591 Charles Street

July 13, 2018 10:00 AM - 12:00 PM

Name	Email Address	Phone
Peter LePage	plepage@provwater.com	401-521-6300
MARISA ALBANESE	MARISA.ALBANESE@NATIONALGRID.COM	401-784-7090
Phil Stocking	Philip.Stocking2@redcross.org	401-408-8667
Elise Leduc	eleduc@whgrp.com	508-495-6234
Dave Aucoin	daucoin@[illegible]navrbay.com	461-8648 x 418
JANET FREEDMAN	jfreedman@crmc.ri.gov	401-783-3370
CHRIS HARWOOD	charwood@jwu.edu	401-598-2668
Dorian Boardman	doriboardman@gmail.com	401.440.4453
Leah Baumberger	lbaumberger@Providence[illegible].gov	
DAVE EVERETT	deverett@providenceri.gov	
JEFFREY LYKINS	JLYKINS@PROVIDENCERI.GOV	680-5777
Kevin Kugel	kkugel@providenceri.gov	680-8091
Jeffrey Varone	JVarone@PRWI[illegible]	
Craig Moore	Horsley Witten Group	

Horsley Witten Group
www.horsleywitten.com

Public Workshop #1
July 25, 2018



Public Workshop

July 25, 2018

Providence Emergency Management Agency
Conference Room
591 Charles Street
Providence, RI 02904

Informal Drop-In Session 5:30 PM—6:30 PM
Formal Presentation 7:00 PM—8:30 PM

Come learn what the City has accomplished
and hear about planning for the future.

About the Hazard Mitigation Plan Update

The City of Providence is currently updating the 2013 Hazard Mitigation Plan. This plan is important because it helps the City plan and receive funding for projects that reduce the risk of injury or damage to property from future natural hazard events such as flooding and hurricanes. The Disaster Mitigation Act of 2000 (DMA) places high priority on the continuation of the planning process after the initial submittal, requiring communities to seek and receive re-approval from FEMA in order to remain eligible for assistance.

For more information, or to review a copy of the 2013 Hazard Mitigation Plan, please visit:
http://www.providenceri.gov/pema/multi-hazard-mitigation-plan/

Contacts

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Horsley Witten Group, Inc.
55 Dorrance St. Suite 200
Providence, RI 02903
cpereira@horsleywitten.com
Phone: (401) 272-1717

Taller Público

25 de julio de 2018

Providence Emergency Management Agency
Sala de conferencias
591 Charles Street
Providence, RI 02904

Sesión de información informal de 5:30 –6:30pm

Presentación formal 7:00pm—8: 30pm

Ven a aprender lo que la Ciudad ha logrado y escucha sobre la planificación para el futuro.

Acerca de la Actualización del Plan de Mitigación de Riesgos

La Ciudad de Providence está actualizando el Plan de Mitigación de Peligros 2013. Este plan es importante porque ayuda a la Ciudad a planificar y recibir fondos para proyectos que reducen el riesgo de lesiones o daños a la propiedad por eventos futuros de peligros naturales como inundaciones y huracanes. La Ley de Mitigación de Desastres de 2000 (DMA) otorga una alta prioridad a la continuación del proceso de planificación después de la presentación inicial, lo que exige que las comunidades soliciten y reciban una nueva aprobación de FEMA a fin de seguir siendo elegibles para recibir asistencia.

Para obtener más información, o para revisar una copia del Plan de Mitigación de Riesgos 2013, visite:

http://www.providenceri.gov/pema/multi-hazard-mitigation-plan/

Contactos

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cpereira@horsleywitten.com
Phone: (401) 272-1717

City of Providence Multi-Hazard Mitigation Plan Update

Public Workshop #1

Providence Emergency Management Agency – Conference Room
591 Charles Street
Providence, RI 02904
July 25, 2018

5:30 – 6:30 PM Informal Drop-In Session

7:00 PM Formal Presentation

Agenda

1. Welcome/Project Overview: Kevin Kugel, Director – Providence Emergency Management Agency

2. Why Hazard Mitigation Planning: Craig Pereira, Project Manager – Horsley Witten Group

3. 2013 Plan Report Card: Craig Pereira

4. Q & A

5. Map Exercise

City of Providence Multi-Hazard Mitigation Plan Update

Public Workshop #1

Providence Emergency Management Agency - Conference Room
591 Charles Street

July 25, 2018 5:30 - 6:30 PM Informal Drop-In Session

Name	Email Address	Phone
DAVID EVERETT	deverett@providenceri.gov	—
Carolyn Solano	carolyjose2306@hotmail.com	—
Vu L	phim1987@hotmail.com	
ERNIE DREW	ernest.drew@cox.net	
Katherine Luchette	katie.luchette@gmail.com	
Shawn Michalek	info@PilotRT.us	
Jameson Clem	jameson.clem@gmail.com	401 354 9262

Horsley Witten Group
Sustainable Environmental Solutions
www.horsleywitten.com

City of Providence Multi-Hazard Mitigation Plan Update

Public Workshop #1

Providence Emergency Management Agency - Conference Room
591 Charles Street

July 25, 2018 5:30 - 6:30 PM Informal Drop-In Session

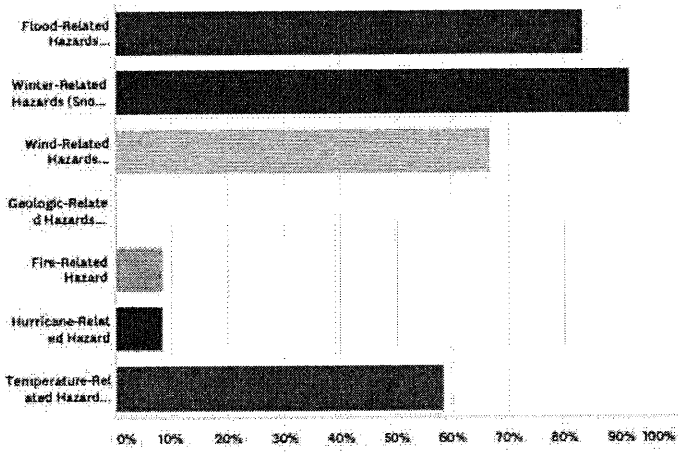
Name	Email Address	Phone
Sarah Bryan	srbryan@my.uri.edu	425-301-2337
Matt Shultz	mshultz@woodsholegroup.com	508-495-6259
Erick Baker	erick.baker@verizon wireless.com	203 450 1783
[illegible]	HORSLEY WITTEN GROUP	

Horsley Witten Group
www.horsleywitten.com

Online Community Survey

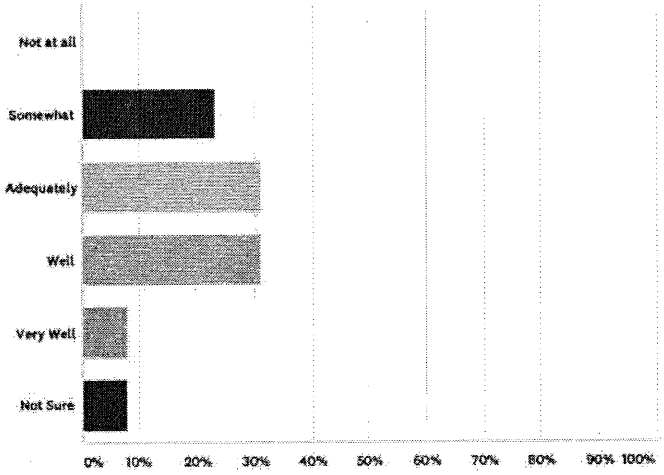
Q1 Which of the following hazard events have you or has anyone in your household and/or business experienced in the past 20 years within the City of Providence? (Check all that apply)

Answered: 12 Skipped: 1



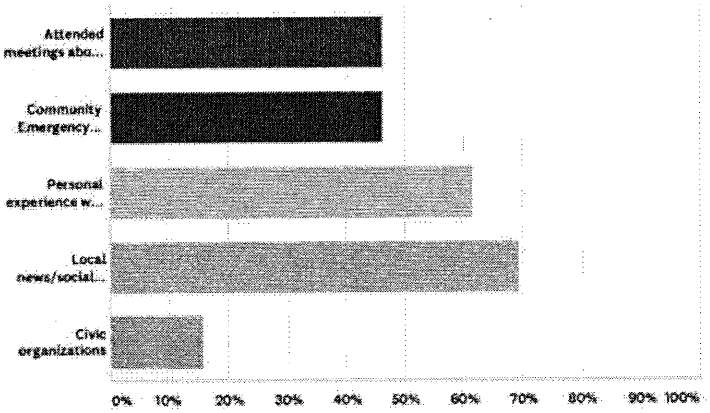
Q2 In your opinion, how prepared is your household and/or business to deal with a natural hazard event?

Answered: 13 Skipped: 0



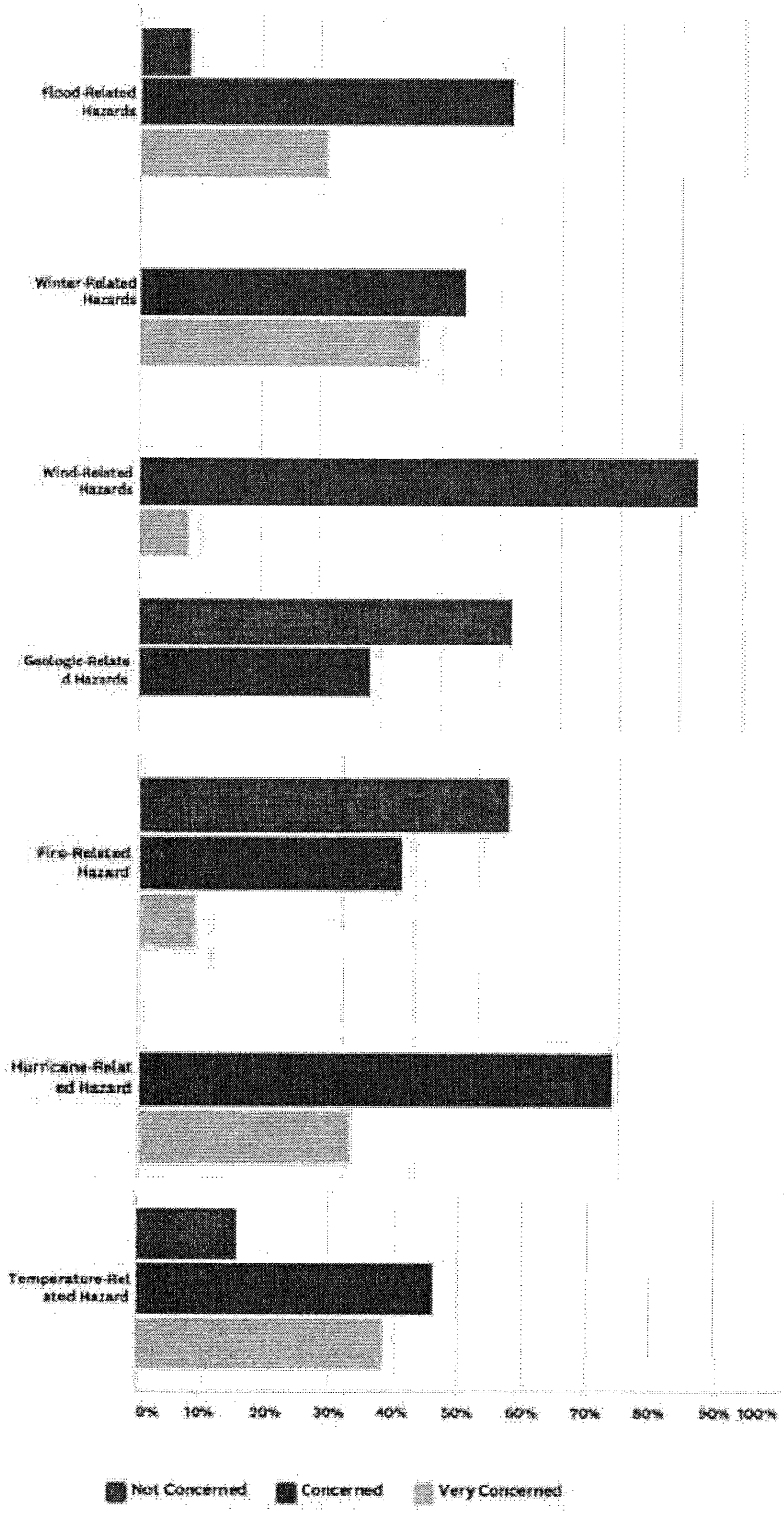
Q3 Which of the following have provided you with useful information to help you prepare for a hazard event? (Check all that apply)

Answered: 13 Skipped: 0



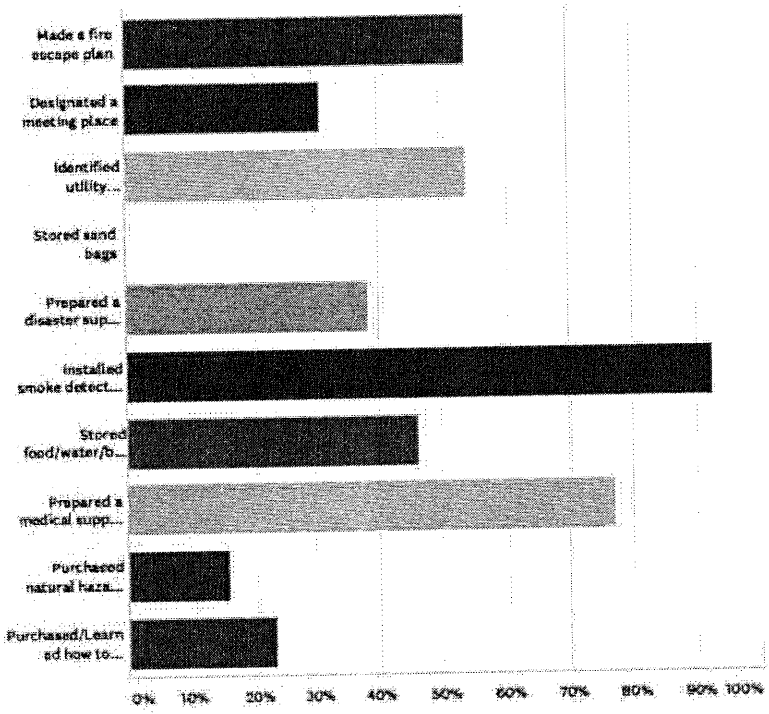
Q4 How concerned are you about the following hazards in the City of Providence? (Check one response for each hazard)

