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Edward A. Mello
Chief of Police

Public Comment Sought on Proposed Hazard Mitigation Plan

The Town of Jamestown through its Planning Department and Emergency Management Agency has been working to develop a comprehensive Hazard Mitigation Plan. Upon approval by State and Federal Emergency Management Officials, the plan will serve as a guide to the Town in its continuing effort to mitigate against various natural hazards and storm related threats. The plan allows for an all hazards approach with a focus on storm related events which may threaten our community. The Town is seeking public review and comment. The draft of the plan is available on the Town's website or in hardcopy at the Town Clerk's Office. The draft will be presented publicly to the Town Council on October 6. At that time, members of the public may comment. If any resident has a comment or concern they may address it at the October 6 meeting or by contacting either Town Planner Lisa Bryer or Police Chief Edward Mello.

Natural Hazard Mitigation Plan

Jamestown
Rhode Island

Prepared for **The Town of Jamestowm**
Jamestown Town Council
93 Narragansett Avenue
Jamestown, RI 02835

Prepared by The Jamestown Natural Hazard Mitigation Committee

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October 2, 2014

Jamestown Natural Hazard Mitigation Planning Committee

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Executive Summary

This plan presents the strategy developed by the Town of Jamestown to prepare for, and mitigate, the potential loss of life and property in the event of natural disasters. Jamestown is a 9.7 square-mile island lying along a north-south axis at the mouth of Narragansett Bay. According to the U.S. Census of 2010, its year-round population is 5,405 – with a transient population estimated to average 1,400-to-1,500 people during the summer. The year-round population density is 580 individuals per square mile, with the greatest density situated in the middle of the town (also known as The Village). There are equally dense, if smaller, population pockets to the north and south of The Village. Jamestown has a bridge linking the island to the mainland on its western side; a second bridge links the island to Newport, R.I., on its eastern side. But, because one or both of the bridges may be closed to traffic during extreme weather, it is particularly important for Jamestown to have in place a comprehensive emergency response plan in addition to its Natural Hazard Mitigation Plan.

This Hazard Mitigation Plan recommends actions and policies enabling the Town of Jamestown, R.I., to mitigate the impacts of naturally occurring emergencies or disasters. Although most of the hazards posed by such events can be anticipated, other risks are emerging as the climate changes. Consequently, the plan will be updated in response to previously unexpected risks. The Plan will ease the social and economic hardships arising from natural disasters, and it will provide Jamestown residents with the assurance that the town is thoroughly prepared for disaster response.

The Jamestown mitigation strategy provides a coordinated, consistent set of goals for reducing or minimizing human and property losses, major economic disruption, degradation of ecosystems and environmental critical habitats, and destruction of cultural and historical resources from natural and technological disasters.

- Provide a basis for intergovernmental coordination in hazard mitigation programs at the state and local level
- Develop partnerships between the town and private sector, local communities and non-profit organizations in order to coordinate and collaborate on hazard mitigation programs
- Identify and establish close coordination with local government departments and agencies responsible for implementing the sound practices of hazard mitigation through building standards and local land use development decisions and practice
- Provide for a continuing public education awareness about the risks and losses from natural and technological disasters, in addition to hazard mitigation programs, policies, and projects

GOALS: To support the implementation of the Jamestown Mitigation Strategy ten goals have been developed:

- **Goal 1:** Reduce impacts from flooding and erosion
- **Goal 2:** Protect essential services and infrastructure
- **Goal 3:** Protect and preserve historic records
- **Goal 4:** Establish conditions for improved post-disaster recovery

Objectives have been crafted to support the achievement of the above goals. These objectives are intended to guide the strategy used in goal achievement. The JNHMC prioritized the selection of objectives that support multiple goals. The selected objectives are:

- **Objective 1:** Incorporate hazard mitigation review in all development projects.
- **Objective 2:** Repair and maintain coastal areas susceptible to erosion.
- **Objective 3:** Enhance Geographic Information Systems (GIS) capabilities to support assessment and planning activities.
- **Objective 4:** Maintain and improve critical infrastructure durability to include instituting protective measures for systems and facilities.
- **Objective 5:** Continue to manage property development and land use through creation and enforcement of appropriate zoning ordinances.
- **Objective 6:** Develop and implement public outreach programs to improve individual preparedness.
- **Objective 7:** Develop and maintain debris management plans to improve post-disaster recovery efforts.
- **Objective 8:** Develop and maintain sufficient shelter capacity to support residents and visitors in the event transportation routes become untenable.

Adoption Documentation

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1.0 Background

1.1 Introduction to Hazard Mitigation

For the purposes of this plan, hazards are defined as natural, or naturally instigated, events that can seriously harm people, property, or both. Hazards referenced in this plan include those natural hazards that have been determined by the JNHMC and RIEMA to be reasonably expected to occur in the region and present a potential risk to the community.

Hazard mitigation is the process of reducing the potential severity of natural or naturally instigated hazards through anticipation and planning. Some hazards require engineering solutions, such as replacing a deteriorating seawall; other hazards, such as an imminent hurricane, require the implementation of an emergency response plan. The current town Emergency Operations Plan was completed in 2013.

Besides affording a wide range of protections for the residents and resources of a town, a Hazard Mitigation Plan decreases the extent, and demands for, municipal emergency response and assistance. This report presents the strategy developed by the Town of Jamestown to prepare for, and mitigate, the potential loss of life and property in the event of natural disasters.

1.2 Community Planning Area

This Plan covers the jurisdictional area of Jamestown, Rhode Island, which is coterminous with Conanicut Island. The Jamestown Natural Hazard Mitigation Committee (JNHMC) developed the original (2001) draft of this Natural Hazard Mitigation Plan for the purpose of protecting residents and property. The plan is also intended to maintain quality of life to the greatest extent practicable in the event, and aftermath, of natural disasters The JNHMC members include the Town Administrator, the Police Chief (who also serves as the Director of Emergency Management), the Fire Chief, the Public Works Director, the Planning Director, the Building Official, and the Town Council President.

Besides implementing the elements of its Natural Hazard Mitigation Plan, the Town of Jamestown intends to promote educational opportunities for residents to learn about existing as well as future mitigation measures. The town will implement this initiative through (1) a public hearing on the latest draft of this Plan; (2) by posting the Plan on its web site before and after its acceptance by RIEMA and FEMA; and (3) by presenting future mitigation expenditures for deliberations by the Town Council and input from the public.

In addition to protecting residents and maintaining quality of life during natural disasters, the plan is intended to enhance "disaster resistance" and "hazard resilience." Disaster resistance is the ability of a community to avoid the worst-possible impacts (such as death and widespread destruction) from a natural disaster. Hazard resilience is ability of structures (such as seawalls) and community systems to withstand the force of natural disasters.

1.2.1 Location Information & Geography

Jamestown encompasses all of Conanicut Island, which is located in lower Narragansett Bay. The island is 26 miles south of Providence; two miles west of Newport; and one mile east of North Kingstown. The southern end of the island lies just outside Rhode Island Sound; its western side lies along the West Passage of the Bay, a mile from North Kingstown; and its eastern side lies along the East Passage, two miles from Newport. The Town of Jamestown includes in its jurisdiction the smaller islands of Dutch and Gould.

Conanicut Island is 8.7 miles long (from north to south); its width varies from 1.0 to 1.16 miles. Jamestown has a bridge linking the island to the mainland on its western side; a second bridge links the island to Newport, R.I., on its eastern side. Because the island is open to both the Bay and Rhode Island Sound, Jamestown and its 23 miles of shoreline are vulnerable to many, potentially severe natural hazards. High tides co-occurring with nor'easters can flood low-lying areas, including stretches of the only road which runs the entire length of the island. Flooding associated with a coastal storm event may essentially split the community into 3 islands with limited or no accessibility. In addition, the two bridges leading to Jamestown are closed to traffic when sustained wind speeds reach 68 miles per hour. Therefore, it is particularly important for Jamestown to have in place an Emergency Operations Plan, which was adopted in 2012 in addition to its Natural Hazard Mitigation Plan.

1.2.2 Demographics/Census, Housing

According to the 2 0 1 0 U.S. Census the year-round population of Jamestown is 5,405 - with a transient population estimated to average 1,400-to-1,500 people during the summer. The year-round population density is 580 individuals per square mile, with the greatest density situated in the middle of the town (also known as The Village). There are equally dense, if smaller, population pockets to the north and south of The Village. There are over 430 residential lots on or near the island's shoreline, and over 75 percent of them are developed. (The remaining lots lie outside flood plains, which are defined as any terrestrial areas susceptible to inundation from any source.)

According to the most recent (2010) data from the U.S. Census Bureau, the population of Jamestown declined by 3.8 percent (or 217 individuals) to 5,405 since the previous Census in the year 2000. An analysis of the most recent birth and mortality data for Jamestown indicates that 49 percent of the town's population decline is attributable to mortalities, while 51 percent of the decline is attributable to out-migration.

1.2.3 Land Use and Infrastructure

The 2014 Jamestown Comprehensive plan includes a detailed inventory of land use. There is a significant amount of undeveloped land which helps to preserve the character of the rural island community. In support of the land use concepts in the current and previous Comprehensive Plan, the town passed a new Zoning Ordinance in October 2009 (amended March 2010). For land use planning purposes, the town is divided into four types of land areas; the village area, Jamestown Shores area, rural residential areas, and conservation and recreation areas (Town of Jamestown, 2002).

Within the village are the town's downtown and limited commercial zones where the majority of commercially used property is located. Adding to the diversity of the village area is the presence of commercial and residential mixed-use structures. Town facilities located within the village area include: Melrose and Lawn Avenue schools, the Philomenian Library, Town Hall and Offices, Recreation Center, the Police Station, and the Fire and Ambulance buildings. The north side of the village area has several large open space areas, including the golf course, the sanctuary, Taylor Point, and Great Creek Marsh (Town of Jamestown, 2002).

The village area has historically been the focal point for commercial, business and civic activity in Jamestown. The village area is the center for the service business and retail industry in town. Over 80 businesses are located in the two largest commercial zones, Commercial Downtown (CD) and Commercial

Limited (CL), with CD having three times more businesses than CL (Town of Jamestown, 2002).

The East Harbor section of the village has the greatest concentration of the town's recreational boating activity, public waterfront access for boat launching and fishing, and commercial businesses (Town of Jamestown, 2002).

The village area between Hamilton Avenue and Mount Hope Avenue comprises the urban service district. Under existing Rules and Regulations of the Board of Water and Sewer Commissioners, only those households with frontage along existing sewer and water lines are allowed to connect to the system. All other connections are allowed at the discretion of the Board (Town of Jamestown, 2002).

The Jamestown Shores area is located both north (to Capstan Street) and south (to Watson Farm) of John Eldred Parkway (Rt. 138) and west of North Road and the Cedar Hill Development. It was subdivided in the early 1940s and developed slowly, mostly as a summer colony. In more recent years, summer cottages have been converted to year-round use and many new houses built on the substandard lots, with infill development continuing (Town of Jamestown, 2002).

Jamestown Shores is exclusively a single-family residential neighborhood. Although the Shores area is currently zoned as R-40, which requires 40,000 square feet as the minimum building lot size, many lots are non-conforming substandard lots of 7,200 square feet as originally platted. The Shores currently has an average density of 2.8 dwelling units per acre and average lot sizes are less than 16,000 square feet. The combination of high density development and potential groundwater pollution due to close proximity between drinking water wells and Individual Sewage Disposal Systems (ISDS) led to the enactment of a merger provision (Town of Jamestown, 2002).

In addition, the Shores neighborhood has poor soils for septic absorption and has a limited groundwater resource. The town wells, which draw groundwater near the town reservoir and pump it to the reservoir, may possibly affect the wells in the Shores area. Problems are encountered with the high rate of run-off from impervious surfaces associated with development and a high water table (Town of Jamestown, 2002).