Answered: 13 Skipped: 0



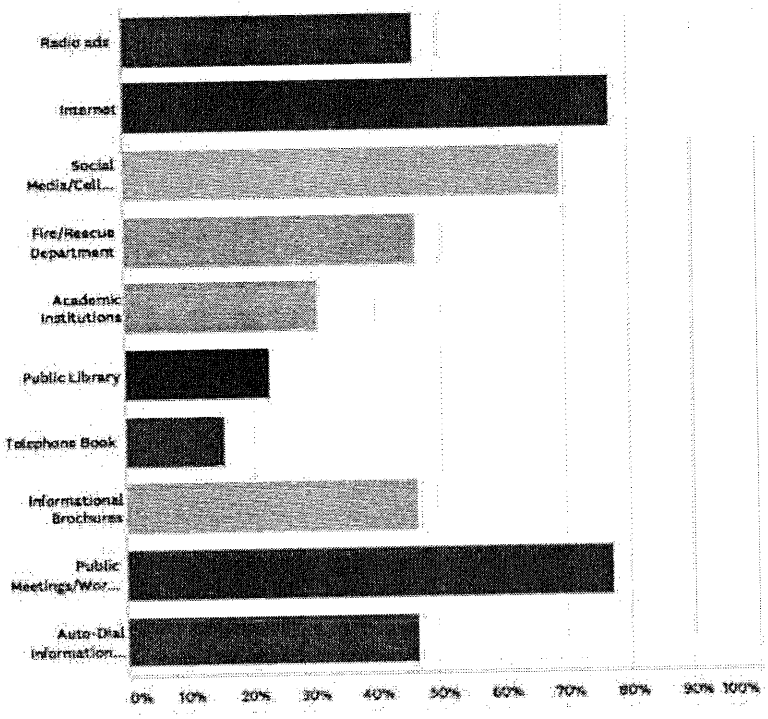
Q5 Which of the following steps has your household and/or business taken to prepare for a hazard event? (Check all that apply)

Answered: 13 Skipped: 0



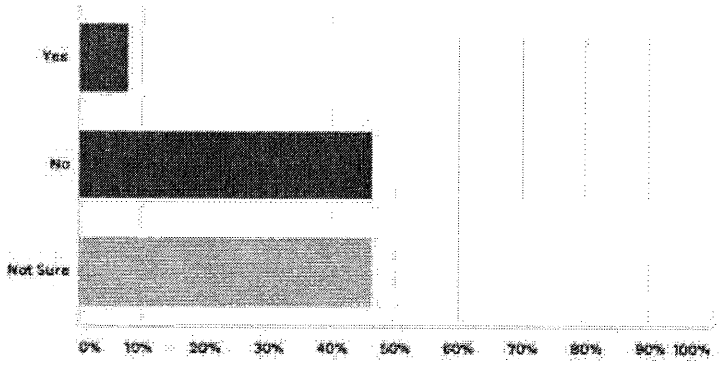
Q6 In your opinion, which of the following methods do you think are most effective for providing hazard and disaster information? (Check all that apply)

Answered: 13 Skipped: 0



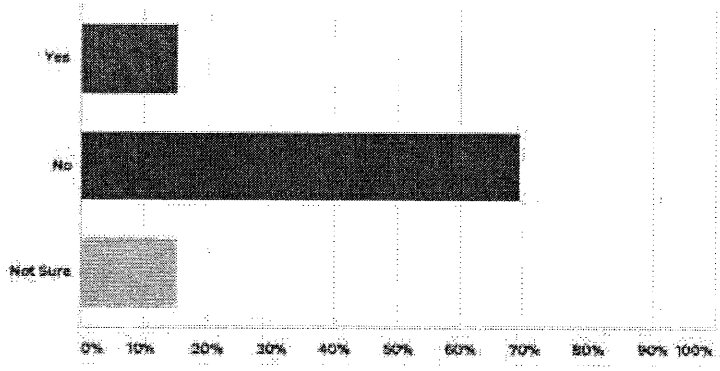
Q7 Is your property located in or near a FEMA designated floodplain?

Answered: 13 Skipped: 0



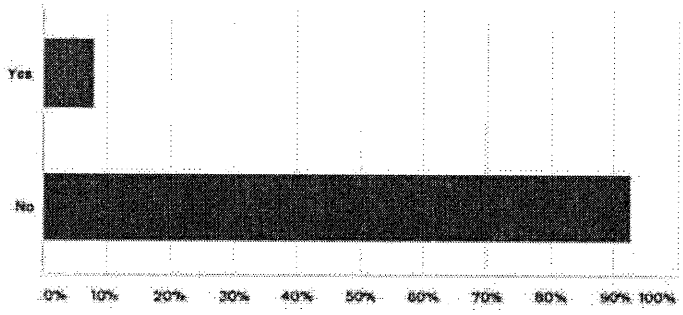
Q8 Do you have flood insurance?

Answered: 13 Skipped: 0



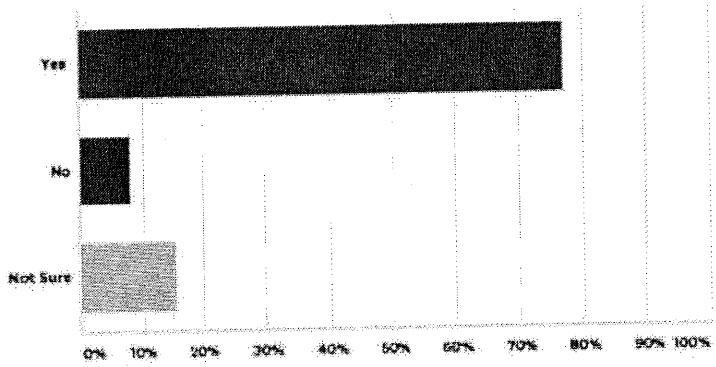
Q9 Do you have any special access or functional needs within your household and/or business that would require early warning or specialized response during disasters?

Answered: 13 Skipped: 0



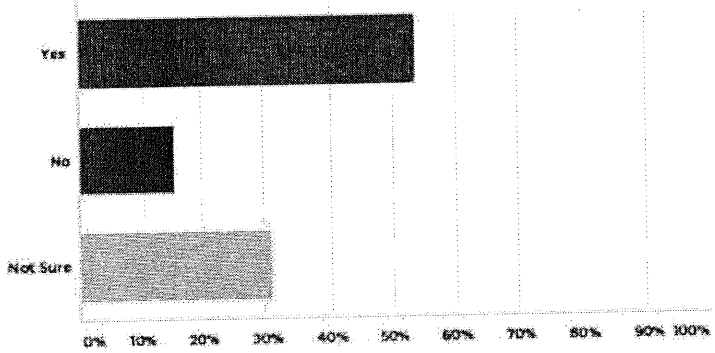
Q10 Are you interested in making your home, business or neighborhood more resistant to hazards?

Answered: 13 Skipped: 0



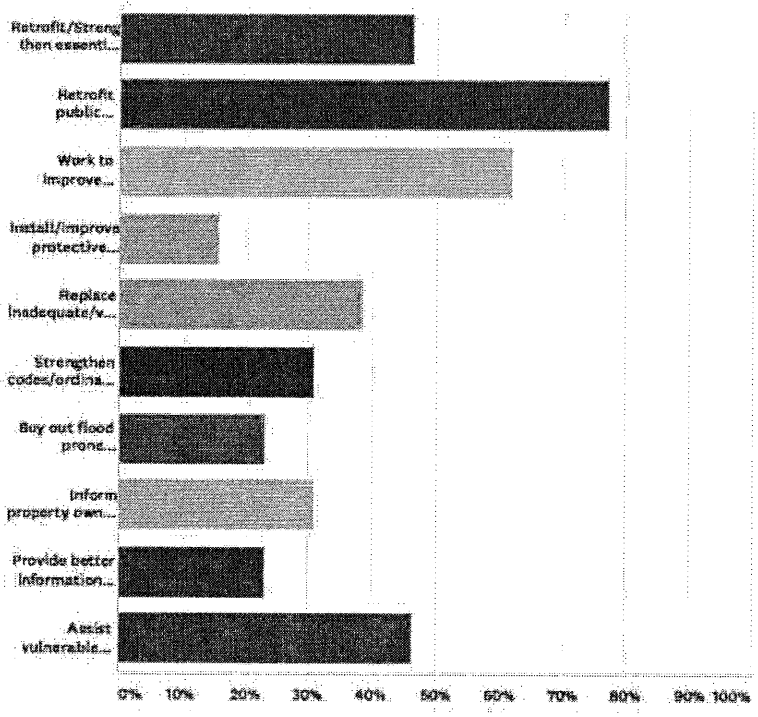
Q11 Would you be willing to spend your own money on your current home and/or business to help protect it from impacts of potential future natural disasters within the community? Examples could include: Elevating a flood-prone home; Elevating utilities in flood-prone basements; Strengthening your roof, siding, doors, or windows to withstand high winds; Removing trees/low branches.

Answered: 13 Skipped: 0



Q12 In your opinion, what types of projects do you believe local, county, state or federal government agencies could be doing to reduce the damage and disruption of natural disasters in Providence? (Select your top three choices)

Answered: 13 Skipped: 0



Q13 Additional comments?

Answered: 4 Skipped: 9

#	RESPONSES	DATE
1	having available, easy to navigate resources for individuals living in flood zones is so critical.	11/19/2018 9:58 AM
2	flood risk is difficult to convey. Most residents assume events are priod at best.	11/7/2018 1:41 PM
3	I'm an East Greenwich resident, but I would love to see Providence emergency preparedness expand to reduce the negative effects during and after a natural disaster.	7/25/2018 4:41 PM
4	WHAT ABOUT MANMADE DISASTERS?	7/21/2018 2:50 PM

PEMA/City/Project Team Meeting #2
August 9, 2018

Horsley Witten Group

Memorandum of Call

To: Kevin Kugel, CEM, Director and Clara Decerbo, Deputy Director - EMA City of Providence

From: Craig Pereira

Date: August 10, 2018

Re: Hazard Mitigation Plan Schedule Update/Follow-up Items

Coordination call between Clara Decerbo and Craig Pereira on August 9, 2018 included the following:

- Project Schedule: Having just recently completed the 2nd LHMC meeting and 1st Public Workshop in July, it was decided to push back the next several upcoming meetings with the City, LHMC, and Public Workshop. This will better distribute the meetings (and time in between) to keep residents engaged and to give the Project Team adequate time to complete the Vulnerability Analyses. The following meetings will be pushed back as follows:
    - PEMA/City Meeting: week of 9/3/18 (excluding 9/5/18)
    - LHMC Meeting #3: week of 10/8/18
    - Public Workshop #2: week of 10/29/18
- Risk Assessment: Craig proposed to modify the ranking criteria for all hazard types for consistency across all hazards…
    - Natural Hazards: HW utilized FEMA's Calculated Priority Risk Index according to NOAA's Event Database.
    - State HIRA Natural and Man-Made Hazards: utilized a standardized methodology that was developed, which includes four categories for 'Probability' (FEMA's Calculated Priority Risk Index includes three categories for 'Probability'). When the draft Risk Index was presented at the last LHMC meeting, there seemed to be some confusion around the difference in criteria across the different hazard types for only the Probability category. Modifying the Natural Hazards criteria ranking to coincide with the State HIRA will provide consistency across all hazards. Can support the change in the text of the document.
    - Several man-made hazard events included in the current City plan, but not the State plan include:
        - Mass casualty
        - Hazardous materials release
        - Terrorism – nuclear
        - Special/VIP events
        - Terrorism- explosive

        …can we use the 2013 rankings…no data to base rankings on. (Craig to set up call with Melinda to discuss).
- Climate Change: State Plan addresses it as a stand-alone hazard…State HIRA considers it an amplifier…Craig will set up call with Melinda on how to address (Kevin/Clara/Lea to participate).
- Healthcare/Education Clusters:
    - Healthcare: Not a great time due to strikes
    - Education: July/August no one around/not a great time of the year.
        - Craig will develop an abbreviated scope with requests for specific elements
        - Possibly meet Education cluster at next RI Association of EM meeting? Clara to follow up with Sam Adams.
        - Need to understand planning assumptions based on City's responsibility.
- Clara forwarded Bridge Update from Craig Hochman. Craig Pereira to follow up directly.

PEMA/City/Project Team Meeting #3
September 14, 2018

Vulnerability Analyses

Flooding

FEMA Flood Zones 9/30/2015

Statewide flood hazard areas compiled from county-based Digital Flood Insurance Rate Map (DFIRM) databases for Rhode Island. The Digital Flood Insurance Rate Map (DFIRM) Database depicts flood risk information and supporting data used to develop the risk data. The primary risk classifications used are the 1-percent-annual-chance flood event, the 0.2-percent-annual-chance flood event, and areas of minimal flood risk. The DFIRM Database is derived from Flood Insurance Studies (FISs), previously published Flood Insurance Rate Maps (FIRMs), flood hazard analyses performed in support of the FISs and FIRMs, and new mapping data, where available. The FISs and FIRMs are published by the Federal Emergency Management Agency (FEMA), and in this case redistributed by the Rhode Island Geographic Information System (RIGIS) at the request of the Rhode Island Emergency Management Agency.

Report Summary:

- Parcels affected by land use classification (includes land/building assessed values)
- Critical Facilities affected
- Critical Infrastructure affected

Climate Change/Sea Level Rise

Mean Higher High Water (MHHW) 1/18/2016

MHHW is the mean elevation of the higher of the two (2) daily high tides over a nineteen year period, in comparison to the mean high water (MHW), which is the average elevation of all high tides over the same period. MHHW is the chosen baseline for the RI SLR study since it reflects a realistic average tidal elevation that communities will experience regularly.

- o MHW = average of all high tides over 19-year tidal epoch
- o MHHW = average of the highest daily tide over a 19-year tidal epoch

Report Summary:

- Critical Facilities affected
- Critical Infrastructure affected

Mean Higher High Water (MHHW) Plus One (1) foot SLR 1/18/2016

Historically, sea level has already risen about 11 inches in the past 100 years. A rise of nine (9) inches has been noted at North Kingstown based on data since 1930 when the Newport tide gauge was installed. With accelerated SLR already being observed in RI, models show that global sea levels are likely to rise one foot in the next 20 to 50 years. MHHW Plus one (1) foot SLR scenario depicts:

- o Areas inundated at mean high tide levels with one (1) foot of SLR, or
- o Areas inundated at spring high tide today.

Report Summary:

- Critical Facilities affected
- Critical Infrastructure affected

Hurricanes

Hurricane Surge Inundation Areas (Worst Case) for Providence 4/30/2009

Worst case Hurricane Surge Inundation areas for category 1 through 4 hurricanes striking the coast of Rhode Island. Hurricane surge values were developed by the National Hurricane Center using the SLOSH (Sea Lake and Overland Surge from Hurricanes) Model. This Surge Inundation layer was created by the U.S. Army Corps of Engineers, New England District. Using ArcInfo's Grid extension, bare earth elevation data from several sources was subtracted from the worst-case hurricane surge values to determine which areas could be expected to be inundated.

This layer was developed to assist emergency management officials in hurricane preparedness and operations.