No public water or sewer service extends to the Shores area. Because a significant amount of all water withdrawn from the ground is eventually returned through ISDS, the continued use of ISDS is necessary to maintain acceptable levels of groundwater (Town of Jamestown, 2002).

Wetlands in the Jamestown Shores area restrict development to some extent. The town and the Conanicut Island Land Trust acquire vacant lots occasionally to prevent overdevelopment (Town of Jamestown, 2002).

Rural residential areas are located north and south of the village area, including: Beavertail, the Dumplings, East Passage and West Reach subdivisions, and areas along North Road and East Shore Road. These areas are scattered with older homes along main roads adjacent to farmlands and larger summer estate properties. The existing zoning requires 80,000 square feet minimum lot size. Because of the large lot sizes and low-density development, these areas rely on ISDS and wells, where most of the soils are poorly suited for ISDS and the groundwater resource has low yields (Town of Jamestown, 2002).

The Conanicut Park area is an exception, containing many smaller lots. Full development of these lots could cause a groundwater quality problem, although many are restricted by wetlands from development (Town of Jamestown, 2002).

The town's primary conservation area is located in the "Center Island" district and consists of the Jamestown Brook watershed, wetlands, farmland, salt marsh, Great Creek, recreation areas, and an abundance of the cultural and historical resources of the island. There exists a very small amount of residential development in this area, including farmhouses and outbuildings. Other conservation areas include Dutch and Gould Islands, Ft. Getty, the Town Beach, Sheffield Cove, Ft. Wetherill and Beavertail Point State Parks. State, local, and private efforts have served to permanently protect approximately 25 percent of the island, including Dutch and Gould Islands, for recreation and conservation purposes, as well as properties partially protected by conservation easements (Town of Jamestown, 2002).

1.2.4 Community Development & Development Trends

Although Jamestown has permanently protected a large amount of open space, there is still vacant land available for residential development. According to the Planning Division of the State Department of Administration, the 2010 population tally does not signal the start of a trend. In fact, the State Planning Division is predicting that, by 2020, Jamestown's population will increase to 6,609 – or a jump of 22%. The projected increase serves to magnify the importance of the town's Natural Hazard Mitigation Plan.

1.2.5 Historic and Natural Resource/Environmental Significance

Jamestown is a community rich in history. The result of a combination of volcanic activity and glacial shifts, the island that is now home to Jamestown residents has been home to Native Americans for over 10,000 years. Following European exploration in the 1500's, Conanicut Island was established at a settlement in the 1630's. As the island became more accessible, first by ferry and, in the 20th century, by bridge to the mainland, it developed into an active community. Today, Jamestown is a thriving community and popular recreational destination. The management of natural resources has helped the town maintain a balance between developed areas and protected environmental spaces (Town of Jamestown, 2002).

1.2.6 Commerce, Industry, Academic

Jamestown's economy is constrained by is island geography; small land mass, finite commercially zoned property, high land costs, relatively small population, and close proximity to regional shopping areas. At the same time, the town's easy accessibility offers greater off-island employment opportunities for residents of Jamestown (Town of Jamestown, 2002).

In recent years, the main components of the economy have been businesses serving residents and visitors to the town, including recreation and leisure services, boating and marine services, retail shops, restaurants, and home-based businesses. The Town of Jamestown is the largest single employer on the island, with over 100 municipal employees and approximately 93 school department employees (Town of Jamestown, 2002).

The summer season boosts Jamestown's economy and benefits many local service and retail businesses. A number of factors have contributed to the development and success of the downtown commercial district in the past ten years. Access to the island has improved with the completion of the Jamestown-Verrazano Bridge in 1992 and the John Eldred Parkway (Route 138) in 1994, which connected the two bridges. The Chamber of Commerce, working with volunteers, provided signage to help direct visitors from the limited access highway to the village commercial district. In addition, the State and National economies have improved, providing visitors and residents with more income to spend locally (Town of Jamestown, 2002).

1.2.7 NFIP, CRS Community

The National Flood Insurance Program (NFIP) was created by Congress in 1968 to protect lives and property and to reduce the financial burden of

providing disaster assistance (Rhode Island Emergency Management Agency, 2007). The NFIP is administered by the Federal Emergency Management Agency (FEMA). Nationwide, over 20,000 communities participate in the NFIP, including all Rhode Island counties, cities, and towns (Rhode Island Emergency Management Agency, 2007).

The NFIP is based on a mutual agreement between the federal government and communities. Communities that participate agree to regulate floodplain development according to certain criteria and standards (Rhode Island Emergency Management Agency, 2007).

Federal flood insurance is required for all buildings in Special Flood Hazard Areas shown on FEMA's maps if they are financed by federally-backed loans or mortgages. All homeowners, business owners and renters in communities that participate in the NFIP may purchase federal flood insurance on any building, even if outside of the mapped flood zone (Rhode Island Emergency Management Agency, 2007).

The NFIP's Community Rating System (CRS) gives "extra credit" to communities in the form of reduced flood insurance premiums. Communities must apply to the CRS and commit to implement and certify activities that contribute to reduced flood risk. Jamestown would like to participate in the CRS program, joining the six other Rhode Island communities that currently take part in it: North Kingstown, Middletown, Narragansett, Westerly, Bristol, and East Providence (Rhode Island Emergency Management Agency, 2007).

1.3 Significant Events

There have been several significant storm events that have impacted Jamestown and the region in recent years. Most notably are Major Flooding (March 2010); Hurricane/Tropical Storm Irene (August 2011); Snowstorms (January 2011 & February 2013); and "Superstorm" Sandy (October 2012). Though it did not have a significant impact on Jamestown, the Virginia Earthquake (August 2011) was felt in the region.

2.0 Planning Process

2.1 Purpose, Overview and Background

The purpose of this Hazard Mitigation Plan is to set forth guidelines of short-term and long-term actions that will help reduce the actual or potential loss of life or property from hazardous events such as winter related hazards, flooding, thunderstorms, droughts, hurricanes and earthquakes. This plan is a directive of the Federal Emergency Management Agency and conforms specifically to 44 CFR Parts 201 and 206 Hazard Mitigation Planning and Hazard Mitigation Grant Program: Interim Final Rule. The Town of Jamestown, upon adoption of this plan, will remain an eligible applicant for the Hazard Mitigation Assistance (HMA) program. This status enables the town to file for resources that may be used to mitigate the effects of hazards on both public and private property.

To ensure a national focus on mitigation, the Federal Emergency Management Agency (FEMA) introduced a National Mitigation Strategy in 1995. The strategy promotes the partnership of government and the private sector to "build" safer communities. Hazard mitigation encourages all Americans to identify hazards that may affect them or their communities and to take action to reduce risks.

2.2 Building Support: Community Involvement, Roles & Responsibilities

The Town of Jamestown has been intensively engaged in developing and updating its Comprehensive Community Plan since 1998, recently adopting the 2014 version. These plans, which are required under Rhode Island law, serve as guidance for town goals in many different areas. One of those goals is maintaining to the greatest extent practicable the quality of life during, and after a natural disaster.

The first community plan was adopted by the Town Council, and subsequently approved by the State in 2004. The plan was significantly updated in 2012, and currently the 2014 plan is under review by the State.

2.2.1 Stakeholders

The JNHMC represents a diverse group of public officials. Members include town departments with direct responsibilities for emergency response, land management, building codes, and strategic planning.

2.2.2 Public

The Natural Hazard Mitigation Planning Process implemented by the Town of Jamestown has - and will continue to - involve the public in three areas: the development of, and recurrent enhancements to the Natural Hazard Mitigation Plan as part of the Town Council's regular business; town-wide opinion surveys in support of periodic revisions to the Comprehensive Community Plan; and public participation in the annual, budgetary reviews of emergency management line items.

2.3 Understanding the Community's Risks

The process of updating the Jamestown Natural Hazard Mitigation Plan has provided an opportunity to review and assess the climactic events that have or may impact the community. To initiate the vulnerability assessment process, the JNHMC examined the town's risk from natural hazards and identified its vulnerabilities to those risks. The JNHMC used the Risk Assessment Matrix and GIS maps as tools for the assessment, which established the basis for mitigation priorities. Sources of information used during the assessment include U.S. Army Corps of Engineers studies, RIEMA reports, municipal records, local knowledge and historical accounts.

2.3.1 Review and Incorporation of Information with Stakeholder and Public Exchange

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2.3.2 Developing/Updating the Risk Assessment

The Town of Jamestown enforces state and local building codes and participates in the National Flood Insurance Program. The Comprehensive

Community Plan, first adopted in 2004 and updated in 2014, outlines resources available to address: increasing development pressure, economic stability, open space preservation, public infrastructure and public facilities. Updating the plan with the elements and recommendations of the Natural Hazard Mitigation Plan will help reduce the actual or potential loss of life or property from a natural disaster. The town acknowledges that incorporating this plan and its mitigation initiatives (both pre-and post-disaster) into the Comprehensive Plan not only benefits the community by reducing human suffering, damages, and the costs of recovery, but will also help build and maintain the sustainability and economic health of the town over the long run.

Plans that were reviewed during the development of this Natural Hazard Mitigation Plan include:

- The Town of Jamestown Emergency Operations Plan, developed in November 1992 by the Town of Jamestown's Emergency Management Agency and updated in 2012
- The Harbor Management Plan, developed in 1994 by the Harbor Management Commission was just revised in 2014.
- The Town of Jamestown Comprehensive Community Plan as adopted by Jamestown in 2002 and by the State of Rhode Island in 2004.
- The Town of Jamestown Comprehensive Community Plan as adopted by Jamestown in 2014, pending state approval.
- The Town of Jamestown Dam Emergency Action Plan, approved in 2014

Appropriate information was included as deemed necessary.

2.4 Developing & Updating the Mitigation Strategy

This revised and updated Natural Hazard Mitigation Plan is the 4th draft to emerge from a process that started in 2001. That year, the Town Administrator appointed the JNHMC to develop a mitigation plan. The panel held five meetings; and, once its draft was completed, the town held a series of community workshops to gather public input.

Prior to the public meetings, which were advertised in the local newspaper and various locations in the downtown area, the plan was posted on the town web site. (Paper copies were available at the town library and the Office of Town Planner.) Once the town had gathered public input from the workshops, the JNHMC revised the draft.

Because RIEMA and FEMA subsequently identified deficiencies in that draft, along with subsequent revisions of the draft, the town did not

solicit any additional public comment on the plan until this latest draft was prepared.

This draft of the Natural Hazard Mitigation Plan will be posted on the town web site and public comment will be solicited. (Paper copies of the plan will also be available at the Library and at the Office of Town Clerk.) Once the comments from Jamestown residents have been gathered, the Jamestown Council will hold a public hearing on the plan; after the hearing the Council will vote on a motion to submit the plan to RIEMA and FEMA.

2.4.1 Identification & Review of Goals, Actions, Priorities, Changes Progress

The purpose of the Natural Hazard Mitigation Plan is to identify local policies and actions that can be implemented over the long term to reduce risk and future losses from hazards. These mitigation policies and actions are identified based on an assessment of hazards, vulnerabilities, and risks, as well as the participation of a wide range of stakeholders and the public in the planning process.

Hazard Mitigation is a sustained action taken to permanently reduce or eliminate long-term risk to people and their property from the effect of natural hazards. Mitigation actions help safeguard personal and public safety, and they can significantly reduce the impact of future disasters.

Pre-disaster planning and investment in preventative measures can significantly reduce the cost of tomorrow's post-disaster recovery and can help post-disaster operations become more efficient. By planning ahead, Jamestown minimizes the economic and social disruption that results from natural hazards including floods, severe weather and hurricanes that can result in the destruction of property, loss or interruption of jobs, loss of business and, potentially, loss of life.

Mitigation strategies include a mix of physical initiatives to limit the impacts of natural hazards, such as rebuilding riprap walls to protect against coastal erosion, as well as regulatory/planning initiatives such as revised zoning ordinances, and maintaining land use regulations.

2.4.2 Review and Incorporation of Stakeholder and Public Exchange

To update its Comprehensive Community Plan, Jamestown performed an in-depth survey of its residents and business owners. Their responses enabled the town to update during 2012 the Goals and Policies specified in the Plan. Many of the previous and updated goals and policies relate directly or

indirectly to natural hazard mitigation. Some of those Goals and Policies call upon the town to:

- Develop a comprehensive Land Acquisition Action Plan to raise funds through bonding and grants to acquire and/or protect the remaining ecologically significant undeveloped land in Jamestown for the preservation of drinking water and coastal resources (which addresses hazards from flooding and drought).

- Preserve and protect unique, fragile, and scenic coastal areas (which directly addresses the hazards from coastal erosion).

- Prevent and protect against filling, dredging, construction, or removal of vegetation within wetlands (which directly addresses efforts to mitigate flooding hazards).

- Protect the quantity of Jamestown's freshwater resources within the public drinking water watershed and private well areas (which directly address a drought hazard).

- Improve roads to provide an acceptable level of service at a reasonable cost to the taxpayer (which addresses the need to ensure that all areas of Jamestown are accessible to emergency response vehicles during a natural disaster).

- Provide a high quality of public services to the community in order to protect the health, safety, and welfare of all residents (which generally address all of the hazards from natural disasters).

2.5 Bringing the Plan to Life: Implementation & Maintenance

The town leadership realizes that a plan can only be successful if it is created in an atmosphere of collaboration and cooperation. To see the actions go from concepts to implementation requires a community-wide effort. The 2014 version of the Jamestown Hazard Mitigation Plan is developed to be a realistic, long term tool. Careful management and application of scarce resources helps to ensure the community is physically and economically resilient. The goals in this plan are challenging, but achievable. There are mitigation measures outlined to be implemented in the near-term that will support the concept of a resilient community for decades to come.

2.5.1 Method, Responsibilities, & Schedule

Each mitigation action has been given a relative priority, a period for implementation, and been assigned to a responsible town department for planning, implementation, and monitoring. The JNHMC and the town leadership realize that successful hazard mitigation is an ongoing process that requires implementation, evaluation, and updated revisions to this plan. Also realized is the importance of integrating appropriate sections of the plan into the town's Comprehensive Plan, Emergency Operations Plan, and land use plan review process. It is intended that this plan and the ongoing efforts of the JNHMC will preserve and enhance the quality of life, property, and resources for the community.

2.5.1.1 Plan Review, Adoption, and Approval

The Hazard Mitigation Plan is a comprehensive strategy designed to help the Town of Jamestown prepare for the impacts of natural disasters. The 2014 plan represents a culmination of planning and collaboration that dates back to the 2001 plan. It will go through several stages of review before its adoption and implementation. Following the Council's approval, the Plan will be forwarded for official review by the Rhode Island Emergency Management Agency (RIEMA) and the Department of Homeland Security (DHS), Federal Emergency Management Agency (FEMA) Region 1. Upon receipt of a FEMA notification of conditional approval, the Hazard Mitigation Plan will be formally adopted by the Jamestown Town Council (Rhode Island Emergency Management Agency, 2014).

Once implemented, the Hazard Mitigation Plan will guide future hazard mitigation efforts. All actions identified in this plan have been determined to be viable mitigation actions. As such the responsible departments for each action will work to develop appropriate implementation timeframes and funding mechanisms. Although the priority ranking of the listed mitigation actions should guide their implementation, final decisions on which actions are to be implemented will inevitably be based upon funding availability.

2.5.1.2 Monitoring

Mitigation plans are action oriented tools that will evolve as the community changes. This plan will be monitored and updated throughout the 5 year planning cycle. Under the auspices of the JNHMC, the implementation of this plan will be reviewed, monitored and updated. At a minimum, the Hazard Mitigation Committee will meet every 6 months and following any significant

events. This committee will continue to be comprised of members from public agencies, nongovernmental groups, business leaders, and private groups with demonstrated expertise in hazard mitigation. They will work collaboratively to strengthen communication and coordination within the town on improving emergency hazard response, operating procedures, and resiliency. As actions are implemented or modified, the department responsible for that action will update the Mitigation Action Table and apprise the other members of the committee.

2.5.2 Continued Public Involvement

As stated in section 2.2.2, the Town of Jamestown has- and will continue to - involve the public in three areas: ,the development of, and recurrent enhancements to the Natural Hazard Mitigation Plan as part of the Town Council's regular business; town-wide opinion surveys in support of periodic revisions to the Comprehensive Community Plan; and public participation in the annual budgetary reviews of emergency management line items. This engagement will continue through the life of this and subsequent Natural Hazard Mitigation Plans.

3.0 Risk Assessment

3.1 Defining Risk & Methodology

The purpose of this section is to provide a comprehensive overview of how various natural hazards can impact Jamestown, Rhode Island. In this section natural hazards will be ranked in order of priority based on the frequency of occurrence and area of impact affected.

Identifying the risk and vulnerability of Jamestown to natural hazards is the primary factor in determining how to allocate finite resources to determine which mitigation actions are feasible and appropriate. The hazard analysis involves identifying the natural hazards that potentially threaten Jamestown, and then analyzing them individually to determine the degree of threat that is posed by each hazard. Addressing risk and vulnerability through hazard mitigation measures will reduce societal, economic and environmental exposure to natural hazards impacts (Rhode Island Emergency Management Agency, 2014).

3.2 Hazards

A natural hazard is defined as "an event or physical condition that has the potential to cause fatalities, injuries, property and infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss." A natural hazard can also be exacerbated by societal behavior and practice, such as building in a floodplain, along a sea cliff or an earthquake fault. Natural disasters are inevitable, but the impacts of natural hazards can, at a minimum, be mitigated or, in some instances, prevented entirely (Rhode Island Emergency Management Agency, 2014).

The Town of Jamestown identified hazards, assessed the degree of vulnerability to the hazards throughout Jamestown, examined the possible impacts of the hazards and assessed future risk. With the assistance of the University of Rhode Island, Jamestown has mapped the hazard risks within the town. The map identifies critical facilities (such as emergency shelters and emergency response facilities) and the potential hazard risks in Jamestown. The potential hazard risk data presents land uses, flood zones, public infrastructure, and social and economic risk areas. Table 3-1 identifies ten potential risks that Jamestown faces and their ranking from high to low in terms of the probability of the event.

3.2.1 Hazard Identification

In order to fulfill the planning guidelines outlined in Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000), this NHMP addresses only on natural hazards, and does not consider man-made hazards (i.e., structural fires, hazardous materials, chemical spills, and weapons of mass destruction).

Keeping in line with Rhode Island SHMP's risk assessment, the natural hazards have been grouped into the following categories and are listed in order of frequency and impact, starting at the top of the list with the most frequently occurring natural hazards. Based on the Rhode Island SHMP and previous versions of the town plan the following hazards will be discussed and analyzed in this report:

Table 3-1. Natural Hazards Assessed For Jamestown Hazard Mitigation Plan, Grouped by Category

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

Source: RI Hazard Management Plan, 2014

3.2.1.1 Statewide Hazards & Jurisdiction's Identification Table

Hazard scores measure the average impact of different hazard types in a region. The hazard score in a region is a function of the geography and natural recurrence of disasters over time in an area. Thus, hazard scores are inherent to a region and theoretically cannot be lowered through mitigation or other intervention. A hazard score is computed for each hazard type and each sub region considered. Hazard scores can be combined within a sub region or across multiple sub regions to evaluate aggregate hazard risk levels.

3.2.1.1 Hazards Excluded from Risk Assessment/ Explanation

It should be noted that the above hazards are not a complete listing of hazards that may impact Jamestown. The State Inter-agency Hazard Mitigation

Committee (SIHMC) agreed that this listing accurately represents those hazards that impact Rhode Island 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 or loss. The following hazards will not be addressed in the SHMP:

- Avalanche
- Expansive soils
- Hail
- Land Subsidence
- Landslides
- Volcanoes
- Tsunamis

3.2.2 Hazard Profiles

The following subsections present a description of each type of natural hazard Jamestown may expect to experience, as determined by the JNHMC.

3.2.2.1 Wind Related Hazards

Description

Wind is the movement of air caused by a difference in pressure from one place to another. Local wind systems are created by the immediate geographic features in a given area, such as mountains, valleys, or large bodies of water. 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 (Rhode Island Emergency Management Agency, 2014)..

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 as shown in Figure 3-1 (FEMA, 2012).

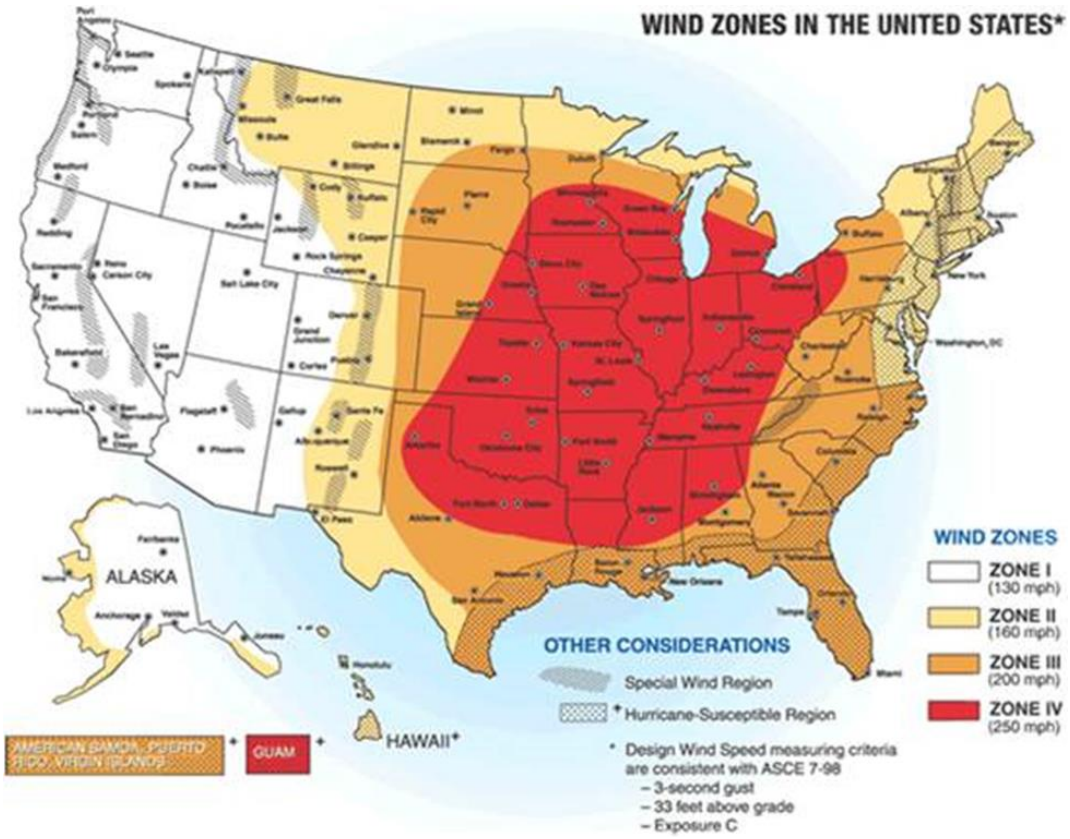

Figure 3-1. FEMA Safe Room Design Wind Speed for the United States.