Report Summary:

- Critical Facilities affected
- Critical Infrastructure affected

Providence Local Hazard Mitigation Committee Meeting #3
October 26, 2018

City of Providence Multi-Hazard Mitigation Plan Update

Local Hazard Mitigation Committee Meeting

Providence Emergency Management Agency – Conference Room
591 Charles Street
Providence, RI 02904
October 26, 2018 10:00 AM – 12:00 PM

Agenda

1. Risk Assessment: Update/Revisions
2. Vulnerability Analyses: Approach/Progress to Date
3. Health Care Cluster: Update
4. Higher Education Group: Update
5. Agenda/Logistics for Public Workshop #2

Horsley Witten Group
Sustainable Environmental Solutions
55 Dorrance Street • Suite 200 • Providence, RI 02903
401-272-1717 • horsleywitten.com

Horsley Witten Group

Memorandum of Meeting

To: Kevin Kugel, CEM, Director and Clara Decerbo, Deputy Director - EMA City of Providence

From: Craig Pereira

Date: December 12, 2018

Re: Providence Emergency Management Agency (PEMA)/City of Providence Local Hazard Mitigation Committee (LHMC) Meeting #3 – Hazard Mitigation Plan Update

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In attendance:

LHMC

Kevin Kugel, CEM, Director - PEMA
Clara Decerbo, Deputy Director – PEMA
Chris Harwood, Johnson & Wales
Janet Freedman, Coastal Geologist - CRMC
Jeff Lykins, Director – Providence Dept. of Inspections/Standards
Dave Everett, Principal Planner - City of Providence
Dave Aucoin, Narragansett Bay Commission
Dawn Lewis, Hospital Association of RI
Melinda Hopkins, State Hazard Mitigation Officer – RIEMA
Gary Marino, Principal Engineer – Providence Water
Pam Rubinoff, Coastal Management Specialist – Coastal Resources Center
Roger Choiniere, Providence Water
Ken Otis, Lifespan
Meg Goulet, Narragansett Bay Commission
Mallory Buys
David Schnell, Women and Infants
Jason Houle
Stephen Capracutta
Christina Cabrera
Philip Sheridan, DOH

Consultant Team

Craig Pereira, Project Manager - Horsley Witten Group, Inc. (HW)
Matt Schultz, Coastal Engineer – Woods Hole Group, Inc.
Dori Boardman, Environmental Planner - Boardman Ecological Services

1. Updated Risk Assessment Matrix
    a. As presented in other LHMC meetings, the scoring criteria for 'probability' relative to human-caused hazards included an additional ranking (4 categories rather than 3) as compared to the natural hazards probability category (3 categories). For consistency throughout the Risk Rubric and ease of understanding, HW re-assessed the scores for natural hazards utilizing the same 4 rankings as provided for human-caused hazards. The relative threat percentages shifted slightly, but now the entire Risk Rubric is scored consistently across all threats.
2. Shelter Capacity Roll-Up

a. Updated to include any changes since the existing plan. Both short- and long-term sheltering needs represent a surplus (+950 short-term, 474 long-term) with the construction of the providence Career and Technical School (56,000 SF)

3. Vulnerability Analyses
    a. After discussions with PEMA personnel and the State Hazard Mitigation Officer, and acknowledging that this update has a 5-year planning horizon, the following Statewide data sets will be utilized to perform overlay vulnerability analyses:
        i. FEMA 1% and 0.2% Flood Zones
        ii. Mean Higher High Water (Baseline for RI SLR study)
        iii. Mean Higher High Water Plus 1-foot SLR (20 – 50 yr planning projection)
        iv. Hurricane Surge Inundation Areas (category 1 – 4)
4. Update: Higher Education/Healthcare Clusters
    a. Healthcare
        i. Membership confirmed
            1. Dawn Lewis (HARI)
            2. Ken Otis (Lifespan)
            3. David Schnell (Women and Infants)
            4. John O'Reilly (Women and Infants)
            5. Alysia Mihalakos (RIDOH)
            6. Philip Sheridan (RIDOH)
            7. Joe Reppucci (RIDOH)
            8. Nicholas Larmore (RIDOH)
            9. Connie Allen (HARI)
        ii. Scope/Approach presented to the group
        iii. Dawn Lewis will vet the Healthcare survey
    b. Education
        i. Membership confirmed
            1. Chris Harwood (JWU)
            2. Steve Morin (Brown)
            3. Sam Adams (URI)
            4. Jennifer Howley (RISD)
        ii. Scope/Approach presented to the group
        iii. Chris Harwood will vet the Education survey
5. Online Surveys update
    a. Survey 123…geographic-based, 4 in total
    b. Survey Monkey…preparedness survey, 7 in total
6. Agenda/Logistics for Public Workshop
    a. November 16, 2018 at Mayor Joseph A. Doorley Municipal Building…6:30 – 8 PM.
    b. Flyer for public workshop in English and Spanish pushed out via City social media, posting in public areas (libraries/rec centers), on PEMA website, through other City Departments social media
    c. PEMA to provide translators
    d. Agenda:
        i. Welcome (PEMA)
        ii. Risk Assessment Rubric update (Craig)
        iii. Shelter Capacity Roll-Up (Craig)
        iv. Vulnerability Analyses (Craig)
        v. Healthcare Cluster Annex (Craig)
        vi. Education Cluster Annex (Craig)
        vii. Hard copies of the Community Preparedness Survey will be available

City of Providence Multi-Hazard Mitigation Plan Update

Local Hazard Mitigation Committee Meeting

Providence Emergency Management Agency - Conference Room
591 Charles Street

October 26, 2018 10:00 AM - 12:00 PM

Name	Email Address
Dawn Lewis	dawnl@hsri.org
Melinda Hopkins	melinda.hopkins@ema.ri.gov
Cory Peterson	cpeterson@horsleywitten.com
Clara Decerbo	cdecerbo@providenceri.gov
Gary Manino	GMANINO@PROVWATER.COM
Pam Rubinoff	rubinoff@uri.edu
Dori Boardman	doriboardman@gmail.com
Roger Citoniere	RogerC@PROVWATER.com
Chris Harwood	charwood@~~gmail~~.fuw.edu
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Ken Otis	kotis@lifespan.org
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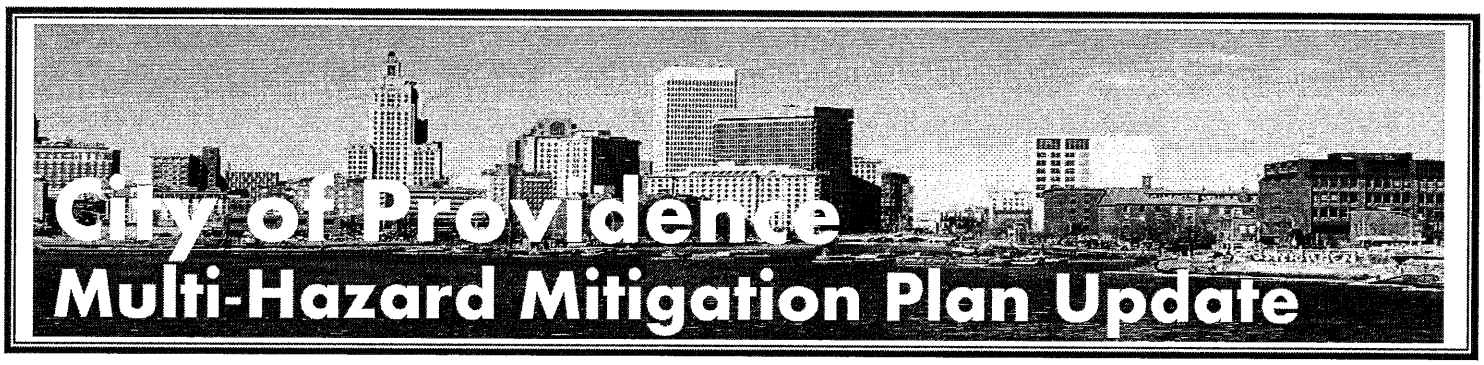
Jason Hovle	Jhovle@Providenceri.com
Stephen Capracotta	Scapracotta@Providenceri.com
DAVID EVERETT	deverett@providenceri.gov
CRISTINA CABREA	cristina@ejlri.org
Jeffrey Lykins	JLYKINS@PROVIDENCEPL.COM
Philip Sheridan	Philip.Sheridan@health.ri.gov

Public Workshop #2
November 16, 2018



Public Workshop

November 16, 2018

Mayor Joseph A. Doorley Municipal Building
Conference Room
444 Westminster Street
Providence, RI 02903

Formal Presentation 6:30 PM—8:00 PM

Come learn what the City has accomplished
and hear about planning for the future.

About the Hazard Mitigation Plan Update

The City of Providence is currently updating the 2013 Hazard Mitigation Plan. This plan is important because it helps the City plan and receive funding for projects that reduce the risk of injury or damage to property from future natural hazard events such as flooding and hurricanes. The Disaster Mitigation Act of 2000 (DMA) places high priority on the continuation of the planning process after the initial submittal, requiring communities to seek and receive re-approval from FEMA in order to remain eligible for assistance.

For more information, or to review a copy of the 2013 Hazard Mitigation Plan, please visit:
http://www.providenceri.gov/pema/multi-hazard-mitigation-plan/

Contacts

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Providence, RI 02903
cpereira@horsleywitten.com
Phone: (401) 272-1717

Taller Público

16 de noviembre, 2018

Mayor Joseph A. Doorley Municipal Building
Sala de conferencias
444 Westminster Street
Providence, RI 02903

Presentación Formal 6:30 PM—8:00 PM

Venga y aprenda lo que la Ciudad ha logrado y escuche sobre la planificación para el futuro.

Acerca de la Actualización del Plan de Mitigación de Riesgos

La Ciudad de Providence está actualizando el Plan de Mitigación de Riesgos 2013. Este plan es importante porque ayuda a la Ciudad a planificar y recibir fondos para proyectos que reducen el riesgo de lesiones o daños a la propiedad de futuros peligros naturales, como inundaciones y huracanes. La Ley de Mitigación de Desastres de 2000 (DMA) otorga una alta prioridad a la continuación del proceso de planificación después de la presentación inicial, lo que requiere que las comunidades soliciten y reciban una nueva aprobación de FEMA para seguir siendo elegibles para recibir asistencia.

Para obtener más información o para revisar una copia del Plan de mitigación de riesgos de 2013, visite: http://www.providenceri.gov/pema/multi-hazard-mitigation-plan/

Contactos

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City of Providence Multi-Hazard Mitigation Plan Update

Public Workshop #2

Mayor Joseph A. Doorley Municipal Building – Conference Room
444 Westminster Street
Providence, RI 02904

November 16, 2018

6:30 – 8:00 PM Formal Presentation

Agenda

1. Welcome: Kevin Kugel, Director – Providence Emergency Management Agency
2. Risk Assessment Rubric: Craig Pereira, Project Manager – Horsley Witten Group
3. Vulnerability Analyses
4. Shelter Capacity Roll Up
5. Healthcare Cluster Annex
6. Higher Education Annex
7. Next Steps

City of Providence Multi-Hazard Mitigation Plan Update

Public Workshop #2

Mayor Joseph A. Doorley Municipal Building
444 Westminster Street

November 16, 2018 6:30 - 8:00 PM

Name	Email Address
Sara Canuel	scanuel@wrwc.org
Marcus Mitchell	publiceisp.com
Dori Boardman	doriboardman@gmail.com
Karen Hlynsky	karen_ena@earthlink.net
Judy DaSilva:	(Interpreter)
[illegible]	[illegible]
Clara Decerbo	cdecerbo@providenceri.gov
Bill LeBron	BilleBron@yahoo.com
Matt Shultz	mshultz@whgrp.com
Vilma DelValle	indiatainaqueen@aol.com
Natasha Shatzkin	nrshatzkin@gmail.com

Municipal/Agency/Organization Interviews

Task 2.2 Assess Community Capability to Address Identified Vulnerabilities

Suggested Staff Interviews (Stakeholders)

Municipal

Mayor's Staff

Sabrina Solares-Hand, Director of Operations, Mayor's Office (ssolareshand@providenceri.gov)
Steven Pare, Commissioner of Public Safety…also Fire Dept. (see below)

Directors

Fire Department, Steven Pare (spare@providenceri.gov)
Information Technology, Jim Silveria (jsilveria@providenceri.gov)
Planning & Development, Dave Everett (deverett@providenceri.gov)
Police Chief, Col. Hugh T. Clements, Jr.
Providence EMA, Clara Decerbo (cdecerbo@providenceri.gov)
Public Property, Co. Michael Borg (mborg@providenceri.gov)
Public Works, Antonio Morabito (Acting) (amorabito@providenceri.gov)
Office of Sustainability, Leah Bamberger (lbamberger@providenceri.gov)
Inspections and Standards, Jeff Lykins (jlykins@providenceri.gov)

Private

Steve Curtis, Waterson Terminal Services LLC (scurtis@watersonllc.com)
Marisa Albanese, National Grid (marisa.albanese@nationalgrid.com)
Peter LePage, Providence Water (plepage@provwater.com)
Dave Aucoin, NBC (daucoin@narrabay.com)
Erick Riker, Verizon Wireless (Erick.Riker@verizonwireless.com)

Capability Areas (See Capability Assessment Worksheets)

Planning and Regulatory

Personnel:

- Dave Everett
- Jeff Lykins

Administrative and Technical

Personnel:

- Everyone…relative to effective coordination and adequate staffing to enforce regulations?

Financial

Personnel:

- Dave Everett

Safe Growth Audit

Personnel:

- Dave Everett

NFIP…Craig has already coordinated with Clara on this

Additional questions

- Hazard-related issues over the last 5 years (if so, what, when, and how much?)
- Structural or operational improvements over the last 5 years
- New development
- Future development/expansion plans
- Climate change/sea level rise implications/efforts

Date: February 1, 2019

Interviewee(s): Antonio Morabito, Director, DPW

Interviewer: Matt Shultz

RE: Providence Hazard Mitigation Plan Update: Assess Community Capability to Address Identified Vulnerabilities (Task 2.2)

Questions:

1. What are the hazard related issues over the last 5 years (if so, what, when and how much?)
    - October 2018 fuel spill on highway – DPW delivered sand for cleanup

2. Have there been any structural or operational improvements over the last 5 years.
    - Snow/ice control plan in progress

3. Any future development/expansion plans?
    - New DPW facility in next 5 years – current facility (700 Allens) dates back to 1927. Traffic management, garage facility. Currently has flooding issues.
    - Would like SOP in place for disasters – not currently aware of any

Date: January 31, 2019

Interviewee(s): Dave Aucoin, Safety Compliance Coordinator, NBC

Meg Goulet, Interceptor Maintenance Manager, NBC

Interviewer: Matt Shultz

RE: Providence Hazard Mitigation Plan Update: Assess Community Capability to Address Identified Vulnerabilities (Task 2.2)

Questions:

1. What are the hazard related issues over the last 5 years (if so, what, when and how much?)
    - Some flood-prone areas with sewer system backing up into homes, but outside of Providence

2. Have there been any structural or operational improvements over the last 5 years.
    - Most outfalls have tide gates or elevation of discharge point has been raised

3. Any future development/expansion plans?
    - Not in Providence, as built out

4. Planned improvements?
    - Address 3 outfalls that may be impacted by tidal flooding

5. Climate change/sea level rise implications/efforts?
    - Climate Resiliency Study – ongoing, started in Fall of 2018. Phase I will identify where to focus with broad options for adaptation. May include hardening (at WWTP), protection of power supply, and reducing recovery time.