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. This section examines the risks associated with damaging wind events with emphasis on hurricanes, tornadoes, and thunderstorms (Rhode Island Emergency Management Agency, 2014).

Nor'easters, while often a less dramatic storm than a hurricane, are far more frequent in Rhode Island, and can still produce considerable damage. On average, one to two nor'easters a year hit Rhode Island with a storm surge equal or greater than two feet. The duration of high surge and winds during a nor'easter can last from 12 hours to three days, while the duration of hurricane conditions generally lasts only six to 12 hours (Rhode Island Emergency Management Agency, 2014).

Location

The Jamestown and Newport Bridges are closed when the wind speed reaches 69 miles per hour (Rhode Island Department of Public Safety). When the bridges close, Jamestown residents are totally dependent upon the limited number of services available on the island. Consequently, severe wind damage to the buildings in which the island's businesses are situated could cause major economic and social hardships.

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Extent

Besides the flooding damage from storm surges (see Section 3.2.2.2), the wind from hurricanes can knock down structures or rip off roofs. Nor'easters pose the same threat to compromised structures; moreover, if they bring a major snowfall along with heavy wind, the resulting snow drifts could block side streets for days (Rhode Island Emergency Management Agency, 2014).

Other hazards posed by high winds include downed power lines, which are lethally dangerous while they continue to carry power. Cable lines can also come down, thereby shutting off communication via telephone and Internet. ("Ice storms" associated with nor'easters are also a threat to utility lines; see Section 3.2.2.5). Other impacts include severe beach erosion, large waves, high winds, flooding, marine over-wash, and loss or injury to life (Rhode Island Emergency Management Agency,

Hurricane- and gale-force winds can also cover roadways with debris, making them impassable to conventional vehicles. This presents a dangerous situation for anyone requiring immediate medical attention (Rhode Island Emergency Management Agency, 2014).

Previous Occurrence, Disasters, and Probability of Future Events

Over the past century, 15 tropical cyclones (Category H1-H5) have directly hit or passed near Rhode Island. In addition, numerous other subtropical and tropical storms/depressions pass through Rhode Island each season generating large swells, storm surges and high winds that cause varying degrees of damage to property (Rhode Island Emergency Management Agency, 2014).

The hurricane events that represent much of the wind hazard for Jamestown are coastal systems. As such, wind hazard areas can be prioritized based on the distance from the coast. Figure 3-2 shows the relative wind hazard ranking for Jamestown and all of Rhode Island. These rankings are based on the American Society of Civil Engineers (ASCE) Minimum Design Loads for Buildings and Other Structures, ASCE 7-98. The Town of Jamestown is located in the risk

Category 4 area (Figure 3-2). While these storms occur infrequently, they have the potential to cause large amounts of damage over a widespread area.

3.2.2.2 Storm Surge

Storm surge is the abnormal rise in water level caused by the wind and pressure forces of a hurricane or nor'easter. Nationally, storm surge flooding has caused billions of dollars in damage and hundreds of deaths. Given today's ever - increasing population densities in coastal communities, the need for information about the potential for flooding from storm surge has become even more important. Storm surge heights in Rhode Island range from a few feet higher than normal tides during nor'easters to more than 10 feet during hurricanes. The breaking wave height is related to water depth so that as water depth over a given surface increases with storm surge, larger waves can be generated.

There are a number of factors that contribute to the generation of storm surge, but the fundamental forcing mechanism is wind and the resultant frictional stress it imposes on the water surface. Winds blowing over a water surface generate horizontal surface currents flowing in the general direction of the wind. These surface currents in turn create subsurface currents which, depending on the intensity and forward speed of the hurricane or nor'easter, may extend from one to several hundred feet below the surface. If these currents are in the onshore direction, water begins to pile up as it is impeded by the shoaling continental shelf causing the water surface to rise. This "dome of water" will increase shoreward until it reaches a maximum height at the shoreline or at some distance inland. The most conducive bathymetry for the formation of large storm surges is a wide gently sloping continental shelf

Figure 3-2. Wind risk score for Rhode Island
Source: American Society of Civil Engineers

3.2.2.3 Hurricanes

Description

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

There are three categories of tropical cyclones:

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

Once a tropical cyclone no longer has tropical characteristics it is classified as an extratropical system.

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

Howling winds associated with nor’easters also have the potential to produce significant storm surge, similar to that of a Category 1 hurricane. In addition, these types of storms can also produce wind gusts to near hurricane force as well as flooding rain and crippling snowfall (Rhode Island Emergency Management Agency, 2014).

Hurricanes are categorized according to the Saffir/Simpson scale (Table 3-2.) with ratings determined by wind speed and central barometric pressure. Hurricane Categories range from 1 through 5, with Category 5 being the strongest (winds greater than 155 MPH). A hurricane watch is issued when hurricane conditions could occur within the next 36 hours. A hurricane warning indicates that sustained winds of at least 74 MPH are expected within24 hours or less (Rhode Island Emergency Management Agency, 2014).

The magnitude of storm surge within a coastal basin is governed by both the meteorological parameters of the hurricane and the physical characteristics of the basin. The meteorological aspects include:

- Hurricane size - measured by the radius of maximum winds (Measured from the center of the hurricane to the location of the highest wind speeds within the storm. This radius may vary from as little as four (4) miles to as much as 50 miles);
- Hurricane intensity - measured by sea level pressure and maximum surface wind speeds at the storm center;
- Hurricane path, or forward track of the storm; and
- Hurricane forward speed.

The counterclockwise rotation of a hurricane's wind field in combination with the forward motion of the hurricane typically causes the highest surge levels to occur to the right of the hurricane's forward track. This phenomenon has been observed in regions where the shoreline is typically straight, not fragmented by large inlets and bays, and when a hurricane travels generally perpendicular to the shore. In Rhode Island, the increased wind stress from the rotational wind field has a large effect on the level of surge. The contribution to surge generation from the forward motion of the storm can be greater than the contribution made by an increase in hurricane intensity.

The Rhode Island shoreline faces south, so storms passing to the west raise the highest storm surges for Rhode Island. In addition, Narragansett Bay funnels the surge northward where decreasing surface area amplifies the surge height (Boothroyd 2008). The 1938 Hurricane made landfall west of Rhode Island as a Category 3 hurricane with a forward speed in excess of 50 miles per hour. Because the center of the storm made landfall in Connecticut, the Rhode Island shoreline experienced the highest storm surge levels.

The reduction of atmospheric pressure within the storm system results in another surge-producing phenomenon known as the "inverted barometer" effect. Within the region of low pressure the water level will rise at the approximate rate of 13.2 inches per inch of mercury drop. This can account for a rise of one (1) to two (2) feet near the center of the hurricane. This effect is considered to be a more important factor in the open ocean where there is no depth related restrictions to water flow.

Location

The entire state of Rhode Island is vulnerable to hurricanes and tropical storms, depending on the storm's track. The entire southwestern portion of Jamestown, closest to the mouth of Narragansett Bay, is designated as a Zone A Hurricane Evacuation Area. Zone A areas are recommended for evacuation prior to an expected Category 1 or 2 hurricane. The perimeter of the rest of the island, including the land immediately adjacent Great Creek, also fall within Zone A (Rhode Island Hurricane Evacuation Study, June 2013).

Extent

Hurricanes are classified by their damage potential according to a scale developed in the 1970s by Robert Simpson and Herbert Saffir, and updated slightly by the National Hurricane Center in 2012. The scale is designed to give public officials and the general public usable information on the magnitude of a storm by giving an indication of the potential flooding and wind damages associated with each hurricane category. The scale rates the intensity and effects of hurricanes based on wind speed and barometric pressure measurements as shown in Table 3-2.

Table 3-2 Saffir/Simpson Scale of Hurricane Intensity, Source: NWS NCDC.

Wind Speed	Typical Effects
Category 1 Hurricane - Weak	
74-95 MPH (64-82kt)	Minimal Damage: Damage is primarily to shrubbery, trees, foliage, and unanchored mobile homes. No real damage occurs in building structures. Some damage is done to poorly constructed signs.
Category 2 Hurricane – Moderate	
96-110 MPH (83-95kt)	Moderate Damage: Considerable damage is done to shrubbery and tree foliage, some trees are blown down. Major structural damage occurs to exposed mobile homes. Extensive damage

	occurs to poorly constructed signs. Some damage is done to roofing materials, windows, and doors; no major damage occurs to the building integrity of structures.
Category 3 Hurricane – Strong	
111-130 MPH (96-113kt)	Extensive damage: Foliage torn from trees and shrubbery; large trees blown down. Practically all poorly constructed signs are blown down. Some damage to roofing materials of buildings occurs, with some window and door damage. Some structural damage occurs to small buildings, residences and utility buildings. Mobile homes are destroyed. There is a minor amount of failure of curtain walls (in framed buildings).
Category 4 Hurricane - Very Strong	
131-155 MPH (114-135kt)	Extreme Damage: Shrubs and trees are blown down; all signs are down. Extensive roofing material and window and door damage occurs. Complete failure of roofs on many small residences occurs, and there is complete destruction of mobile homes. Some curtain walls experience failure.
Category 5 Hurricane – Devastating	
Greater than 155 MPH (135kt)	Catastrophic Damage: Shrubs and trees are blown down; all signs are down. Considerable damage to roofs of buildings. Very severe and extensive window and door damage occurs. Complete failure of roof structures occurs on many residences and industrial buildings, and extensive shattering of glass in windows and doors occurs. Some complete buildings fail. Small buildings are overturned or blown away. Complete destruction of mobile homes occurs.

Previous Occurrence, Disasters, and Probability of Future Events

Rhode Island has experienced tropical depressions and tropical storms as well as hurricanes ranging from Category 1 to Category 3 (NOAA 2013). Hurricanes are rare but devastating events in Rhode Island. Hurricane wind damages can be costly but the related storm surge is by far the most destructive force acting on the Rhode Island coast (Rhode Island Emergency Management Agency, 2014)..

There have been some devastating historical hurricanes in Rhode Island that have impacted Jamestown substantially. In the hurricane of 1938 Rhode Island suffered an estimated $100 million in property damage and 262 deaths statewide. In Jamestown seven school children died on their way home from an early school dismissal (Burns, 2005). Jamestown also lost all connection to electric power, and the three ferries that connected Jamestown to the main land were damaged from the hurricane and were inoperable (Ward and Hartley, 1938). These effects contributed to such a sense of isolation that it spurred the construction of the Jamestown Bridge that connected the island to mainland in 1940 (Scotti, 2003).

Hurricane Bob struck Rhode Island in 1991 and made landfall over neighboring Newport as a category 2 hurricane. It carried wind gusts up to 100 mph in

Newport, drenched the state is seven inches of rain and four individual tornadoes were reported (Valle and Dion, 1998).). The winds from the hurricane knocked down trees and utility poles throughout Rhode Island, causing 60% of Rhode Island residents to lose power (Del Santo, 2013). Rhode Island was declared a Federal Disaster area by President George H. W. Bush and total damages in Southern New England amounted to 680 million dollars (Del Santo, 2013).

The most recent hurricane to affect Jamestown and much of the East Coast was Superstorm Sandy in November 2012. Rhode Island sought and received a federal emergency declaration from President Barack Obama prior to the storm to ensure access to funds to assist in the recovery effort. This hurricane left over 122,000 people in Rhode Island without power. In total, Rhode Island received $39.4 million in support from federal disaster relief programs, a majority of which came from NFIP ($31.1 million; Rhode Island Emergency Management Agency).). Jamestown did not sustain the extent of damage that other southern Rhode Island towns experienced, however, the town beach at Mackerel Cove was severely damaged via the erosion of its dune system (Shane, 2012). This temporarily closed the adjacent access road to Beavertail. In addition, shoreline erosion adjacent to Bay View Drive and North Bay View Drive was severe and will cause road failure if not repaired in the near future.