6. Additional actions that would help to mitigate hazards:
    - Providence tunnel – need to protect against flooding though manual intervention. NBC has SOP through O&M Manual. Once the hurricane barrier closes, they are to close the Prov tunnel. This requires coordination with the City who manages the hurricane barrier closures. It would be beneficial to have formal communication process identified.

Date: January 31, 2019

Interviewee: Elaine Richards, Deputy Commissioner, Department of Public Safety

Interviewer: Matt Shultz

RE: Providence Hazard Mitigation Plan Update: Assess Community Capability to Address Identified Vulnerabilities (Task 2.2)

The purpose of this survey is to create an assessment of the city's program capabilities in terms of pre- and post- disaster activities. This information will be used to better define the programs, policies, and funding opportunities each department is implementing to reduce risk and work towards implementing hazard mitigation programs targeted at increased resiliency.

Questions:

1. What are the hazard related issues over the last 5 years (if so, what, when and how much?)
    - October 2018 gas spill on highway, 11,000 gallons of fuel→Foam was dispersed from reserves, required replenishing ($115,000)

2. Have there been any structural or operational improvements over the last 5 years.
    - Have been successful at acquiring grant funding:
        - Conducted training and acquired new ladder truck through Assistance to Firefighters (AFG) grants from FEMA
        - OSPAR grant through REMA→boat modernized and conducted marine training
        - Safer Grant → $15M funded 90 firefighters

3. Any new development?
    - Continue training exercises – Marine Strike Force Team, Flammable Liquids Task Force, Special Hazards Division Task Force – conducting scenario-based training at Port (i.e. ice rescue)
    - In October 2018, regulators approved the construction of a natural gas processing plant on the Providence waterfront

4. Climate change/sea level rise implications/efforts?

    Looking at options for Atwell's Ave Station subject to flooding

5. Are there mutual aid agreements (yes/no)? Describe capability – is coordination effective? Yes, numerous with fire/police. Coordination very effective.

6. Fire Department ISO Rating? City recently awarded a class 1 rating effective July 1, 2018.

Date: February 1, 2019

Interviewee(s): Erick Riker, Major Account Manager, Verizon Wireless

Bobbi Colleta, RI/CT Manager, Verizon Wireless

Interviewer: Matt Shultz

RE: Providence Hazard Mitigation Plan Update: Assess Community Capability to Address Identified Vulnerabilities (Task 2.2)

Questions:

1. Any future development/expansion plans?
    - Would like ability have virtual bridge with PEMA
        - Presence/communication line to EOC (have with State, not City)
        - Point of contact/direct line for more proactive communication
    - City emergency personnel devices to have priority access (during emergency)→would like paperwork finalized (in process)
    - Have 24/7 monitoring of coverage / internal plans during emergency/disaster but not coordinated with City
    - Requesting meeting with City Mayor's Office/PEMA to coordinate additional capabilities
    - Possibly linking network assets to shelters/gathering places
        - Look at coverage status/network gaps & plan to improve

2. Additional capabilities that help to mitigate hazards:
    - Have deployable assets available during emergency (no cost) such as mobile cell towers/generators.

Date: February 8, 2019

Interviewee(s): Hugh Clements, Chief of Police

Interviewer: Matt Shultz

RE: Providence Hazard Mitigation Plan Update: Assess Community Capability to Address Identified Vulnerabilities (Task 2.2)

Questions:

1. Have there been any operational improvements over the last 5 years.
    - Police differently over past 5 years
        - OPS plan for every event
        - DPW trucks at entries/egresses, snipers, etc. for events
    - Work closely with fire & rescue
    - Specialized response unit
    - Holistic/comprehensive policing
        - Meshed with business community
            - Build on partnerships (i.e. Providence Mall, Dunkin Donuts Center)
            - Cross-training and communication are key

2. Additional capabilities that help to mitigate hazards:
    - Continuity of Operations Plan (COOP) – each department contributes
    - Weekly meeting (open to public) to review planned events and potential threats
    - Communicate well internally!
    - One staff member assigned to Joint Terror Task Force
    - RI Fusion Center – receipt, analysis, gathering and sharing of threat-related information

Date: February 1, 2019

Interviewee(s): Jim Silveria, Information Technology

Interviewer: Matt Shultz

RE: Providence Hazard Mitigation Plan Update: Assess Community Capability to Address Identified Vulnerabilities (Task 2.2)

Questions:

1. What are the hazard related issues over the last 5 years (if so, what, when and how much?)
    - Have lost networks due to power outages
    - Not all offices have power backup, but primary systems have 2 levels of backup

2. Have there been any structural or operational improvements over the last 5 years.
    - Emergency notification process has been updated. PEMA has been leading this.

3. Any future development/expansion plans?
    - Moving to cloud service model – will change response process and could be an added layer of risk (more pieces out of City's control)

Date: February 8, 2019

Interviewee(s): Peter LePage, Director of Engineering, Providence Water

Interviewer: Matt Shultz

RE: Providence Hazard Mitigation Plan Update: Assess Community Capability to Address Identified Vulnerabilities (Task 2.2)

Questions:

1. What are the hazard related issues over the last 5 years (if so, what, when and how much?)
    - 2010 storm produced highest reservoir levels→guided recent procedures for regulating levels/increasing capacity prior to storms

2. Have there been any structural or operational improvements over the last 5 years.
    - Water supply management plan→updated every 5 years
        - Emergency response plan
            - Identifies vulnerability, criticality, response
            - All on SCADA→ automated notifications

3. Any future development/expansion plans?
    - Reinvest $25M per year through IF replacement program (updated every 5 years)
        - Reinvestment $$ included with rates
        - Updated SCADA system ongoing
        - Security/cyber threat plans in development

4. Additional capabilities that help to mitigate hazards:
    - 800Mhz radios (if other comm. goes down) / exercises with RI National Guard
    - Table top exercises with State Cyber Team
    - 120M gallons of storage (2 days of supply)
    - Code Red→ notify customers of problems
    - In hurricanes
        i. Proactive response→ pull flashboards out to handle flows
        ii. Facilities have generators→transfer to generator prior to storm
    - In blizzards
        i. Plow their own facilities→ can get fuel to specific sites

Date: February 1, 2019

Interviewee(s): Stephen Curtis, Port Facility Manager, Waterson Terminal Services

Interviewer: Matt Shultz

RE: Providence Hazard Mitigation Plan Update: Assess Community Capability to Address Identified Vulnerabilities (Task 2.2)

Questions:

1. What are the hazard related issues over the last 5 years (if so, what, when and how much?)
    - Mostly wind related issues- impacts operations/commerce (need to shut down cranes)
    - Flood related impacts to infrastructure – seawall minimally overtopped only once or twice during high water events (especially if hurricane barrier is closed). Other areas protected by containment berms, or are located on higher ground.

2. Have there been any structural or operational improvements over the last 5 years.
    - No

3. Any future development/expansion plans?
    - Expansion in the works, but no specific parcels identified. Looking at potential additional storage locations. Expecting 1-2 parcels within next 2 years.

4. Climate change/sea level rise implications/efforts?
    - No immediate plans to improve/elevate seawall.
    - Try to address by tailoring tenant base through 1) how close they would need to be to the water, and 2) the duration of lease.

5. Additional capabilities that help to mitigate hazards:
    - Assets are made available to the City in a hazardous event: heavy machinery, crane equipment, rail access, access to trucks, etc.

PEMA/City/RIEMA Meeting #4
February 19, 2019

PUBLIC EDUCATION AND AWARENESS

Action #1

Create a Stormwater Learning Center in Roger Williams Park.
Staff/Agency/Organization Interviews

Partner with academic institutions, government agencies, and nonprofits to create a living laboratory for green infrastructure. The primary functions are to 1) provide opportunities for learning best practices for project design, construction and maintenance, 2) scientific research and analysis to measure water quality impacts of stormwater management practices, and 3) training, outreach and education to build the community of practice and foster broad public engagement in sustainable environmental practices.

- Action Type: Planning, Pre-Disaster
- Priority Score: ____
- Lead: Office of Sustainability
- Supporting: Community institutions/agencies/non-profits
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City budget
- Cost Estimate: Staff time
- Benefit: Institutional awareness of hazards, impacts on stormwater system and water quality
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #2

Implement Mitigation Education and Incentive Program.
Rhode Island 2018 State Hazard Mitigation Plan

The Inspection and Standards Department will provide information to contractors and homeowners on risks of building in hazard-prone areas and inform builders and homeowners of the benefits of building and renovating structures to current standards. The City will use FEMA's *Home Builder's Guide to Coastal Construction* (Publication #499), FEMA's *Coastal Construction Manual*, (Publication #55CD Third Edition), *No Adverse Impact (NAI) Coastal Land Management Guidelines* developed by the Association of State Floodplain Managers, *R.I. Coastal Properties Guide*, and other FEMA publications, as applicable.

In addition, the City will promote and support enforcement of the latest policy revisions relative to climate change and sea level rise and distribute literature related to mitigation techniques including information from the Institute of Business and Home Safety, retrofit methodology (FEMA's library of Technical Bulletins), grant/loan sources, and insurance options.

Consider developing public/private partnership incentives to implement mitigation measures in coordination with local, state, and federal funding opportunities. Incentives could include tax incentives, cost-sharing, and regulatory streamlining or acceleration of the permit process for those who implement mitigation activities.

- Action Type: Planning, Pre-Disaster
- Priority Score: ____
- Lead: Inspection and Standards Department
- Supporting: Department of Planning and Development
- Time Frame: 0 – 6 months (Short-term)
- Financing Options: City budget
- Cost Estimate: Staff Time
- Benefit: Institutional awareness of hazards for contractors/homeowners, increased property protection/improved resiliency
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #3
Identify municipal personnel to become a Certified Floodplain Manager.

Personnel from the Inspection and Standards Department should become a Certified Floodplain Manager (CFM) through the Association of State Floodplain Managers. In addition to providing floodplain coordination information to the public, a CFM can assist with floodplain mapping, elevation certificates and floodplain mitigation alternatives.

- Action Type: Planning, Pre-Disaster
- Priority Score: ____
- Lead: Inspection and Standards Department
- Supporting: Department of Planning and Development
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City budget
- Cost Estimate: Staff time (Minimal)
- Benefit: Institutional awareness of hazards for contractors/homeowners, increased property protection/improved resiliency
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #4
Implement a public outreach campaign to inform citizens about evacuation routes and which bridges and roads are subject to periodic flooding.
Rhode Island 2018 State Hazard Mitigation Plan

Steps should be taken to inform residents about which bridges and roads are subject to flooding, as well as about indicators to begin evacuation. Principles of the Emergency Response Plan that are pertinent to given neighborhoods or the population in general should be summarized and distributed. Hazardous locations and warning signs, along

with critical phone numbers and evacuation routes, could be conveyed on a calendar, a refrigerator magnet, or some other item commonly displayed in households. Outreach to residents could also be in the form of an annual mailing prior to hurricane season to give information on property protection and preparedness. Public service messages in the newspaper, on the radio, or during public forums may be a sufficient alternative.

Incorporate education/awareness for out of town/state visitors/tourists. Visitors/tourists may not be familiar with local authorities, evacuation routes, or know what to expect if police-enforced evacuation becomes necessary. Distribute information on city evacuation routes and emergency services to hotels, Bed and Breakfasts, real estate agencies dealing with seasonal rentals, and other facilities and events hosting tourists.

This action should include the annual update on the vulnerability of these critical infrastructure components in relation to climate change and sea level rise, with revisions made accordingly.

- Action Type: Planning, Pre-Disaster
- Priority Score: ____
- Lead: PEMA
- Supporting: DPW/RIDOT
- Time Frame: 0 – 6 months (Short-term)
- Financing Options: City budget
- Cost Estimate: Staff Time (Minimal)
- Benefit: Protection of life, institutional awareness of hazards, accelerated evacuation
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #5

Develop and implement an annual Disaster Mitigation Workshop for businesses, industry, and shoreline users.

City of Providence Harbor Management Plan

Prior to the start of hurricane season (June 1st), PEMA will:

- Develop and implement an education/training program for harbor and shorefront users that includes the distribution of the Harbor Hazard Mitigation Plan and a storm readiness checklist for boaters
- Update accurate lists of principal marine interests and pumpout facilities including marinas, waterfront businesses, neighboring Harbormasters, Coast Guard, Towing and Salvage Companies, Environmental teams, Key vessel operators, and fishing cooperatives

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: _____
- Lead: PEMA
- Supporting: RIEMA, harbormaster, Harbor Management Commission

- Time Frame: 0 – 6 months (Short-term)
- Financing Options: City budget
- Cost Estimate: Staff time and materials cost
- Benefit: Reduced damage, improved resiliency, accelerated recovery
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #6

Develop and implement a public outreach program to notify property owners in A- and V-zones of the requirements to comply with new floodplain standards.

Strategy for Reducing Risks from Natural & Human-Caused Hazards in Providence, Rhode Island: A Multi-Hazard Mitigation Plan 2013

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: Inspection and Standards
- Supporting: Department of Planning and Development
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: FEMA Flood Mitigation Assistance Program
- Cost Estimate: Staff time and materials cost
- Benefit: Reduced damage, improved resiliency
- Vulnerable Area: A-V Zone properties

Action #7

Conduct periodic review on the feasibility of enrolling in the NFIP's Community Rating System (CRS) as a means to soften the likely increase in many flood insurance policy rates resulting from new reforms to the NFIP.

Rhode Island 2018 State Hazard Mitigation Plan

Strategy for Reducing Risks from Natural & Human-Caused Hazards in Providence, Rhode Island: A Multi-Hazard Mitigation Plan 2013

CRS is a voluntary program that recognizes and encourages a community's efforts that exceed the NFIP minimum requirements for floodplain management. The CRS program emphasizes three goals:

- the reduction of flood losses
- facilitating accurate insurance rating
- promoting the awareness of flood insurance

By participating in the CRS program, communities can earn a 5-45% discount for flood insurance premiums based upon the activities that reduce the risk of flooding within the community.

The City evaluated the feasibility of enrolling in the CRS program in 2013 and again in 2015. In both instances, it was determined as not cost-beneficial to pursue enrolling given the limited number of existing policies and limited capacity of staff to complete.

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: _____
- Lead: Inspection and Standards/Department of Planning and Development
- Supporting: RIEMA
- Time Frame: >24 months (Long-term)
- Financing Options: FEMA Flood Mitigation Assistance Program
- Cost Estimate: Staff time
- Benefit: Reduced flood insurance policy premiums
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

PLANNING AND PREVENTION

Action #8

Conduct a full-scale exercise to test RI's Medical Emergency Distribution System (MEDS) and its ability to rapidly dispense medical countermeasures to the general public at PODs and to predefined populations in hospitals and nursing homes within the City of Providence.

RIDOH Outreach
Rhode Island 2018 State Hazard Mitigation Plan

MEDS is intended to mitigate the spread of morbidity and mortality during public health emergencies (such as large-scale disease outbreak or bioterrorism attack) through the timely provision of countermeasures. The state's plan includes:

- Receive, stage, distribute, and dispense medical countermeasures and supplies from the Strategic National Stockpile during a public health emergency
- Prepare the state to respond to bioterrorism by having a plan for each city and town to rapidly dispense medication to their entire population within 48 hours of the decision to do so as part of the federal Cities Readiness Initiative
- Store chemical nerve agent antidotes throughout Rhode Island so they are available to local emergency responders in the case of a chemical nerve agent event
- Coordinate annual exercises of Points of Dispensing
- Utilize points of dispensing for: flu vaccine, water distribution during hurricanes, and Tdap and Seasonal Flu vaccinations
- Train staff, volunteers, and medical professionals
- Review and offer guidance for all local Medical Emergency Distribution System Point-of-Dispensing Plans

    - Action Type: Planning, Pre/Post-Disaster
    - Priority Score: _____
    - Lead: RIDOH
    - Supporting: HARI/PEMA
    - Time Frame: 6 – 24 months (Medium-term)
    - Financing Options: RIDOH MEDS Budget, FEMA HMA/EMPG
    - Cost Estimate: RIDOH MEDS budget
    - Benefit: Protection of life
    - Vulnerable Area: City of Providence

Action #9

Develop a climate resilience checklist for new construction and large renovations.

Boston, MA (https://www.boston.gov/departments/public-works/climate-resilient-design-standards-and-guidelines)

Checklist to dictate the design of all new construction and major rehabilitation projects to be evaluated based on climate change variables, including temperature, precipitation,

and sea level rise. This checklist will inform future policy decisions, as well as help guide developers to consider long-term climate impacts.

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: Office of Sustainability, Department of Planning and Development
- Supporting: Inspection and Standards
- Time Frame: 6 – 24 Months (Medium-term)
- Financing Options: ____
- Cost Estimate: ___
- Benefit: Protection of life/property, reduced damage, improved resiliency,
- Vulnerable Area: City of Providence

Action #10

Develop a report to reflect the long-term monitoring of climate change projections for Rhode Island/City of Providence that evaluates the efficacy of the hurricane barrier to protect the City of Providence.

Analyzing Coastal Flood Protection Strategies for Providence, Rhode Island

The City of Providence continues to investigate the impacts of climate change on the frequency of flood events within the city, more recently with a particular focus on the Fox Point Hurricane Barrier. A 2016 analysis quantitatively assessed risks and potential economic losses due to sea level rise, as well as informing the timing of decisions for future climate resilience investments. The primary concern is whether the hurricane barrier will continue to protect against future storm surge due to sensitivity of the sea level rise projection used in the long-term. Results of this analysis indicate if a low-probability, high sea level rise projection is used, then the optimal strategy is to build a new, taller barrier by the end of the century. However, under the highest-probability, lower sea level rise projections, the existing barrier is expected to be cost effective in protecting the city from storm surge well into the 22nd century (assuming it can be maintained past its design lifetime).

This report (every five years, and in advance of the next hazard mitigation plan update) should include findings from federal, state and local agencies and leaders who will continue to monitor climate change projections in order to inform the timing of decisions about the future of the hurricane barrier (current analysis suggests a decision be made by 2050).

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: Office of Sustainability/Operations Department
- Supporting: Army Corps, PEMA, RIEMA, DPW, NBC, CRMC
- Time Frame: >24 months (Long-term)
- Financing Options: City budget
- Cost Estimate: Staff time

- Benefit: Protection of life/property, reduced damage, improved resiliency, accelerated recovery
- Vulnerable Area: Hurricane Barrier

Action #11

Implement a public engagement process to inform community members and other stakeholders of the long-term impacts of climate change on the City's waterfront and to create guiding principles and values for how to manage these impacts going forward.

Analyzing Coastal Flood Protection Strategies for Providence, Rhode Island

Due to the increase in the frequency of tidal flooding (so-called nuisance flooding), tide heights that prompt a precautionary closing of the hurricane barrier occur about 10 times a year today. However, they would occur more than weekly by 2050 and twice daily by 2100. While it is anticipated the hurricane barrier will continue to mitigate nuisance flooding through 2100, questions remain about whether it can withstand near-constant use, as projected by 2050.

A 2016 analysis determined the most cost-effective approach to address tidal flooding is to raise the threshold at which the hurricane barrier is shut and prepare the waterfront to be periodically flooded, rather than invest in infrastructure to stop the infiltration of water. The construction of sea walls to prevent nuisance flooding was also an examined alternative of this analysis.

A public engagement process should be undertaken to determine the community's tolerance for flooding along the Riverwalk. Such a process should focus on whether the community wants to invest in sea walls (and accept the resulting change in character of low-lying waterfront areas) or maintain current views and character and accept periodic flooding. If the construction of sea walls was determined to be the preferred alternative, the 2016 analysis suggested construction begin in 2040 – 2050.

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: Office of Sustainability
- Supporting: Parks Department, DPW, Department of Planning and Development
- Time Frame: 0 – 6 months (Short-term)
- Financing Options: City Budget
- Cost Estimate: Staff time
- Benefit: Protection of life/property, reduced damage, improved resiliency, accelerated recovery
- Vulnerable Area: A-V Zone properties, Hurricane Barrier, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #12

Promote resiliency, protection of water and air quality, compatible uses, and economic vitality in the port area by encouraging port-area businesses to participate in certification programs such as Green Marine.

City of Providence Harbor Management Plan

Support development of a green port initiative designed to encourage port operators to adopt best practices in areas such as stormwater management, green infrastructure, renewable energy, energy conservation, air quality, habitat protection, living shorelines, public access, and future climate change considerations for expansion plans. Enforce all port area operators and businesses to comply with hazard mitigation and debris management regulations. Work with the Harbormaster and others to manage the cleanup of large debris after storms, including derelict vessels, damaged and derelict piers, and downed tree limbs.

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: _____
- Lead: Harbormaster
- Supporting: ProvPort, Office of Sustainability
- Time Frame: Medium-term
- Financing Options: ___
- Cost Estimate: Staff time
- Benefit: Continuity of services, improved resiliency, accelerated recovery
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #13

Form a partnership with National Grid to implement tree-trimming and debris management program.

Strategy for Reducing Risks from Natural & Human-Caused Hazards in Providence, Rhode Island: A Multi-Hazard Mitigation Plan 2013

The City just updated its Debris Management Plan. The City of Providence Forestry Division conducts 'block pruning' on a 10-year cycle. National grid conducts systematic pruning on a 4/5-year cycle. Both entities should coordinate cycles for more efficient mitigation.

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: _____
- Lead: Parks Department/City Forester
- Supporting: National Grid
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: National Grid, City Budget
- Cost Estimate: Moderate
- Benefit: Protection of life and property, continuity of services, improved resiliency

- Vulnerable Area: Tree-Trimming and Debris Management Program

Action #14

Strengthen port storm resilience at the port through strategic partnerships and planning.

Resilient Rhody

City of Providence Harbor Management Plan

Shipping lines will turn to ports that rapidly resume normal operations after hurricanes. The City of Providence should approach storm resilience and climate change as a business opportunity through inclusion of resilience planning such as, developing pre-contracts for debris removal after an event, or businesses could implement data backup mechanisms to help the port resume operations more quickly after an event. Encourage the establishment of a new collaborative partnership between the state and port community to better understand the economic implications of severe weather events and benefits of resiliency planning.

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: _____
- Lead: Harbor Management Council, Department of Planning and Development
- Supporting: Office of Strategic Partnerships and Economic Advancement
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City budget
- Cost Estimate: Staff time
- Benefit: Reduced losses and improved resiliency
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #15

Develop a stakeholder committee to execute Phase III of the Upper Narragansett Bay Regional Stormwater Management (UNBRSM) Initiative to develop a regional stormwater utility.

Exploring Regional Solutions to Regional Problems Upper Narragansett Bay Regional Stormwater Utility Feasibility Study - Phase I Final Report

Resilient Rhody

City of Providence Harbor Management Plan

A long term, sustainable solution to stormwater management is needed in the Upper Narragansett Bay region due to real, growing, shared and unresolved challenges in managing stormwater. City staff identified several concerns regarding limited public awareness about a stormwater utility within the city, including aging infrastructure, flooding problems (local streets), MS4 permit compliance, and water quality concerns. City staff also indicated a significant gap in funding for routine maintenance of the CSS and MS4 systems, as well as capital improvements to address water quality. A public education/awareness campaign, perhaps hosted on the City's website could provide the information necessary for the City to make more informed decisions on the topic.

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: Office of Sustainability,Operations Department
- Supporting: Stakeholder Committee
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City budget
- Cost Estimate: Significant
- Benefit: Public awareness regarding minimized flood damage, improved water quality
- Vulnerable Area: A-V Zone properties

Action #16

Implement green infrastructure to reduce flooding, ease the burden on traditional stormwater systems, and improve and protect water quality.

Rhode Island 2018 State Hazard Mitigation Plan
Resilient Rhody
City of Providence Harbor Management Plan

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: Department of Planning and Development, Office of Sustainability, DPW
- Supporting: RI Department of Environmental Management
- Time Frame: >24 months (Long-term)
- Financing Options: FEMA PDM funds
- Cost Estimate: Significant
- Benefit: Reduced losses and improved resiliency
- Vulnerable Area: A-V Zone properties

PROPERTY PROTECTION

Action #17

Identify new location for vital municipal documents.

Strategy for Reducing Risks from Natural & Human-Caused Hazards in Providence, Rhode Island: A Multi-Hazard Mitigation Plan 2013

For the most part, City Hall is protected from serious flooding by the Hurricane Barrier. In the unlikely event that the barrier should fail, the City's Department of Public Property must insure that vital documents are stored in upper stories or in flood-proof cabinets, or located outside of a flood zone

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: Department of Public Property, City Archives, Public Records
- Supporting: Department of Planning and Development
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City budget, FEMA, FMAP
- Cost Estimate: Significant
- Benefit: Minimized damage, protection of vital documents
- Vulnerable Area: City Hall and Other Public Properties

Action #18

Retrofit older buildings to comply with current code requirements.

Strategy for Reducing Risks from Natural & Human-Caused Hazards in Providence, Rhode Island: A Multi-Hazard Mitigation Plan 2013

Like City Hall, Downtown Providence is protected from serious flooding by the Hurricane Barrier. Moreover, most new buildings are earthquake resistant. Some buildings both in and out of downtown would require some retrofitting. Buildings constructed after the end of the World War II would have been designed according to then- accepted structural engineering practice, resembling current code requirements, to withstand hurricane force winds. Some pre-war buildings may not have utilized structural engineering criteria resembling current code requirements. Structural analysis should be provided by property owners to determine which buildings are structurally consistent with current code requirements and currently accepted engineering practice.

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: Department of Public Property
- Supporting: Inspection and Standards
- Time Frame: >24 months (Long-term)
- Financing Options: City budget/private funds
- Cost Estimate: Significant
- Benefit: Minimized damage, improved resiliency
- Vulnerable Area: Buildings with Archaic Structural Systems

Action #19
Develop a dam safety notification system to coordinate the actions of officials at the federal, state, and local levels.
Resilient Rhody

Establish a notification system for dam safety to coordinate the actions of officials at the federal, state, and local levels. The system should use the process developed by the National Weather Service for severe weather, including a dam advisory, a dam watch, and a dam warning.

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: RI Department of Environmental Management
- Supporting: RIEMA
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: RIDEM
- Cost Estimate: Staff time
- Benefit: Minimized flood damage
- Vulnerable Area: A-V Zone properties

Action #20
Mitigate impacts of coastal and riverine flooding on stormwater infrastructure and its performance by conducting a risk assessment.
Rhode Island 2018 State Hazard Mitigation Plan
Resilient Rhody

Identify at-risk structures, then develop projects and/or policies to address risks and establish process for maintenance of stormwater ponds.

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: DPW
- Supporting: RI Department of Environmental Management
- Time Frame: >24 months (Long-term)
- Financing Options: Pre-Disaster Mitigation/Hazard Mitigation Grant Program funds
- Cost Estimate: Moderate
- Benefit: Reduced losses and improved resiliency
- Vulnerable Area: A-V Zone properties

NATURAL RESOURCE PROTECTON

Action #21

Facilitate redundancy of supply across water supply districts throughout the state.
Rhode Island 2018 State Hazard Mitigation Plan
Resilient Rhody

Assist water suppliers in developing local Emergency Interconnection Programs. Emergency water system interconnections provide redundancy of supply and the ability to address water emergencies rapidly and efficiently across water supply districts particularly in small systems throughout the state.

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: RI Water Resources Board
- Supporting: RI Department of Health
- Time Frame: >24 months (Long term)
- Financing Options: Drinking Water State Revolving Fund
- Cost Estimate: Staff time
- Benefit: Continuity of operations
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #22

Ensure spillway management and coordination between water suppliers and downstream municipalities.
Rhode Island 2018 State Hazard Mitigation Plan
Resilient Rhody

Advance common goal setting and communication between water suppliers that manage reservoirs and downstream municipalities. Ensure downstream flood mitigation via proactive spillway management without adverse impacts on safe yield.

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: RI Department of Health/Providence Water Supply Board
- Supporting: RI Water Resources Board
- Time Frame: 0 – 6 months (Short -erm)
- Financing Options: Drinking Water State Revolving Fund
- Cost Estimate: Staff time
- Benefit: Reduced losses and improved resiliency
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #23

Use Total Maximum Daily Loads (TMDLs), watershed plans and local land use analysis and planning to identify areas of existing impervious surface that can be removed/minimized.

Resilient Rhody

There may be opportunities to include drainage and/or Low Impact Development techniques, such as infiltration strips and reduced pavement, in existing commercial and municipal parking lots that are being resurfaced. As the City continues to assess the feasibility of a Stormwater Management Utility District, provisions should be made to incorporate the development of 'criteria' relative to incentive credits for stormwater improvements across three typologies: retrofit of existing paved surfaces (reductions); new/expansion of parking for commercial sites; and, residential conversions.

- Action Type: Mitigation, Pre-Disaster
- Priority Score: ___
- Lead: Department of Planning and Development
- Supporting: Office of Sustainability
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City Budget, FEMA grants, private funds
- Cost Estimate: Staff time
- Benefit: Reduced flow/loading to the WWTF, increased infiltration onsite, increased property protection/resiliency
- Vulnerable Area: A-V Zone properties

Action #24

Develop erosion mitigation strategies for shoreline areas including India Point, Richmond Square, and the Seekonk River along River Drive, and promote living shorelines along currently hardened shoreline where appropriate and feasible.

City of Providence Harbor Management Plan
Resilient PVD Lab Report

- Action Type: Mitigation, Pre-Disaster
- Priority Score: ___
- Lead: Parks Department, Department of Planning and Development, DPW
- Supporting: CRMC
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City Budget, FEMA grants, private funds
- Cost Estimate: Moderate
- Benefit: Improved water quality and resilience
- Vulnerable Area: A-V Zone properties

STRUCTURAL PROJECTS

Action #25

Support implementation of Resilience Strategies for the NBC Bucklin Point Wastewater Collection and Treatment Facility.