3.2.2.4 Tornado Hazards

Description

A tornado is a violently rotating column of air in contact with and extending between a cloud and the surface of the earth. Winds in most tornadoes are 100 MPH or less, but in the most violent, and least frequent tornadoes, wind speeds can exceed 250 MPH. Tornadoes typically track along the ground for a few miles or less and they measure less than 100 yards wide, though some can remain in contact with the earth for well over fifty miles and exceed one (1) mile in width (Rhode Island Emergency Management Agency, 2014)..

Several conditions are required for the development of tornadoes and the thunderstorm clouds with which most tornadoes are associated. Abundant low level moisture is necessary to contribute to the development of a thunderstorm, and a "trigger" (perhaps a cold front or other low level zone of converging winds) is needed to lift the moist air aloft. Once the air begins to rise and becomes saturated, it will continue rising to great heights and produce a thunderstorm cloud, if the atmosphere is unstable. An unstable atmosphere is one where the temperature decreases rapidly with height. Finally, tornadoes usually form in areas where winds at all levels of the atmosphere are not only strong, but also turning with height in a clockwise, or veering, direction (Rhode Island Emergency Management Agency, 2014).

Tornadoes can appear as a traditional funnel shape, or in a slender rope-like form. Some have a churning, smoky look to them, and others contain "multiple vortices" – small, individual tornadoes rotating around a common center. Others may be nearly invisible, with only swirling dust or debris at ground level as the only indication of the tornado's presence (Rhode Island Emergency Management Agency, 2014).

A tornado begins in a severe thunderstorm called a supercell. A supercell can last longer than a regular thunderstorm. The wind coming into the storm starts to swirl and forms a funnel. The air in the funnel spins faster and faster and creates a very low pressure area that sucks more air (and possibly objects) into it. The severe thunderstorms that produce tornadoes form where cold dry polar air meets warm moist tropical air. This is most common in a section of the United States called Tornado Alley (Rhode Island Emergency Management Agency, 2014).

Tornadoes can form any time during the year, but most form in May. Northern areas experience the peak tornado season later because it takes longer to warm the northern parts of the plains so tornadoes form later. Most tornadoes spin cyclonically but a few spin anti-cyclonically. Because there are records of anti-cyclonic tornadoes, scientists do not think that the Coriolis Effect causes the rotations (Rhode Island Emergency Management Agency, 2014).

The Fujita scale, introduced in 1971 by Dr. Ted Fujita, provided a way to characterize tornadoes based on the damage they produce and relating that damage to the fastest quarter-mile wind at the height of a damaged structure. An Enhanced Fujita scale became operational in 2007 and improves upon the original scale by including more damage indicators, taking into account construction quality and variability, and providing a more definitive correlation between damage and wind speed (Table 3-3).

Table 3-3. Fujita Scale and Enhanced Fujita Scale

Fujita Scale			**Enhanced Fujita Scale**	
F Number	**Fastest ¼ mile (MPH)**	**3 Second Gust (MPH)**	**EF Number**	**3 Second Gust (MPH)**
0	40-72	45-78	0	65-85
1	73-112	79-117	1	86-110
2	113-157	118-161	2	111-135
3	158-207	162-209	3	136-165
4	208-260	210-261	4	166-200
5	261-318	262-317	5	Over 200

The Storm Prediction Center issues tornado and severe thunderstorm watches. A tornado watch defines an area shaped like a parallelogram, where tornadoes and other kinds of severe weather are possible in the next several hours. A tornado watch does not indicate an imminent tornado; rather, a tornado watch is an advisory for citizens to be alert and prepared to go to safe shelter if tornadoes

do develop or if a tornado warning is issued (Rhode Island Emergency Management Agency, 2014).

Local National Weather Service (NWS) offices are responsible for issuing tornado warnings. Tornado warnings indicate that a tornado has been spotted, or that Doppler radar detects a thunderstorm circulation capable of spawning a tornado.

Nationally, the tornado season lasts from March to August, with peak tornado activity normally occurring in April, May, and June. The highest concentrations of tornadoes have been in the Central U.S. and portions of the Gulf Coast states (Rhode Island Emergency Management Agency, 2014).

Location

Tornado Alley, which extends from Texas to the Dakotas, receives the most tornado activity, and while Rhode Island falls well outside of that region, tornadoes may occur in Rhode Island at any time. This situation may be more dangerous than states in Tornado Alley because Rhode Island residents do not expect severe tornadoes and are ill-prepared to respond to a tornado strike. Tornadoes are considered to be low frequency, high-impact events. All areas of Rhode Island face nearly uniform susceptibility to tornadoes (Rhode Island Emergency Management Agency, 2014).

Extent

The immediate threat of tornadoes is danger to life and property from wind and large debris carried by winds (Tennessee Emergency Management Agency). Other vulnerabilities include electrical utilities, gas lines, and communications infrastructure. Damage to power lines, gas 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 and broken gas lines present a threat to personal safety. Further, downed wires and lightning strikes have been known to spark fires (Tennessee Emergency Management Agency).

Other critical infrastructure that can be damaged by tornadoes include water mains and sewer systems. Damage to these systems can interrupt drinking water service and cause water contamination if treatment systems fail (Tennessee Emergency Management Agency).

A structure’s tornado vulnerability is based in large part 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 (Rhode Island Emergency Management Agency, 2014).

Human vulnerability is based on the availability, reception and understanding of early warnings of tornadoes (i.e. Tornado Warning issued by the NWS) and access to substantial shelter. In some cases, despite having access to technology (computer, radio, television, outdoor sirens, etc.) that allows for the reception of a warning, language differences are sometimes a barrier to full understanding of the risk. Once warned of an impending tornado hazard, seeking shelter indoors on the lowest floor of a substantial building away from windows is recommended as the best protection against bodily harm (Rhode Island Emergency Management Agency, 2014).

Previous Occurrence, Disasters, and Probability of Future Events

New England does not frequently suffer destruction from tornados, with the region's most serious' tornado event occurring in Worcester Mass., on July 9, 1953. In that event, 90 people were killed and 1,300 injured. From 1950 to the present approximately 20 tornadoes were reported in or near Rhode Island, but none of them was as devastating as the Worcester event. A tornado is reported in southern New England, on average, once every two-to-three years.

Tornadoes are a rare occurrence in Rhode Island, however there are past records of tornadoes occurring in or nearby Rhode Island. The strongest tornado on record in Rhode Island occurred on August 7, 1986 (Del Santo, 2013). An F2 tornado struck Providence County, mostly staying within Providence and Cranston, and caused 20 injuries. Damage costs totaled $5,237,067 (in 2012 dollars).

While rare in the New England region, a powerful tornado outbreak occurred on June 1, 2011 that spanned southwest and south-central Massachusetts and southern Maine (NOAA, 2011). Four tornadoes, one ranked as an EF3, touched down in Massachusetts causing three deaths, over 200 injuries, and cost over $140 million in property damages (Spotts, 2011; Turner, 2011;Yee, 2011). 2011; Turner 2011; Yee 2011). On July 28, 2014 an EF-2 tornado touched down in the coastal community of Revere, Massachusetts. At least 65 buildings were destroyed or damaged and over 2,800 residents lost power. Thus, while uncommon, tornadoes occurring in New England are capable of inflicting substantial damage. Jamestown itself has no known records of tornadoes; however that does not preclude the possibility of one occurring (NOAA, 2003).

3.2.2.5 High Wind and Thunderstorms

Description

Thunderstorms are formed when the right atmospheric conditions combine to provide moisture, lift, and warm unstable air that can rise rapidly. Thunderstorms occur any time of the day and in all months of the year, but are most common during summer afternoons and evenings and in conjunction with frontal boundaries. The NWS classifies a thunderstorm as severe if it produces

hail at least one inch in diameter, winds of 58 MPH or greater, or a tornado. About 10 percent of the estimated 100,000 annual thunderstorms that occur nationwide are considered severe (NOAA, Preparedness Guide for Thunderstorms). Thunderstorms affect a smaller area compared with winter storms or hurricanes, but they can be dangerous and destructive for a number of reasons. Storms can form in less than 30 minutes, giving very little warning; they have the potential to produce lightning, hail, tornadoes, powerful straight-line winds, and heavy rains that produce flash flooding (Rhode Island Emergency Management Agency, 2014).

Wind is the motion of air past a given point caused by a difference in pressure from one place to another. Severe wind poses a threat to Rhode Island in many forms, including that produced by severe thunderstorms and tropical weather systems. The effects can include blowing debris, interruptions in elevated power and communications utilities and intensified effects of winter weather. Harm to people and animals as well as damage to property and infrastructure may be the result. Two basic types of damaging wind events other than tropical systems affect Rhode Island: synoptic-scale winds and thunderstorm winds. Synoptic-scale winds are high winds that occur typically with cold frontal passages or nor'easters. When thunderstorm winds exceed 58 MPH, the thunderstorm is considered severe and a warning is issued. "Downbursts" cause the high winds in a thunderstorm. Downburst winds result from the sudden descent of cool or cold air toward the ground. As the air hits the ground, it spreads outward, creating high winds. Unlike tornadoes, downburst winds move in a straight line, without rotation. The term "microburst" refers to a small downburst with damaging winds up to 168 MPH and less than 2.5 miles in length. The term "macroburst" refers to a large downburst that can extend greater than 2.5 miles with winds up to 134 MPH and can last 5 to 30 minutes (Rhode Island Emergency Management Agency, 2014).

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. Lightning strike victims often suffer long-term effects such as memory loss, sleep disorders, weakness and fatigue, chronic pain, depression and muscle spasms. Lightning has the potential to start both house fires and wildfires. Lightning causes an average of 55-60 fatalities, 400 injuries, and over $1 billion in insured losses annually nationwide (Rhode Island Emergency Management Agency, 2014).

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.[1] Hail larger than 0.75 inch in diameter can do great damage to both property and crops, and some storms produce hail over two inches in diameter. Hail causes about $1 billion in damages annually in the U.S. (Rhode Island Emergency Management Agency, 2014).

Location

All areas of Rhode Island are vulnerable to severe thunderstorms and winds, especially those along the Atlantic coast in Washington and Newport Counties, and those areas located on Narragansett Bay. New England, with Rhode Island in particular, has a low incidence of lightening-related fatalities and damages (Figure 3-3; National Lightning Safety Institute, 1990-2003). As an island community, dependent on bridge access, Jamestown is particularly vulnerable to the impacts of high wind events. The two bridges leading to the community are closed to traffic when sustained wind speeds reach 68 miles per hour.