Implications of Climate Change for RI Wastewater Collection and Treatment Infrastructure
Resilient Rhody

The coastal flood hazard assessment predicted that all the treatment facility components situated within the berm-protected low-lying area would be inundated by storm surge at the 100-year return period. Taking into consideration the increased berm height, the modeled 100-year storm stillwater level would overtop the berm by approximately 12 to 18 inches and the average water depth in the driveway between the wet weather tanks and the secondary treatment would be approximately 10.5 feet deep. Factoring the addition of 1 foot of SLR, the extent of flooding during a 100-year storm would reach the centrate holding tanks located up the hill. With the addition of 5 feet of SLR, the entire centrate tank area would be inundated during a 100-year storm event.

A wave analysis predicted that the significant wave height for a 100-year storm event would be approximately 5 feet as it approached the berm. Because waves are additive to the storm surge, wave action would lead to overtopping of the berm, even for storms that are less severe than the 100-year event. The berm will minimize wave action so that the significant wave height experienced at the facility components would be approximately 1-2 feet without SLR, and approximately 3-4 feet with 5 feet of SLR.

Due to facilities with a low risk of failure by inundation from the events modeled could experience localized site flooding or other hazard situations that could partially or fully disable operations, in addition to the planning horizon for this Update (5 years), the top three priority mitigation strategies are included to maintain operations in the short-term. Resiliency measures and cost estimates are listed by individual system components at risk below the mitigation action framework. Several of which have multiple resiliency measures for consideration, with associated costs for each.

System Component	Resiliency Measure	Cost Estimate	Mitigation Strategy
Influent Pump Station	Hardening Repairable/ Replaceable	> $1,000,000 $50,000 - $250,000	Raise/Extend perimeter berm Store replacement pump components on-site
Generator			Mount generator at elevated location
Effluent Pump Station	Hardening Relocation	>$1,000,000 $50,000 - $250,000	Raise/Extend perimeter berm Relocate drive systems to high ground
Disinfection System	Hardening Relocation	>$1,000,000 $50,000 - $250,000	Raise/Extend perimeter berm Relocate critical components to high ground

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: Narragansett Bay Commission
- Supporting: DPW, Office of Sustainability
- Time Frame: >24 months (Long-term)
- Financing Options: NBC
- Cost Estimate: varies upon measure selected
- Benefit: Minimized flood damage, continuity of operations
- Vulnerable Area: NBC WWTF

Action #26

Support implementation of Resilience Strategies for the NBC Fields Point Wastewater Collection and Treatment Facility.

Implications of Climate Change for RI Wastewater Collection and Treatment Infrastructure
Resilient Rhody

The coastal flood hazard modeling predicted that the majority of the facility would be inundated by storm surge at the 100-year return period including nine secondary clarifiers, the chlorine contact tank, the aeration tank, four primary clarifiers and four former primary clarifiers that are now wet weather tanks. In addition, the Ernest Street Pump Station (the facility's main pump station) would be inundated along with the area surrounding the wet weather tunnel entryway. The tunnel entrance is covered and raised above grade, protecting it from entering floodwaters. Access from Ernest Street would still be possible, but Fields Point Drive will be inundated. The water depth on site would vary up to 7 feet. With the addition of 2 feet of SLR, the extent of flooding during a 100-year storm would reach the maintenance building and preliminary treatment area, which though slightly elevated, will also be inundated along with equipment that is stored below ground.

A wave analysis was conducted at two transects through the Fields Point facility. The analysis for Transect 1 predicted that the significant wave height for a 100-year storm event would be approximately 5 feet at the shoreline and then drop gradually to 2 feet approximately 1,000 feet inland as the grade gradually rises. With 5 feet of SLR and the 100-year storm event, the significant wave height experienced at the facility would be approximately 5 feet and gradually drop to 4' approximately 1,350 feet inland. The analysis for Transect 2 showed different results because of the steep rise in grade approximately 350 feet from shore. Here, the significant wave height for a 100-year storm event would be approximately 5 feet up until about 350 feet from shore where it drops to about one foot moving inland until approximately 750 feet from shore. With 5 feet of SLR, the significant wave height is approximately 6 feet at the shoreline and follows the same trajectory and drop off pattern until approximately 350 feet from the shoreline to approximately 750 from shore where a one-foot wave height would be experienced to approximately 1,100 feet from shore.[1]

[1] Implications of Climate Change for RI Wastewater Collection and Treatment Infrastructure, page 3-37.

Similar to the mitigation action for the Bucklin Point WWTF, due to facilities with a low risk of failure by inundation from the events modeled could experience localized site flooding or other hazard situations that could partially or fully disable operations, in addition to the planning horizon for this Update (5 years), the top three priority mitigation strategies are included to maintain operations in the short-term. Resiliency measures and cost estimates are listed by individual system components at risk below the mitigation action framework. Several of which have multiple resiliency measures for consideration, with associated costs for each.

System Component	Resiliency Measure	Cost Estimate	Mitigation Strategy
Influent Pump Station	Hardening	<$50,000	Protect facility entrances with Flood barriers
Generator			Elevate generator equipment
Disinfection System	Hardening	<$50,000	Protect facility entrances with flood barriers
Washington Park PS	Hardening	<$50,000	Protect facility entrances with flood barriers

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: Narragansett Bay Commission
- Supporting: DPW, Office of Sustainability, City of East Providence
- Time Frame: >24 months (Long-term)
- Financing Options: NBC
- Cost Estimate: varies upon measure selected
- Benefit: Minimized flood damage, continuity of operations
- Vulnerable Area: NBC WWTF

EMERGENCY SERVICES

Action #27

Improve the collective preparedness and response of various agencies, healthcare providers, and municipal departments within the City of Providence.

RIDOH Outreach

- Establish mutual aid agreements between home health agencies to ensure coverage for patients at home or in shelters who require continuity of care after a disaster.
- Given the types of specialty (tertiary) care provided at hospitals within Providence, establish mutual aid agreements with neighboring states to ensure that plans are in place to move patients to appropriate levels of care during disasters.
- Ensure that Providence can effectively utilize the R.I. Special Needs Emergency Registry (RISNER) when responding to a disaster.

  - Action Type: Planning, Pre/Post-Disaster
  - Priority Score: _____
  - Lead: RIDOH
  - Supporting: PEMA
  - Time Frame:6 – 24 months (Medium-term)
  - Financing Options: RIDOH
  - Cost Estimate: Staff time
  - Benefit: Protection of life
  - Vulnerable Area: City of Providence

Action #28

Develop partnerships with businesses to provide public/private collaboration for coordinated mitigation, preparedness, response and recovery (Business Continuity Plans).

Rhode Island 2018 State Hazard Mitigation Plan

PEMA, in coordination with the RI Alliance for Business will develop strategies to help local businesses in flood prone areas recover from the effects of a natural disaster. In particular, these strategies will include organizing business owners for collective clean-up of their properties after a disaster and the creation of a list of businesses and the people connected with those businesses that are authorized to enter the businesses in the period of time immediately following a disaster. This list would be used by the Police Dept. in their role of guarding properties after a disaster. The Police Dept. will develop criteria for determining when safety considerations outweigh the rights of a given business owner to access their property.

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: PEMA
- Supporting: RI Alliance for Business
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: Private businesses

- Cost Estimate: Staff time
- Benefit: Accelerated clean-up and recovery
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #29

Evaluate one of the following two options to determine which would be better in the long-term for the City's Fire Station on Atwells Avenue: 1) Relocation of the fire station 2) Build a retaining wall on the fire station side of the river to protect from possible flooding.

Strategy for Reducing Risks from Natural & Human-Caused Hazards in Providence, Rhode Island: A Multi-Hazard Mitigation Plan 2013

The City's Fire Station on Atwells Avenue at Valley Street is in a floodplain.

- Action Type: Planning, Pre-Disaster
- Priority Score: _____
- Lead: Fire Department
- Supporting: PEMA
- Time Frame: 6 – 24 Months (Medium-term)
- Financing Options: City budget, FEMA grants, Army Corps, Bonds
- Cost Estimate: Staff time
- Benefit: Minimized flood damage, continuity of operations
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #30

Enhance the coordination and capabilities between the City and Verizon.

Staff/Agency/Organization Interviews

Verizon Wireless has capabilities during emergencies that could be coordinated with various municipal departments for enhanced emergency services and recovery citywide, including:

- Establish a virtual bridge with PEMA
  - Presence/communication line to EOC
  - Primary Point of Contact/direct line for more proactive coordination
- Provide priority access to emergency personnel
- Share 24/7 monitoring of coverage/internal plans during emergencies
- Consider linking network assets to shelters/gathering locations
- Share deployable assets during emergencies such as mobile cell towers and generators

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: _____
- Lead: PEMA
- Supporting: Verizon Wireless

- Time Frame: 6 – 24 Months (Medium-term)
- Financing Options: City/Verizon budgets
- Cost Estimate: Staff time
- Benefit: Expedited recovery, continuity of operations
- Vulnerable Area: Public Buildings and Critical Infrastructure

PLANNING AND PREVENTION

Action #31

Work collaboratively with RIDOT to utilize RIDOA's Technical Paper 164 - Vulnerability of Transportation Assets to Sea Level Rise to prioritize improvements for transportation assets evaluated under various sea level rise scenarios throughout the city.

Technical Paper 164 – Vulnerability of Transportation Assets to Sea Level Rise

This study utilized a GIS-based methodology to assess transportation assets under state jurisdiction (including Roadways, Rail, RIPTA, Passenger Intermodal Hubs, Ports and Harbors, Bridges, Bicycle Infrastructure) at risk under 1, 3, and 5-foot scenarios across the state. The study is intended to be a resource for the state and affected communities to incorporate sea level rise data into informed decision-making regarding spending, planning, goal setting, communication and capacity building, and for additional analysis.

A variety of medium- and long-term policy adaptation strategies exist to help local decision makers manage sea level rise risks to transportation assets (e.g. degree of impact if lost, expense associated with different adaption alternatives). General adaption alternatives fall into four categories: protect, accommodate, retreat, and do nothing.

- Protect – Armor:
  - Hard armoring often includes protections like sea walls and bulkheads
  - Not universally realistic given the expense of building and maintenance, adverse impacts to adjacent neighborhoods, and impacts to environmental systems
- Protect – Enhance Natural Protections:
  - Similar, if not superior protection to that promised by hard-armoring protection
  - Fewer aesthetic and environmental consequences
  - Subject to topography and land use
  - Fiscal costs can be significant
- Accommodate – In Place:
  - Increase the size of culverts, planning pavement materials to minimize life-cycle costs, enhancing scour protection on bridges
  - Elevate the asset
  - Fiscal costs can be significant
  - Impacts to viewsheds
  - Day to day impact management (cones, re-routing traffic)
- Accommodate – Through Realignment:
  - Easiest for flexible infrastructure (RIPTA bus routes)
  - Challenging for assets with firm rights-of-way
- Retreat:
  - Politically/legally complicated

    - Generally, most cost-efficient as a whole when combined with efforts to reorganize land use at the water's edge, and can provide additional community needs such as new parks/open space
- Do Nothing:
    - Often resembles retreat
    - May have significant economic impacts on communities

- Action Type: Planning, Pre-Disaster
- Priority Score: ____
- Lead: RIDOT
- Supporting: DPW
- Time Frame: >24 Months (Long-term)
- Financing Options: Transportation Improvement Program (TIP)
- Cost Estimate: Staff time
- Benefit: Minimized damage disruption to transportation assets, improved resiliency
- Vulnerable Area: A-V Zone properties, Woonasquatucket River, WaterPlace Park to the Hurricane Barrier, Port of Providence

Action #32
Ensure agency and municipality data consistency.
Rhode Island 2018 State Hazard Mitigation Plan

Updating, coordinating, and standardizing foundational resilience data including GIS layers (e.g. STORMTOOLS, critical infrastructure, precipitation projections) and related metadata should be centralized. Hosting coordinated data will provide support for municipal/agency decision-making on infrastructure/public facility investments.

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: _____
- Lead: Information Technology Department/GIS/PEMA
- Supporting: State Agencies
- Time Frame: 0 – 6 months (Short-term)
- Financing Options: City budget
- Cost Estimate: Staff time
- Benefit: Improved resiliency
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #33
Develop and maintain a database of technological and human-related vulnerabilities.
Rhode Island 2018 State Hazard Mitigation Plan

Work with the state to include how technological and human-related threats and hazards impact communities, in addition to documenting frequency and intensity of past threats and future probabilities.

- Action Type: Planning, Pre/Post-Disaster
- Priority Score: _____
- Lead: RIEMA
- Supporting: PEMA
- Time Frame: >24 months (Medium-term)
- Financing Options: RIEMA
- Cost Estimate: Staff time
- Benefit: Improved resiliency
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #34
Acquire properties in the Special Flood Hazard and Repetitive Flood Loss Areas.
Rhode Island 2018 State Hazard Mitigation Plan

Providence now includes 26 residential and non-residential repetitive flood loss properties, as well as properties subject to periodic flooding. The City will work with private property owners in these areas and FEMA to identify an acquisition project (s), obtain approval by the State and FEMA, and seek funding to purchase the property. By purchasing these residential properties, the City is utilizing an effective program designed to move people and property away from high-risk areas to reduce disaster losses. The buildings are either demolished or relocated, and the land is then restricted to open space, recreation, or wetlands in perpetuity.

- Action Type: Mitigation, Pre-Disaster/Post-Disaster
- Priority Score: ___
- Lead: Department of Planning and Development
- Supporting: RIEMA/FEMA
- Time Frame: >24 Months (Long -term)
- Financing Options: City Budget, State/FEMA/Open Space grants
- Cost Estimate: Significant
- Benefit: Reduced losses, improved resiliency, also satisfies other community objectives of additional open space, parks/recreation sites and/or scenic areas
- Vulnerable Area: A – V Zone properties

Action #35
Work with the state to develop an education/outreach campaign for the public and private sector on ways to mitigate cyber threats affecting personal, private, municipal, and state agency security and other sensitive information.
Rhode Island 2018 State Hazard Mitigation Plan
Providence Healthcare and Higher Education Cluster

- Action Type: Planning, Pre-Disaster
- Priority Score: ___
- Lead: RIEMA
- Supporting: PEMA

- Time Frame: >24 Months (Long -term)
- Financing Options: City Budget
- Cost Estimate: Staff/Personnel time
- Benefit: Improved resiliency
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #36
Design and implement a comprehensive, targeted strategy addressing energy security vulnerabilities at the municipal and/or facility level, based on findings of the Energy Assurance Plan.
Resilient Rhody

This strategy should address risks specific to discrete critical infrastructure assets, including hospitals, police and fire, water and wastewater infrastructure, senior centers and nursing homes, shelters, fueling stations, and grocery stores. Smart energy security investments at these locations and energy resilience solutions could alleviate the impacts of power outages and fuel supply disruptions in energy emergencies (i.e. backup generation, fuel reserves, distributed generation, combined heat and power, energy storage, and microgrids).

- Action Type: Planning, Pre-Disaster
- Priority Score: ___
- Lead: Department of Planning and Development
- Supporting: Utility providers
- Time Frame: >24 Months (Long -term)
- Financing Options: City Budget, FEMA PDM/FMA/HMGP funds
- Cost Estimate: Staff time
- Benefit: Reduced disruption of services, improved resiliency
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #37
Establish a formal communication process (Standard Operating Procedure) between the City of Providence and NBC for the closure of the Providence Tunnel in coordination with the closure of the Hurricane barrier.
Staff/Agency/Organization Interviews

The NBC maintains a Standard Operating Procedure (SOP) for the closure of the Providence Tunnel (manual intervention) to protect against flooding once the Hurricane Barrier closes. This requires coordination with the City who manages the Hurricane Barrier closures. A formal communication SOP would expedite this coordination.

- Action Type: Planning, Pre-Disaster
- Priority Score: ___
- Lead: DPW
- Supporting: NBC
- Time Frame: 0 – 6 months (Short-term)

- Financing Options: City/NBC budgets
- Cost Estimate: Staff time
- Benefit: Protection of property, improved resiliency
- Vulnerable Area: Public Buildings and Critical Infrastructure

Action #38
Host annual "Game of Extremes" with key City officials, community members, and other stakeholders.
Staff/Agency/Organization Interviews

This training, which is an evolution of the "Game of Floods," was hosted in 2018 in Providence with great success. It is an engaging way for decision-makers to understand long-term climate risks, conduct vulnerability assessments, prioritize assets, and mitigate impacts.

- Action Type: Planning, Pre-Disaster
- Priority Score: ___
- Lead: Office of Sustainability
- Supporting: Department of Planning and Development
- Time Frame: 6 – 24 months (Medium-term)
- Financing Options: City budget
- Cost Estimate: Staff time
- Benefit: Protection of property, improved resiliency
- Vulnerable Area: Public Buildings and Critical Infrastructure

Providence Local Hazard Mitigation Committee Meeting #4
March 1, 2019

City of Providence Multi-Hazard Mitigation Plan Update

Local Hazard Mitigation Committee Meeting

Providence Emergency Management Agency – Conference Room
591 Charles Street
Providence, RI 02904
March 1, 2019 10:00 AM – 12:00 PM

Agenda

1. Risk Assessment: Update/Revisions
2. Vulnerability Analyses: Map revisions
3. Health Care Cluster/Higher Education: Update
4. Mitigation Actions Prioritization
5. Agenda/Logistics for Public Workshop #3

Horsley Witten Group
Sustainable Environmental Solutions
55 Dorrance Street • Suite 200 • Providence, RI 02903
401-272-1717 • horsleywitten.com

Horsley Witten Group

Memorandum of Meeting

To: Kevin Kugel, CEM, Director and Clara Decerbo, Deputy Director - EMA City of Providence

From: Craig Pereira

Date: March 1, 2019

Re: Providence Emergency Management Agency (PEMA)/City of Providence Local Hazard Mitigation Committee (LHMC) Meeting #4 – Hazard Mitigation Plan Update

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In attendance:

LHMC

Kevin Kugel, CEM, Director - PEMA
Clara Decerbo, Deputy Director – PEMA
Chris Harwood, Johnson & Wales
Janet Freedman, Coastal Geologist - CRMC
Dave Everett, Principal Planner - City of Providence
Mike Caruolo, Narragansett Bay Commission
Melinda Hopkins, State Hazard Mitigation Officer – RIEMA
Gary Marino, Principal Engineer – Providence Water
Peter LePage, Providence Water
Marisa Albanese, National grid

Consultant Team

Craig Pereira, Project Manager - Horsley Witten Group, Inc. (HW)
Dori Boardman, Environmental Planner - Boardman Ecological Services

1. Prioritization of Mitigation Actions for consideration

Public Education and Awareness

Action 1
Janet: Under Vulnerable Areas, change A-V Zone to City wide
Dave: Technical – this action pending grant funding
Kevin: Administrative – If the grant funding has not come through, then this is a no. Providence does not have the administrative capacity to implement the action.

Action 2
Dave: All the information listed in Action 2 is currently available.
Kevin: This action is changing rules and guidance - not staff.

Action 3
Dave: Can we add that we identify municipal personnel to become a Certified Floodplain Manager and then they are the Floodplain Coordinator for the City? PEMA can be listed under Supporting.
Melinda: the cost of the CFM exam is $400 and $160 to become a member of ASFPM. The CFM needs 16 CEU credits every 2 years and has to pay $70 every 2 years.
Marisa: Can you identify two or three people as the Certified Floodplain Manager?
Kevin: No, if we expand beyond one person then administration support goes down

Action 4
Marisa: Is this action in advance of a storm or if you have to evacuate first? City has control over the city LED lights to point people (by color code) to evacuate. It directs people to travel out of the way of harm.

Kevin: Once you develop a program, it becomes a long-term issue. It is not a stock and forget program. People will complain if the program is established and then taken away.

Action 5
Chris: There is an annual port evacuation drill. Maybe this action should be combined with Action #38 – Maybe alternate the years between Action 5 and Action 38?

Dave: The Harbor Hazard Mitigation Plan is a stand-alone plan. Target city officials with Action 38. Action 5 and Action 38 have different audiences but use the same resources.

Janet: There definitely has to be funding sources.

Action 6
Carry over from 2013 plan. Straightforward ranking – no discussion.

Action 7
Carry over from 2013 plan.
Craig: Originally, he was going to remove this for the update but PEMA decided to keep it and describe it as an internal periodically review.
Janet: Look at the number of properties in the flood zone. Have they increased? Are there more NFIP policies in flood zones?

Planning and Prevention

Action 8
Straightforward ranking – no discussion.

Action 9
Reference Boston checklist for list for new development
Gary: Does that comply with the Building Code?
Dave: They are just guidelines
Janet: There is a Risk Assessment that uses the Beach SAMP plan process. Race to zero guidelines.
Kevin: It does not change the building codes
Gary: As long as it is local to Providence.

Action 10
Dave: Condense the words in this Action.
Craig: This action represents incremental progress through annual update meetings

Action 11
Janet: Can you include in this action to close the floodgates on the streets? When does it become part of an exercise? Tell the public it is an ongoing analysis.
Dave: Do not know if we are ready to make this big decision.
Marisa: There is different technology now.
Janet: Are there sacrificial flood areas in Providence?
Dave: It is too determined - outreach would happen before the report.
Marisa: Cost to pump the water is astronomical.

Action 12
Dave: Green marine is different. Port operations interact with the neighborhoods – they do not pollute. Green marine are individual operators instead of taking a comprehensive look at this.
The Harbormaster is not the lead on Action 12. Add Planning
This paragraph is not the correct paragraph for this action. Dave wants the Port to be the focus.

Action 13
Carryover 2013
Doug: The action should be modified to say that the city does tree pruning and has better coordination with National Grid.
Marisa: Already coordinating installing and removing trees. National Grid is already doing this.
Craig: This will be moved to the Capability Section.

Action 14
Kevin: Going back to the Port Workshop – all of these things can be combined into one action.
Dave: Harbor Management Council is not the lead. Combine these two actions. A workshop is not the method for doing this.

Action 15
The first step is to get the educational campaign on the City's website.
The second step is forming the Stakeholder Committee.

Action 16
Dave: These things happen when resources become available. It is ongoing. Would not combine this Action with anything else. Has to do with water quality. Implementation is happening. Not going to stop 'doing' green infrastructure.
Kevin: Checklists focus on private developers and build outs.
Dave: Add RIDOT as a Supporting.

Property Protection

Action 17
Straightforward ranking – no discussion.

Action 18
Dave: 'Like City Hall' – why use this wording?
Janet: Do you know how many buildings are not flood proofed?
Dave: No.
Kevin: As buildings age, they will need to undergo rehab and when that happens the City of Providence will bring the building up to code.

Action 19
Add PEMA to be notified.
Melinda: Look at the system as a whole. It is not just a single community affected by dam failure - all are affected. It goes up to RIEMA to handle. Can use Code Red System too. The effect on downstream communities depends on which dam(s) may break.
Kevin: This is a state action not a local one.

Action 20
Marisa: This should be Action #1
Janet: Is DEM asking to collaborate with the City on this?
Dave: Stormwater infrastructure is not green infrastructure. The City relies on floodplain or piping stormwater to where the water can be infiltrated. This action is strange.

Kevin: Should we leave it in the plan but score it low? We do not own a lot of them.
Is NBC or DPW responsible for this action? The outfall system (CSOs) are not stormwater but combined sewer overflows. Not NBC's responsibility.
Dave: Is this 'not applicable'? There are no resources for DPW to do much of anything toward this. It can stay in but it is a question of who is responsible for this action.

Natural Resource Protection

Action 21
Straightforward ranking – no discussion.

Action 22
Pete LePage: The lead is Providence Water as far as dams go. Add RIDEM, they have all the engineering surveys. Add RIEMA and NOAA as supporting

Action 23
Dave: Coordinate with the Urban Forest master. Include the Urban Forest master in green infrastructure action item

Action 24
This will be an ongoing action depending on funding. Also case by case.
Dave: Planning will always support this
Janet: Need a user group that will initiate it.

Structural Projects

Action 25
Bucklin Point would be the environment
Mike Caruolo: We are assessing all properties. It is not an exact science. These studies supports this.
Merge Action 25 and Action 26 and generalize it.

Action 26
Combined with Action 25

Emergency Services

Action 27
Marisa: Special needs registry is not updated enough. There is a lot of wasted effort with the special needs registry. Because people self-report phone numbers and the reports are not updated the registry is not regularly updated. It is a lot of effort to use the special registry list for low results.
Clara: Remove '*effectively*'. A lot of this guidance and policy comes from RIDOH

Action 28
Straightforward ranking – no discussion.

Action 29
Clara: Need to evaluate the options. Move the fire station? Not moving it currently. Using short-term private parking.
Dave: Every time you close a fire station, it is a big deal.
Clara: The whole issue is lack of adequate resources to deal with it. If the fire station is in an underprivileged neighborhood, closing the fire station is not an option.
Dave: If there were enough money, it would not be an issue to move it.

Action 30
Kevin: This is an ad for Verizon. Change '*Verizon*' to all wireless providers

Planning and Prevention

Action 31
Dave: Planning should be added as Supporting. This action is driving at what RIDOT should already be providing.
Clara: There should be additional resources on this action.

Action 32
Dave is good with this

Action 33
Clara: We are working with RIEMA

Action 34
Dave: We have never done that before. If they are city properties, this may be considered. It has to be with full support from the legal department. Planning can be Supporting.
Kevin: Equity issues – many properties are in low income areas.

Action 35
Add Fusion Center and Cyber Task Force State Police as Supporting

Action 36
Marisa: They are all covered under the National Grid recovery plan. Cross off senior centers.
Kevin: There is a push to get supermarkets to be more resilient but it is more of a COOP than this. It is a high profile situation.

Action 37
Meg Goulet at NBC has comment on this. Craig will follow-up with Meg. Shelf this action for now.

Action 38
Marisa: Host an annual activity – remove the 'game of floods' title. Host an annual interactive workshop (tabletop exercise).
Kevin: Would like to talk about the benefit of this action. The level of administration support is not there. However, it is beneficial to the community.

City of Providence Multi-Hazard Mitigation Plan Update

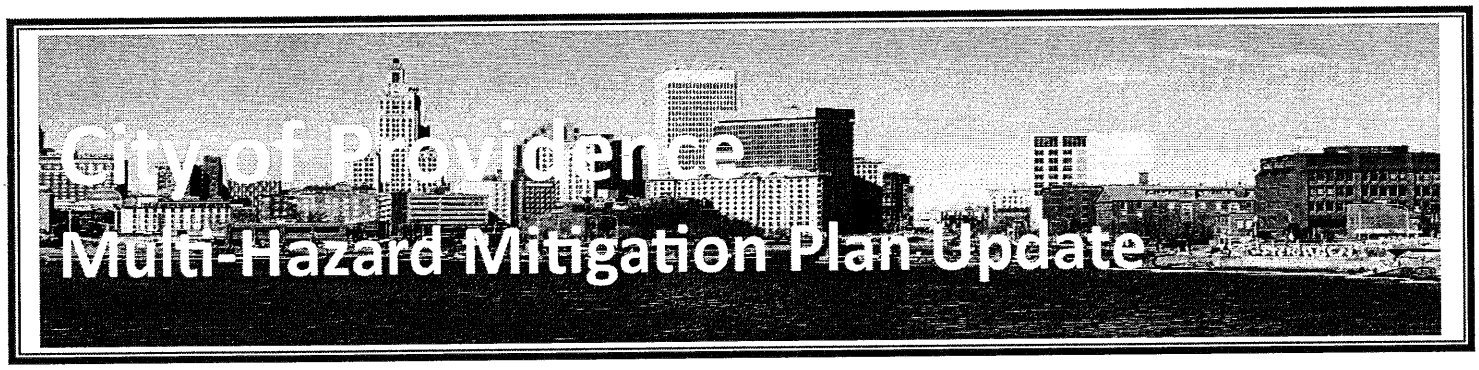
Local Hazard Mitigation Committee Meeting

Providence Emergency Management Agency - Conference Room
591 Charles Street

March 1, 2019 10:00 AM - 12:00 PM

Name	Email Address
CRAIG PERFEIRA	
Melinda Hopkins	melinda.hopkins@ema.ri.gov
Dori Boardman	doriboardman@gmail.com
CHRIS HARWOOD	charwood@jcb.edu
PETER LEPAGE	plepage@provwater.com
GARY MANNO	GMANNO@PROVWATER.COM
Marisa Albanese	Marisa.albanese@nationalgrid.com
Kevin Kugel	kkugel@providenceri.gov
MIKE CARNOLO	MCARNOLO@NAREALTY.COM
DAVID EVERETT	deverett@providenceri.gov
Clara Decerbo	cdecerbo@providenceri.gov
JAKE FREEDMAN	jfreedman@crmc.ri.gov

Public Workshop #3
March 20, 2019



Public Workshop

March 20, 2019

Providence Emergency Management Agency
591 Charles Street—Conference Room
Providence, RI 02904

6:00 PM—8:00 PM

Come learn what mitigation measures are being considered for inclusion in the 2019 update and provide your input.

About the Hazard Mitigation Plan Update

The City of Providence is currently updating the 2013 Hazard Mitigation Plan. This plan is important because it helps the City plan and receive funding for projects that reduce the risk of injury or damage to property from future natural hazard events such as flooding and hurricanes.

2019 Draft Hazard Mitigation Plan

The 2019 Draft Hazard Mitigation Plan is available online for public comment until March 29, 2019. Please refer all comments to Craig Pereira, Project Manager.—Horsley Witten Group, Inc. (cpereira@horsleywitten.com)

To review a copy of the 2019 Draft Hazard Mitigation Plan, please visit:
http://www.providenceri.gov/pema/

Contacts

Clara Decerbo—Deputy Director
Providence Emergency Management Agency
591 Charles Street
Providence, RI 02904
cdecerbo@providenceri.gov
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Craig Pereira—Project Manager
Horsley Witten Group, Inc.
55 Dorrance St. Suite 200
Providence, RI 02903
cpereira@horsleywitten.com
Phone: (401) 272-1717

Taller Público

20 de marzo de 2019

Providence Emergency Management Agency
591 Charles Street—Conference Room
Providence, RI 02904

6:00 PM—8:00 PM

Venga y aprenda qué medidas de mitigación se están considerando para inclusión en la actualización de 2019 y proporcione su opinión.