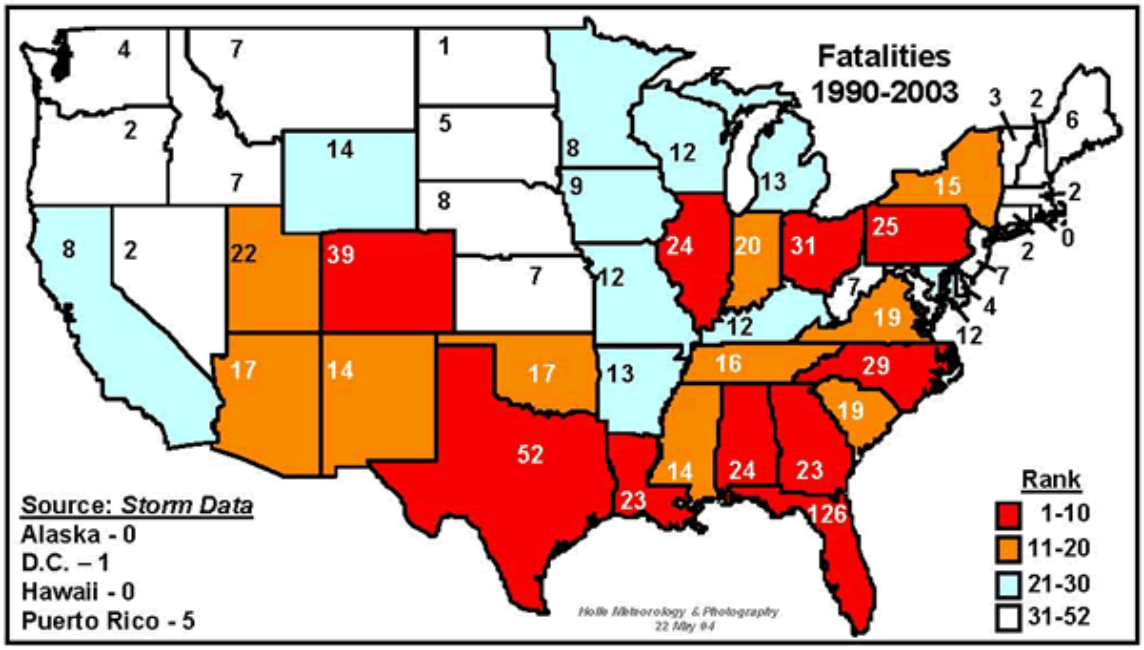

Figure 3-3. Number of lightning strike deaths in the United States, 1990-2003. Source: National Lightning Safety Institute, NOAA

Extent

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.[2] In general,

▼

[1] University Corporation for Atmospheric Research, http://www.ucar.edu/communications/factsheets/Hail.html.
[2] Hasbrouck, P.E. *Determining the Probability of Lightning Striking a Facility*, National Lightning Safety Institute, http://lightningsafety.com/nlsi_lhm/prbshort.html (April 2004).

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 (Rhode Island Emergency Management Agency, 2014).

Structure vulnerability to hail is determined mainly by construction and exposure. Metal siding and roofing is better able to stand up to the damages of a hailstorm than many other materials, although it may also be damaged by denting. Exposed windows and vehicles are also susceptible to damage. Crops are extremely susceptible to hailstorm damage, as even the smallest hail stones can rip apart unsheltered vegetation (Rhode Island Emergency Management Agency, 2014).

Human vulnerability is largely determined by the availability and reception of early warnings for the approach of severe storms, and by the availability of nearby shelter. Swimming, boating, and fishing are particularly dangerous during periods of frequent lightning strikes, which can also cause power outages, topple trees, and spark fires. Individuals who immediately seek shelter in a sturdy building or metal-roofed vehicle are much safer than those who remain outdoors. Early warnings of severe storms are also vital for aircraft flying through the area (Rhode Island Emergency Management Agency, 2014).

Previous Occurrence, Disasters, and Probability of Future Events

Rhode Island does not experience severe thunderstorms with the same frequency as the Midwestern and Southeastern states, but there has been a number of destructive wind, hail, and lightning events in recent history (Rhode Island Emergency Management Agency, 2014). The NCDC has recorded 151 significant (those causing injury, fatalities, and/or damage) lightning and hail events and 344 high wind events; and these events have caused more than $15.5 million in total damages. One death as a result of lightning was recorded on August 11, 2004 in Washington County. Eleven additional injuries have been recorded since 1956 due to lightning. Some of the most significant wind and lightning events in the state's history are listed in Table 3-4.

Table 3-4. Significant National Climate Data Center hail, lightning, and wind events

Date	HIRA Type	County	Property Damage (Inflated to 2012 dollars)
12/23/1994	Wind	Statewide	$7,746,053
8/5/1994	Lightning	Providence	$774,605
8/24/1996	Wind	Washington	$1,097,481
6/22/1997	Lightning	Kent	$357,621
6/17/2001	Lightning	Kent	$357,621
8/21/2004	Wind	Providence	$194,460
10/28/2006	Wind	Kent	$170,828
6/9/2011	Wind	Providence	$255,173

6/25/2012	Lightning	Providence	$150,000

As indicated by the data in Table 3-5, lightning can pose a risk of personal and property damage in Rhode Island. Examples of effects from recent thunder storms include the following: on September 3, 2013 a series of thunderstorms traveled through Rhode Island causing more than 5,000 people to be without power. Lightning struck a South Kingstown fire station twice, although no injuries were reported (Providence Journal, Sept 2, 2013). While lightning strikes are uncommon, they still occur. In 2012 in the northwestern town of Glocester, three children were indirectly struck by lightning while playing in a yard (Boston.com, July 2, 2012).

Table 3-5. Lightning Strike Casualties and Damage Reports

State	Causalities				Damage			
	1960s	1970s	1980s	1990-94	1960s	1970s	1980s	1990-94
Connecticut	13	29	25	11	70	75	79	28
Maine	51	26	19	23	91	48	64	45
Massachusetts	104	101	74	39	166	174	178	57
New Hampshire	14	14	37	11	60	40	64	33
Rhode Island	12	8	25	1	31	40	38	10
Vermont	18	7	3	2	74	27	15	33

3.2.2.6 Winter Related Hazards – Snow, Ice and Extreme Cold

Jamestown faces the risk of heavy snow and ice accumulation as well as extreme cold every winter. The worst winter weather suffered by the island is always a result of nor'easters (which can occur at any time of the year but are most common during winter). Nor'easters are cyclonic storms which travel north -typically very slowly – along the East Coast. Deriving their name from their wind direction, Nor'easters draw a huge volume of moisture from the Atlantic. When these storms arrive during the winter, the moisture can fuel a blizzard; or, under certain conditions, the moisture can fuel an ice storm. Either type of storm can cause massive damage and pose serious health and safety hazards.

Description

A heavy snow is generally defined as having more than eight inches of accumulation in less than 24 hours. Heavy snow can bring a community to a standstill by inhibiting transportation, knocking down trees and utility lines, and by causing structural collapse in buildings not designed to withstand the weight of the snow. Repair and snow removal costs can be significant and surpass annual municipal salt and snow removal budgets, often before the end of the season. A winter storm warning is issued when snowfall is expected to accumulate more than four inches in 12 hours and/or a quarter inch or more of

freezing rain accumulation (Rhode Island Emergency Management Agency, 2014).

The storm radius of a nor'easter is often as large as 1,000 miles, and the horizontal storm speed is about 25 miles per hour, traveling up the eastern United States coast. Sustained wind speeds of 10-40 MPH are common during a nor'easter, with short term wind speeds gusting up to 70 MPH. Unlike hurricanes and tropical storms, nor'easters can sit off shore, wreaking damage for days. Nor'easters are a common winter occurrence in New England and repeatedly result in flooding, various degrees of wave and erosion-induced damage to structures, and erosion of natural resources, such as beaches, dunes and coastal bluffs. The erosion of coastal features commonly results in greater potential for damage to shoreline development from future storms (Rhode Island Emergency Management Agency, 2014).

Nor'easters cause varying amounts of coastal erosion depending on the intensity and the duration of the storm; the tidal phase at the time of the storm (neap or spring tide); the path of the storm; and the time interval between storms (Boothroyd, 2008). Back to back storms do not allow time for the beaches and dunes to recover sand that has been transported offshore. Damages resulting from nor'easters are often due to coastal erosion and undermining the structures that were previously behind the dunes or on the top of coastal bluffs. Damages to a house that topples off an embankment are usually much more costly than damages resulting from localized areas of flooding (Rhode Island Emergency Management Agency, 2014).

The term "ice storm" is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Ice storms result from the accumulation of freezing rain, which is rain that becomes super-cooled and freezes upon impact with cold surfaces. Freezing rain most commonly occurs in a narrow band within a winter storm that is also producing heavy amounts of snow and sleet in other locations. If extreme cold conditions are combined with low/no snow cover, the cold can better penetrate downward through the ground and potentially create problems for underground infrastructure as well. When utilities are affected and heaters do not work, water and sewer pipes can freeze and even rupture (Rhode Island Emergency Management Agency, 2014).

Excessive cold may accompany winter storms, be left in their wake, or can occur without storm activity. Extreme cold can lead to hypothermia and frostbite, which are both serious medical conditions. The definition of an excessively cold temperature varies according to the normal climate of a region. In areas unaccustomed to winter weather, near freezing temperatures are considered "extreme cold." In Rhode Island, extreme cold usually involves temperatures below zero degrees Fahrenheit (Rhode Island Emergency Management Agency, 2014).

The wind chill index attempts to quantify the cooling effect of wind with the actual outside air temperature to determine a wind chill temperature that

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

Location

Given its exposure to the mouth of Narragansett Bay, Jamestown is highly vulnerable to the effects of winter storms, in particular the storm surges that accompany nor'easters. Mackerel Cove, the small embayment between the larger, northeastern portion of Conanicut Island and the smaller southwestern portion of the island, is an area that is especially susceptible to the eroding forces of nor'easters. Other areas of vulnerability include the East Ferry seawall that runs along Conanicus Avenue near the downtown commercial district of Jamestown, the Dumpling seawall along Dumpling Drive, the roadways of Bay View Drive and North Bay View Drive. All areas were damaged in 2011 and 2012 by Tropical Storm Irene and Superstorm Sandy. The seawalls have since been repaired, but remain as critical infrastructure designed to protect roadways from the effects of storms. Both Bay View and North Bay View Drives remain vulnerable to collapse. In terms of snow, the entire state is susceptible to heavy snowfall, although the average annual snowfall in Jamestown is 36.6 inches, which is slightly more than the overall Rhode Island state average of 33.80 inches.

Extent

While the winds from nor'easters are not as powerful as hurricane winds, their wind gusts can approach hurricane force, which means Nor'easters also have the potential to tear off roofs and topple structures. If a Nor'easter hits the coast as a blizzard, the ensuing snowfall can collapse weak roofs as well. The winds also produce storm surges which, because nor'easters are prolonged events, can continue through multiple high tides – the period when the threat of flooding along an island such as Jamestown is greatest.

The loss of power and internet communication because of an ice storm presents a very dangerous situation. Furnaces and pellet stoves need electricity to function, and the temperatures following winter nor'easters typically plunge as cold fronts sweep in behind the departing weather system.

Previous Occurrence, Disasters, and Probability of Future Events

Winter weather events in Rhode Island can be described as unpredictable. Days of frigid, arctic air and below freezing temperatures may be followed by days of mild temperatures in the 40s or 50s. Snowfall and rainfall vary; however, Rhode

Island residents can expect to experience several nor'easters, which usually bring coastal erosion and a possibility for blizzard conditions or heavy rainstorms dependent on the temperature (Rhode Island Emergency Management Agency, 2014). Table 3-7 details historic winter storm in Rhode Island.

The worst nor'easter to strike Rhode Island in the last 100 years was The Blizzard of 1978, which had extreme impacts on Rhode Island. Snow accumulation reached 3-to-4 feet and wind speeds exceeded 60 miles per hour. Abandoned cars caused the interstate highways to shut down and more than 10,000 people were stranded on roads and highways throughout the State. In Jamestown the state pier lost many planks and the town's entire east side suffered severe erosion (Weisman, 2012). In Rhode Island 26 deaths and 232 injuries were attributed to the storm and damage totaled $15 million (Strauss, 2008). The blizzard of 1978 is still regarded as the storm of the century and is the storm to which all subsequent storms are compared.

More recently Rhode Island experienced a powerful nor'easter in February 2013 known unofficially as Winter Storm Nemo. Governor Lincoln Chafee declared a state of emergency in Rhode Island and enacted a state travel ban that lasted nearly 24 hours (Rapoza, 2013). National Grid estimated more than 180,000 customers lost power. By Saturday night, 129,000 customers in Rhode Island remained without power, with Bristol and Newport Counties suffering the majority of the outages. Rhode Island received $1 million in reimbursements from the Federal Emergency Management System (FEMA) for snow removal costs from the storm (Cicilline, 2014).

The National Climatic Data Center (NCDC) data suggests that any county of Rhode Island can anticipate between two to six significant winter weather events per winter season. Between the years of 1999-2012 Newport County has experienced the fewest number of significant winter weather events (39) than any other Rhode Island county in that timeframe, with Providence County experiencing the highest frequency of events (139). Given this winter storm history, Jamestown's annual budget for winter storm maintenance errs on the side of caution with financing approved for an expectation of six winter storms (Shane, 2013). A separate budget exists for snow-removal overtime and $22,000 was allotted for that in 2012-2013 winter season (Sullivan, 2013). However, in recent years this relatively conservative budget has been strained with storms like Nemo falling over weekends, which requires overtime pay for publics works crews and police officers (Shane, 2013). In terms of cost, winter storm Nemo cost approximately twice the amount of a typical winter storm and required $17,960 of the allotted $22,000 overtime pay (Sullivan, 2013).

Table 3-6. Historical Nor'easter Losses for Rhode Island

Year	Deaths	Total Losses (Actual)
1888	400+	Unknown
1978	99	$202M
1991	33	$200M
1992	19	$1,000-2,000M

1993	270	$3,000-6,000M
1996	187	$3,000M

3.2.2.7 Flood Related Hazards

The island lies within Narragansett Bay, and its southern shoreline is open to Narragansett Bay and Rhode Island Sound (See Map 1). The island is also exposed to severe storms: Nor'easters and hurricanes. According to the National Oceanic and Atmospheric Administration (NOAA), nine hurricanes have directly struck Rhode Island from 1851 through 2009; however, many other tropical cyclones~~, such as Hurricane~~Superstorm ~~Sandy in 2012, have hit the state indirectly, resulting in widespread flooding and wind damage. "Eastward" hurricanes, meaning those whose eyes pass to the east of the state, produce less rainfall than the "westward" hurricanes, which pose the greatest flooding hazards to the island.~~

Description

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

- A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from: overflow of inland or tidal waters; unusual and rapid accumulation or runoff of surface waters from any source; or a mudflow; or

- The collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above.

By their very nature, floodplains are the low, flat, periodically flooded lands adjacent to rivers, lakes and oceans and are subject to geomorphic (land-shaping) and hydrologic (water flow) processes. It is only during and after major flood events that the connections between a river and its floodplain become more apparent. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. In addition, the floodplain represents a natural filtering system, with water percolating back into the ground and replenishing groundwater. When a river is divorced from its floodplain with levees and other flood control structures, natural benefits are either lost, altered, or significantly reduced (Rhode Island Emergency Management Agency, 2014).

Riverine Flooding

Riverine flooding is a function of precipitation levels (both rain and snow) and water runoff volumes within the stream or river. Riverine flooding is defined as the periodic occurrence of overbank flows of rivers or streams resulting in partial or complete inundation of the adjacent floodplain. The recurrence interval of a flood is defined as the average time interval, in years, expected to take place between the occurrence of a flood of a particular magnitude to an equal or larger flood. Flood magnitude increases with increasing recurrence interval. When land next to or within the floodplain is developed, these cyclical floods can become costly and dangerous events (Rhode Island Emergency Management Agency, 2014).

Flash Flooding

A flash flood is the fastest-moving type of flood. It happens when heavy rain collect in a stream or gully, turning the normally calm area into an instant rushing current. Any flood involves water rising and overflowing its normal path. A flash flood is a specific type of flood that appears and moves quickly across the land, with little warning making it very dangerous (Rhode Island Emergency Management Agency, 2014).

Flash floods are the result of heavy rainfall concentrated over one area. Most flash flooding is caused by slow-moving thunderstorms, thunderstorms that repeatedly move over the same area, or heavy rains from hurricanes and tropical storms. Dam failures can create the most damaging flash flood events. When a dam or levee breaks, a large quantity of water is suddenly let loose downstream, potentially destroying anything in its path (Rhode Island Emergency Management Agency, 2014).

Flash flood waters move at very fast speeds. They have the power to move boulders, tear out trees, destroy buildings, and obliterate bridges. Walls of water can reach heights of 10’ to 20’, and generally carry a huge amount of debris with them. The best response to any signs of flash flooding is to move immediately and quickly to higher ground (Rhode Island Emergency Management Agency, 2014).

Urban/Stormwater Flooding

Urban flooding occurs where there has been development within stream floodplains. This is partly a result of the use of waterways for transportation purposes in earlier times. Sites adjacent to rivers and coastal inlets provided convenient places to ship and receive commodities. Floodways and wetlands which are the natural storage basins for flood waters were filled to accommodate development. The price of this accessibility to the rivers was increased flooding of those urban areas. Urbanization increases the magnitude and frequency of floods by increasing impermeable surfaces, increasing the speed of drainage collection, reducing the carrying capacity of the land and, occasionally, overwhelming sewer systems. The most common result from these areas flooding is due to poor or insufficient storm water drainage, high groundwater levels, and high percentage of impervious surfaces which prevent

groundwater recharge. More often than not, when heavy rains occur, Rhode Island's aging sewer systems (or combined sewer overflows – CSOs) are overrun and this results in raw sewage flowing into Narragansett Bay, often creating Bay closures to shell fishing and swimming (Rhode Island Emergency Management Agency, 2014).

Coastal Flooding

Coastal flooding is typically a result of storm surge and wind-driven waves, which erode the coastline. These conditions are produced by hurricanes (tropical storms) during the summer and fall, and nor'easters and other large coastal storms (extra-tropical storms) during the fall, winter, and spring. Storm surges may overrun barrier islands and push sea water up coastal rivers and inlets, blocking the downstream flow of inland runoff. Thousands of acres of crops and forest lands may be inundated by both saltwater and freshwater. Escape routes, particularly from barrier islands, may be cut off quickly, stranding residents in flooded areas and hampering rescue efforts (Rhode Island Emergency Management Agency, 2014). As noted previously, coastal flooding is a particular concern to Jamestown because of the potential to essentially separate the community into three islands and significantly impact accessibility. Beavertail, the Village area and the north end are susceptable to being separated and more inaccessable than other areas for either leaving the island or proper access.

Location

With the exception of several shoreline areas elevated by cliffs, much of Jamestown's coast is vulnerable to serious flooding. Tropical cyclones, such as Superstorm Sandy in 2012, have hit the state indirectly, resulting in widespread flooding and wind damage. "Eastward" hurricanes, meaning those whose eyes pass to the east of the state, produce less rainfall than the "westward" hurricanes, which pose the greatest flooding hazards to the island.

Flooding in Jamestown is generally limited to the coastal lowlands along Narragansett Bay (FEMA, 2010). When the waters of the inland marsh (Great Creek, also known as "Zeke's" Creek) overflow, a quarter-mile stretch of the road passing through the marsh- North Road- can become impassable to most vehicles. This is a serious concern because North Road leads to and from the Jamestown Bridge; moreover, it is the only road that runs the entire length of the island (albeit with a different name in the southern half of the island: Southwest Avenue which then connects to Beavertail Road). Another potential flooding threat to North Road is the North Pond dam, which is centrally located on Conanicut Island and retains the water in Jamestown's primary reservoir.

A portion of the only road leading directly to the Newport Bridge, Conanicus Avenue, floods during hurricanes and Nor'easters because its downtown stretch is adjacent to a beach along the East Passage, which funnels Atlantic storm surges into upper Narragansett Bay. Storm surges can spill over the

East Ferry seawall and inundate the road (especially during high tides); if torrential rain is falling during a hurricane or Nor'easter, the flooding will be even more severe during high tides.

Other areas vulnerable to flooding include Fox Hill Pond, Sheffield Cove, Potter Cove, Hull Cove, and Mackerel Cove. When the water of Mackerel Cove breaches the barrier dunes, the water inundates the causeway adjacent to the Cove. This is a serious concern because Southwest Avenue, which is the name for the southern half of North Road, is the only road leading into and out of the southern end of the island.

Because Jamestown has a high water table throughout most of the island, side roads can, and do, flood if heavy rain from a hurricane or Nor'easter combines with overflowing water from storm drains and saturated lawns over a period of several days. When torrential rain falls in early spring – before grass and trees are ready to absorb and transpire water from the soil – the flooding is worse than it would be if the same volume of rain fell during the summer.

As part of the town's Hurricane Evacuation Study, the town performed an inventory of all local streets and structures in the flood zone areas. This area is referred to as a SLOSH Zone (Sea, Lake, and Overland Surge from Hurricanes) and corresponds to the V Zones (areas of 100 year coastal flood with velocity) identified by the Federal Emergency Management Agency, February 1986. Results of this study showed that there are presently over 800 persons residing in 350 houses located in the SLOSH Zone. Only a small of these residences are occupied seasonally.

Extent

Populations and property are extremely vulnerable to flooding. Homes and business may suffer damage and be susceptible to collapse due to heavy flooding. Floodwaters can carry chemicals, sewage, and toxins from roads, factories, and farms; therefore any property affected by a flood may be contaminated with hazardous materials. Debris from vegetation and man-made structures may also be hazardous following a flood. In addition, floods may threaten water supplies and water quality and initiate power outages (Rhode Island Emergency Management Agency, 2014).

Water damage that homeowners and businesses face after flooding can also be an issue. If water damage is not addressed quickly following flood events, which may be the case after significant floods, the likelihood of mold contamination greatly increases (Brandt et al., 2006). Molds are ubiquitous in nature and grow indoors and outdoors, however, moist environments created post-flooding provide optimal mold growth conditions (Brandt et al., 2006). While undisturbed mold is not a substantial health hazard for most people, it can be hazardous to people with conditions such as impaired host defenses or mold allergies (Brandt et al., 2006).

The flood hazard varies by location and type of flooding. Coastal areas are most at risk from flooding caused by hurricanes, tropical storms and nor'easters. Low-lying coastal areas in close proximity to the shore, sounds or estuaries are exposed to the threat of flooding from storm surge and wind-driven waves, as well as from intense rainfall, such as the areas near Mackerel Cove and Conanicus Avenue. Areas bordering rivers may also be affected by large discharges caused by heavy rainfall over upstream areas, such as North Road where it bisects Great Creek. Inland areas are most at risk from flash flooding caused by intense rainfall over short periods of time. Stream flow tends to increase rapidly. Large amounts of impervious surfaces in urban areas increase runoff amounts and decrease the lag time between the onset of rainfall and stream flooding. Manmade channels may also constrict stream flow and increase flow velocities (Rhode Island Emergency Management Agency, 2014).

More intense rainfall, the result of climate change, is likely to increase peak flooding, particularly in urban environments in the future. The magnitude of this increase is dependent on the level and rate of greenhouse gas emissions through the end of the century.

Previous Occurrence, Disasters, and Probability of Future Events

Jamestown has few streams and brooks on the island so the primary flood vulnerabilities stem from coastal flooding from storms such as hurricanes and nor'easters. However, Jamestown's entire coastline is vulnerable to high tides and wave action during severe storms, however since the shoreline in most areas is generally rocky and rises steeply from the bay, the flood zones do not extend very far inland (Town of Jamestown, 2002). The Great New England Hurricane of 1938 and Hurricane Carol in 1954 were severely damaging hurricanes that caused extensive coastal flooding in southern New England (Valle and Dion, 1998). Hurricane Carol produced a powerful storm surge of 14.4 feet in Narragansett Bay, which surpassed the surge created by the Hurricane of 1938. Flooding hastens coastal erosion and Mackerel Cove provides strong evidence of shoreline shifting due to erosion (Sullivan, 2012).