Acerca de la Actualización del Plan de Mitigación de Riesgos

La Ciudad de Providence está actualizando el Plan de Mitigación de Peligros 2013. Este plan es importante porque ayuda a la Ciudad a planificar y recibir fondos para proyectos que reducen el riesgo de lesiones o daños a la propiedad por eventos futuros de peligros naturales como inundaciones y huracanes.

Borrador Plan de Mitigación de Riesgos 2019

El Borrador Plan de Mitigación de Riesgos 2019 está disponible en línea para comentario público hasta el 29 de marzo de 2019. Por favor refiera todos los comentarios a Craig Pereira, Project Manager—Horsley Witten Group, Inc. (cpereira@horsleywitten.com)

Para revisar una copia del Borrador Plan de Mitigación de Riesgos 2019, por favor visite:

http://www.providenceri.gov/pema/

Contactos

Clara Decerbo—Deputy Director
Providence Emergency Management Agency
591 Charles Street
Providence, RI 02904
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Craig Pereira—Project Manager
Horsley Witten Group, Inc.
55 Dorrance St. Suite 200
Providence, RI 02903
cpereira@horsleywitten.com
Phone: (401) 272-1717

City of Providence Multi-Hazard Mitigation Plan Update

Public Workshop #3

Providence Emergency Management Agency – Conference Room
591 Charles Street
Providence, RI 02904

March 20, 2019

6:00 – 8:00 PM Presentation

Agenda

1. Welcome: Kevin Kugel, Director – Providence Emergency Management Agency
2. Hazard Mitigation Action Strategy
3. Next Steps

Horsley Witten Group

Memorandum of Meeting

To: Kevin Kugel, CEM, Director and Clara Decerbo, Deputy Director - EMA City of Providence

From: Craig Pereira

Date: March 21, 2019

Re: Providence Multi-Hazard Mitigation Plan Update – Public Workshop #3

The third Public Workshop for the Multi-Hazard Mitigation Plan Update was held March 21, 2019 at the Providence Emergency Management Agency (591 Charles Street) with twelve participants in attendance. The purpose of the meeting was to discuss the draft mitigation actions for consideration to be incorporated into the draft update. The following items were brought up for discussion:

1. Action #5:
   Consider adding a statement about elevating utilities within the port.
2. Action #10:
   How much rain can the Barrier handle?
   When the flood gates are closed to keep a storm surge out, the entire flow of the river must be continuously pumped up and over the barrier. Otherwise the river would be held back, overflow its banks, and flood the city. The five pumps, operating together, can lift 3.1 million gallons per minute and discharge the flow to the downstream side of the barrier.

   When the Barrier is closed, what about electrical utilities?
   Electrical utilities are elevated, and provisions are in place for a direct power line to National Grid service (as a priority critical infrastructure asset identified in the Energy Assurance Plan).
3. Action #28 and Table 19 in the draft update:
   Consider adding the Barrier to the list of critical infrastructure at risk.
4. Action #29:
   Consider adding the Woonasquatucket River to the 'Vulnerable Areas' bullet.
5. Action #31:
   Consider adding a statement about the ability of the port to bring in necessary gas reserves.

General Comments:

1. Can the RI DEM bond funds for dredging in the City be used to leverage additional grant funds?
   Dependent upon the federal grant assistance pursued, perhaps it could be used as the local match.
2. Can you add funds to the Operations and Standards Department's operational budget?
   That would need to be incorporated into the City's Budget discussions and development of the Capital Improvement Plan.

City of Providence Multi-Hazard Mitigation Plan Update

Public Workshop #3

Providence Emergency Management Agency
591 Charles Street

March 20, 2019 6:00 - 8:00 PM

Name	Email Address
CRAIG PERRIERA	cperreira@horsleywitten.com
John O'Neilly	JONeilly@WHRI.org
Teri Diiorio	teri.diiorio@gmail.com
David Schnell	dschnell@whri.org
BUFF CHACE	BUFF@CORNISHLA.com
Alicia Lehrer	alehrer@wrwc.org
Clara Decerbo	cdecerbo@providenceri.gov
Rick Burroughs	rburroughs@uri.edu
Dean Audet	daudet@fondo.com
Alexa Schmitt	schmitt@oneb.org
Marcus Mitchell	public@isp.com

Horsley Witten Group
www.horsleywitten.com

Providence Local Hazard Mitigation Committee Meeting #5
March 29, 2019

City of Providence Multi-Hazard Mitigation Plan Update

Local Hazard Mitigation Committee Meeting

Providence Emergency Management Agency – Conference Room
591 Charles Street
Providence, RI 02904
March 29, 2019 10:00 AM – 12:00 PM

Agenda

1. Feedback from Public Workshop #3/Comments received on Draft Update

2. Draft Multi-Hazard Mitigation Plan Update

Horsley Witten Group

Memorandum of Meeting

To: Kevin Kugel, CEM, Director and Clara Decerbo, Deputy Director - EMA City of Providence

From: Craig Pereira

Date: March 29, 2019

Re: Providence Emergency Management Agency (PEMA)/City of Providence Local Hazard Mitigation Committee (LHMC) Meeting #5 – Hazard Mitigation Plan Update

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In attendance:

LHMC

Kevin Kugel, CEM, Director - PEMA
Clara Decerbo, Deputy Director – PEMA
Chris Harwood, Johnson & Wales
Janet Freedman, Coastal Geologist - CRMC
Dave Everett, Principal Planner - City of Providence
Drew Wethington, Lifespan
Jeff Lykins, Building Official – Inspection and Standards Dept.
Dawn Lewis, HARI

Consultant Team

Craig Pereira, Project Manager - Horsley Witten Group, Inc. (HW)
Matt Shultz, Woods Hole Group

1. Overview of comments received on the draft Update.
    - Public Workshop (3/21/19)
        - Action #5…consider adding a statement about elevating utilities within the port.
        - Table 19…consider adding the Hurricane barrier to the list of critical facilities.
        - Action #29…consider adding the Woonasquatucket River to the 'Vulnerable Areas'.
        - Action #31…consider adding a statement about the ability of the port to bring in necessary gas reserves.
    - Woonasquatucket River Watershed Council
        - Add new action…Develop a flood resiliency plan for the Woonasquatucket River to both account for existing flooding as well as make it more resilient to future change.
    - Jeff Lykins
        - Revise Table of Contents reference for Fujita Scale (Table 2.7, page 38).
    - Dave Everett
        - An annotated list of suggested revisions.
    - Dori Boardman
        - An annotated list of suggested revisions.
    - Melinda Hopkins (Local Mitigation Plan Review Tool – Preliminary Review)
        - Annotated Review Tool with both required and suggested revisions.
    - Adjacent Communities
        - Nothing returned to date
    - RI DOH
        - Action #8…revise to reflect Providence's role in MEDs distribution, and remove water distribution during hurricanes, lead should be PEMA, supporting should be RIDOH/HCRI

    - Action #22…lead should be PWSB, supporting should be RIDOH
    - Action #27…remove

2. Healthcare Cluster Annex revisions
    - Clara will revise based on meeting 3/28/19
        - Provide a more generalized description of sites/facilities, updated HVA, and chart with healthcare facilities in Providence (where folks live, receive services and distribution).
3. Higher Education Cluster Annex revisions
    - Clara will revise based on her coordination
        - Provide a more generalized description of vulnerabilities

General Comments:

- Suggestion was made to develop a consolidated final plan excluding the appendices to facilitate 'a living document' that folks can have as a resource
- Melinda suggested perhaps removing some of the files provided in the appendices. PEMA/Project team to coordinate with Melinda on this.
- Clara will update the project webpage.

City of Providence Multi-Hazard Mitigation Plan Update

Local Hazard Mitigation Committee Meeting

Providence Emergency Management Agency - Conference Room
591 Charles Street

March 29, 2019 10:00 AM - 12:00 PM

Name	Email Address
CRAIG PERSIRA	
Kevin Kugel	kkugel@providenceri.gov
Drew Wethington	Dwethington@Lifespan.org
JANET FREEDMAN	jfreedman@crmc.ri.gov
DAVE EVERETT	deverett@providenceri.gov
Clara Decerbo	cdecerbo@providenceri.gov
Matt Shultz	Mshultz@whgrp.com
JEFFREY JIKINS	JJIKINS@PROVIDENCERI.GOV
Chris Harwood	charwood@jwu.edu
DAWN LEWIS	dawnl@hsri.org

Correspondences

Craig Pereira

From: Craig Pereira
Sent: Sunday, March 10, 2019 2:58 PM
To: Christopher Harwood; Dave Aucoin; Dave Everett; Dawn Lewis; Derek Jordan; Dorian Boardman; Gary Marino; James Boyd; Janet Freedman; Jared Rishel; Jeff Emidy; Jeff Lykins; Jeffrey Varone; Kevin Kugel; Lea Bamberger (lbamberger@providenceri.gov); Manuel Cordero; Margaret DeVos; Marisa Albanese; Matt Shultz; Melinda Hopkins; Michael Bates; Michael Borg; Peter LePage; Philip Stocking; Roger Choiniere; Stephen Morin; Steve Curtis; William Kenyon
Cc: Clara Decerbo; Craig Pereira
Subject: Draft City of Providence Hazard Mitigation Plan Update

Hi Everyone,

The draft City of Providence Hazard Mitigation Plan Update is ready for review, available at the link provided below. This does not include the Healthcare and Education Annexes as I am still waiting for some folks to return information to me.

Please take some time to review the draft and return comments directly to me by March 29, 2019.

Thank you!
Craig

Click the following link to download your file(s).

Click to Retrieve File(s)

Draft Providence Multi-Hazard Mitigation Plan Update 2019.pdf

If the above link is not clickable, copy and paste the following URL into your browser.

https://www.sendthisfile.com/bXqQGfP7b3lO2UB92vq6mcxV

Note: These files will expire in 14 days from the time this email was generated.

Craig Pereira

From: Craig Pereira
Sent: Friday, March 22, 2019 4:55 PM
To: 'jpezzullo@CranstonRI.org'
Cc: Clara Decerbo; Craig Pereira
Subject: Draft Providence Multi-Hazard Mitigation Plan Update available for public comment

Hi Jason,

Hope this finds you well.

The City of Providence has been working on an update to the Multi-Hazard Mitigation Plan for about a year. The below link will take you to a draft plan that is a result of several meetings of our Local Hazard Mitigation Committee, as well as public meetings and feedback. In the interest of being a good neighbor, we want to ensure that you get a chance to review the draft plan before it goes through the review process at RI EMA and FEMA. Please
take this opportunity to review the draft plan.

Click to Retrieve File(s)
If the above link is not clickable, copy and paste the following URL into your browser.

https://www.sendthisfile.com/QJ5BpoTAqCMfKVs6vhccxBCi

The comment period closes next Friday, March 29, 2019. Please reach out if you have any questions.

Regards,
Craig

Craig Pereira

From: Kugel, Kevin <kkugel@providenceri.gov>
Sent: Friday, March 8, 2019 1:05 PM
To: dfeather@cityofeastprov.com
Cc: Decerbo, Clara; Craig Pereira
Subject: Draft Providence Multi-Hazard Mitigation Plan for Review

To Whom It May Concern:

Providence has been working on an update to our Multi-Hazard Mitigation Plan for about a year. The below link will take you to a draft plan that is a result of several meetings of our Local Hazard Mitigation Committee, as well as public meetings and feedback. In the interest of being a good neighbor, we want to ensure that you get a chance to review the draft plan before it goes through the review process at RI EMA and FEMA. Please take this opportunity to review the draft plan.

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If the above link is not clickable, copy and paste the following URL into your browser.

https://www.sendthisfile.com/QJ5BpoTAqCMfKVs6vhccxBCi

If you have any questions, issues or concerns, please contact Clara Decerbo and/or Craig Pereira at the contact information below. Clara and Craig are leading this effort for Providence. Thank you.

Craig Pereira, CFM
Project Planner
Horsley Witten Group
401.272.1717
cpereira@horsleywitten.com

Clara Decerbo, PhD
Deputy Director
Providence Emergency Management Agency
401-680-8092
cdecerbo@providenceri.gov

Regards,

Kevin Kugel, CEM®
Director
Emergency Management Agency
City of Providence
591 Charles Street
Providence, RI 02904

401-680-8091 (office)
401-744-7205 (cell)
401-680-8058 (fax)

KEVIN KUGEL CEM
DIRECTOR
PROVIDENCE EMERGENCY MANAGEMENT AGENCY
+ OFFICE OF HOMELAND SECURITY

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401 680-8058 FAX
kkugel@providenceri.gov
www.readyprov.com

CITY OF PROVIDENCE

Craig Pereira

From: Kugel, Kevin <kkugel@providenceri.gov>
Sent: Friday, March 8, 2019 1:00 PM
To: dpwoffice@johnston-ri.us; Johnston (Joseph Razza) (jrazza@johnstonpd.com)
Cc: Decerbo, Clara; Craig Pereira
Subject: Draft Providence Multi-Hazard Mitigation Plan for Review

To Whom It May Concern:

Providence has been working on an update to our Multi-Hazard Mitigation Plan for about a year. The below link will take you to a draft plan that is a result of several meetings of our Local Hazard Mitigation Committee, as well as public meetings and feedback. In the interest of being a good neighbor, we want to ensure that you get a chance to review the draft plan before it goes through the review process at RI EMA and FEMA. Please take this opportunity to review the draft plan.

Click to Retrieve File(s)

If the above link is not clickable, copy and paste the following URL into your browser.

https://www.sendthisfile.com/QJ5BpoTAqCMfKVs6vhccxBCi

If you have any questions, issues or concerns, please contact Clara Decerbo and/or Craig Pereira at the contact information below. Clara and Craig are leading this effort for Providence. Thank you.

Craig Pereira, CFM
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cpereira@horsleywitten.com

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Regards,

Kevin Kugel, CEM®
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CITY OF PROVIDENCE

Craig Pereira

From: Kugel, Kevin <kkugel@providenceri.gov>
Sent: Friday, March 8, 2019 1:02 PM
To: planning@northprovidenceri.gov; ema@northprovidenceri.gov
Cc: Decerbo, Clara; Craig Pereira
Subject: Draft Providence Multi-Hazard Mitigation Plan for Review

To Whom It May Concern:

Providence has been working on an update to our Multi-Hazard Mitigation Plan for about a year. The below link will take you to a draft plan that is a result of several meetings of our Local Hazard Mitigation Committee, as well as public meetings and feedback. In the interest of being a good neighbor, we want to ensure that you get a chance to review the draft plan before it goes through the review process at RI EMA and FEMA. Please take this opportunity to review the draft plan.

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If you have any questions, issues or concerns, please contact Clara Decerbo and/or Craig Pereira at the contact information below. Clara and Craig are leading this effort for Providence. Thank you.

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Regards,

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CITY OF PROVIDENCE

Craig Pereira

From: Kugel, Kevin <kkugel@providenceri.gov>
Sent: Friday, March 8, 2019 1:04 PM
To: smara@pawtucketri.com; ddeloge@pawtucketpolice.com; Dave Deloge (ddeloge@pcfema.com)
Cc: Decerbo, Clara; Craig Pereira
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