Continuing flood losses during the last 30 years have shifted the federal government's focus from flood "control" to flood "management". The goal of flood management is to prevent loss of life and damage to public and private property by reducing the effects of flood damage and forming effective plans for recovery and rehabilitation. The change from flood control to flood management resulted in revisions and improvements to Federal policies. One major impetus was flood hazard mapping. The development of SFHA maps was the first comprehensive attempt to identify flood hazard risk in the Nation's floodplains (Rhode Island Emergency Management Agency, 2014).

This effort began in 1968, with the passage of the NFIP Act by Congress. The program's intent is to reduce future damage and to provide protection for property owners from potential losses. Flood insurance is made available in communities participating in the NFIP. Policyholders pay premiums that are

based on the level of flood risk at an identified location in the community. To accurately identify the risk, FEMA produces Flood Insurance Rate Maps (FIRMs) that show areas subject to flooding. The flood risk information presented on the FIRMs is based on historic, hydrologic, and hydraulic data, as well as open-space conditions, flood-control works, and development.

A 100-year flood is not a flood that occurs every 100 years. In fact, the 100-year flood has a 26-percent chance of occurring during a 30-year period, the typical length of many mortgages. The 100-year flood is a regulatory standard used by Federal agencies, States, and NFIP-participating communities to administer and enforce floodplain management programs. The 100-year flood is also used by the NFIP as the basis for insurance requirements nationwide. The main recurrence intervals used on the FIRMS are shown in **Table X**. In those FEMA SFHAs or velocity zones (V-Zones) where there are armored shorelines, or any other manmade structures impeding the beaches' natural process of sediment transport, there is a greater likelihood of coastal flooding as the beaches erode and can no longer protect these areas from flooding (Rhode Island Emergency Management Agency, 2014).

Table 3-7. Annual Probability Based on Flood Recurrence Intervals

Flood Recurrence Interval	Annual Chance of Occurrence
10-yr	10.0%
50-yr	2.0%
100-yr	1.0%
500-yr	0.2%

Flooding is the most prevalent and frequent natural hazard that impacts the state. Although there is no distinct flood season in Rhode Island and major river flooding can occur in any month of the year, NOAA has studied a number of past floods from the 1990's to 2000 (Vallee and DelliCarpini)and has noted three (3) times of the year of particular importance with regard for the potential of flood activity to occur:

- Late winter/spring melt
- Late summer/early fall
- Early winter

3.2..2.8 Climate Change and Sea Level Rise

Based on the NOAA Technical Report NESDIS 142-1, Regional Climate Trends and Scenarios for the U.S. National Climate Assessment: Climate of the Northeast, two climate model simulations have been developed that project the effects of high and low greenhouse gas emission scenarios. Analyses of the simulated future climate are provided for the periods of 2021-2050, 2041-2070, and 2070-2099, with changes calculated with respect to a historical climate reference period (1971-1999, 1971-2000, or 1980-2000)

(NOAA142-1). The resulting climate change conditions are to be viewed as scenarios, not forecasts, and there no explicit or implicit assumptions about the probability of either scenario (NOAA TR NESDIS 142-1).

Key findings of the simulated climate models are as follows:

- Models indicate an increase in temperature for all three future periods, with little spatial variation. Changes along coastal areas, such as Jamestown, are slightly smaller than inland areas.
- Simulated temperature changes are similar in value for the high and low emissions scenarios for the near future, whereas late in the 21st century the high emissions scenario indicates nearly twice the amount of warming.
- The range of model-simulated temperature changes is substantial, indicating substantial uncertainty in the magnitude of warming associated with each scenario. However, in each scenario, the modeling is unequivocal and large compared to historic variations.
- Increases in the number of days with a maximum temperature above 95ºF are simulated to occur throughout the northeast, with the largest increases occurring in the southern and western areas.
- Simulated decreases in the average annual number of days with a minimum temperature below 10ºF are largest (21 days or more) in northern areas. Decreases in the number of days with a minimum temperature below 32ºF are 20-23 days across most of the region.
- The freeze-free season is simulated to lengthen by at least 19 days across the region by mid-21st century. Simulated increases in most areas are 3-4 weeks.
- The far northern regions show the largest simulated increases in average annual precipitation, while southern and coastal areas show less of an increase. Models are mostly in agreement that precipitation will increase over the entire region under these scenarios. Simulated seasonal changes are mostly upward in winter, spring, and fall, and downward in summer.
- All areas see simulated increases in the number of days with precipitation totals exceeding 1 inch, with the greatest increases (up to 30%) occurring in parts of New York. The simulated increases are statistically significant in most northern areas.
- Most models do not indicate a statistically significant change in temperature (with respect to 2001-2010) for the near future; however, as the time period increases a greater number of models simulate statistically significant temperature changes, with all being significant at the 95%

confidence level by 2055 (for the high emission scenario).

Theses modeled scenarios of hotter weather and increased precipitation, along with current climate trends such as increased sea level rise will affect Jamestown in the long term. Increased precipitation can lead to inland flooding and potentially cause issues, such as dam breach of the two drinking water reservoirs, which already have already been determined to be of significant hazard. Conversely, hotter weather can lead to drought-like conditions and strain Jamestown's limited drinking water supply. The rise in sea level will intensify coastal erosion and damage vulnerable areas such as Mackerel Cove. Based on the actions outlined in this natural hazard mitigation plan, Jamestown will be prepared to respond to and mitigate the effects of climate change.

3.2.2.8 Coastal Erosion

Description

Coastal zones are dynamic areas that are constantly undergoing change in response to a multitude of factors, including sea level rise (SLR), wave and current patterns, hurricanes, coastal flooding and human influences. High winds and associated marine flooding from storm events such as hurricanes, nor'easters, flooding and SLR, increase the risk exposure along developed coastal lands. Storm impacts and long-term erosion threatens developed areas with potential loss of life and billions of dollars in property damage. In addition to the natural processes that cause erosion, human alterations are affecting erosion rates (Rhode Island Emergency Management Agency, 2014).

Erosion has been wearing away bluffs and moving beaches and barriers along the U.S. coastal and Great Lakes shores from the powers of flooding, storm surge, rising sea levels, and high surf. As shorelines retreat inland, waterfront homes, public infrastructure such as roads, bridges, wastewater treatment facilities, and stormwater drainage systems, eventually become severely damaged. The Heinz Center report on the "Evaluation of Erosion Hazards" predicts that over the next 60 years erosion may claim one out of four houses within 500 feet of the U.S. shoreline. Most of the damage will occur in low-lying areas – areas also subject to the highest risk of flooding. Additional damage will also occur along coastal bluffs as waves reach higher on the shoreline and erode the toe of the bluff and gravity takes its course (Rhode Island Emergency Management Agency, 2014).

The beaches, barrier spits and coastal bluffs of Rhode Island are vital economic, environmental, and cultural resources. A healthy, wide sandy beach provides protection against the effects of storm surge, coastal flooding, and high surf impacts. The beach and barrier environment provides habitat for marine and terrestrial organisms with beach dependent life stages and is home to species of

indigenous and endemic Rhode Island plants. Beaches, barrier spits and coastal bluffs are also the basis for the tourism industry, exceeding by a factor of three all other industries combined when providing direct income to the State (Rhode Island Emergency Management Agency, 2014).

Rhode Island's beaches and barriers serve as natural protective buffers between the ocean and the land. During storm events, a beach is able to modify its slope and overall morphology to dissipate the waves. The beach profile is flattened, and the waves coming inshore shoal further out offshore, thus minimizing further erosion. Beaches recover when sand is moved back onto the shore by fair weather waves, and then is blown inland to reestablish the frontal dunes. The final stage of recovery of the beach and dunes occurs when vegetation grows back over these new dunes. Hence, the narrowing of healthy beaches in response to a high wave event is often a temporary condition (Rhode Island Emergency Management Agency, 2014).

Location

The low-lying areas of Jamestown, particularly the sandy beaches, are vulnerable to erosion because of storm surges, waves, and tidal forces. About a third of the coastline is elevated and rocky. However, there are several areas of Jamestown facing serious erosion threats. The first area, which would impact residencies and roads, is the east side of Jamestown, north of Potter Cove and an area of low-lying shoreline along Bayview Drive along Taylor Point, which has lost 8-to-10 feet of the sandy buffer separating the road from the East Passage of Narragansett Bay. The second area is the Mackerel Cove beach, which protects a causeway serving as the only link to the Beavertail Peninsula. Superstorm Sandy devastated the dunes along the causeway (a stretch of Southwest Ave), leaving the road more vulnerable to flooding when storms co-occur with high tides. North Bayview Drive, which runs along the northern tip of Jamestown has experienced roadway failure from both coastal erosion and overland flow and was closed to traffic in 2014.

The Coastal Resources Management Council (CRMC) has adopted shoreline change maps that delineate shoreline rates of change that will be applied to pertinent sections of the Council's regulatory programs to address issues including setbacks of activities from coastal features. These shoreline change maps detail erosion rates for the shoreline, and are further detailed into shoreline segments for each map. In total there are 21 such maps for Jamestown (Hehre and Boothroyd, 2007).

Extent

The average coastal erosion rate is 1.6 feet per year in Rhode Island (Sullivan, 2012). Rhode Island's shoreline is naturally eroding and migrating over time (Save the Bay, 2013). Most of this erosion occurs during short term storm events such as hurricanes and nor'easters, although factors such as sea level rise and coastal armoring also contribute to erosion (Save the Bay, 2013). The

vulnerability of many of Rhode Island's beaches and shoreline areas to coastal erosion and flooding tends to dramatically increase as manmade structures are allowed to be built along the shoreline thus impeding the natural, dynamic system of the beach. Coastal armoring and the construction of jetties and groins may save the beach or one private property owner, but it severely impacts sediment deposits from occurring down shore of the structure, thus accelerating erosion activity and negatively impacting property owners in these locations (Rhode Island Emergency Management Agency),.

There are several seawalls constructed along the east side of Jamestown that are designed to prevent the action of tides and waves from flooding roads and buildings. However, these seawalls conflict with dynamic nature of the coast and prevent the natural exchange of sediment between lands and sea (Shipman and Stojanovic, 2007). Although these seawalls provide an important function in that they reduce the hazards of coastal flooding, they may also contribute to the coastal erosion of beaches. The CRMC is in the process of developing a Shoreline Change Special Area Management Plan (SAMP), which will provide a long-term place for coastal cities and towns to plan for and be more resilient to natural processes like erosion, SLR, and flooding (Rhode Island Emergency Management Agency, 2014). It is important to enact mitigation strategies because erosion poses a significant threat to property owners, the public and the state's natural resources (Rhode Island Emergency Management Agency, 2014).

Previous Occurrence, Disasters, and Probability of Future Events

Superstorm Sandy had substantial coastal erosion impacts in several areas of Jamestown: extensive dune destruction in Mackerel Cove, and portions of Bayview Drive and Potter Cove were eroded (Town of Jamestown, 2012). These areas, in particular Mackerel Cove, have historically been impacted by erosion during significant storm events. In 2011 and 2012 during Tropical Storm Irene and Superstorm Sandy the East Ferry seawall that runs along Conanicus Avenue near the downtown commercial district of Jamestown and the Dumpling seawall along Dumpling Drive were damaged, however, both have since been repaired.

3.2.2.9 Dam Breach

Description

Dam failures can result from natural events, human-induced events, or a combination of the two. Failures due to natural events such as prolonged periods of rainfall and flooding can result in overtopping, which is the most common cause of dam failure. Overtopping occurs when a dam's spillway capacity is exceeded and portions of the dam that are not designed to convey flow begin to pass water, erode away, and ultimately fail. Other causes of dam failure include design flaws, foundation failure, internal soil erosion, inadequate

maintenance, or misoperation. Complete failure occurs if internal erosion or overtopping results in a complete structural breach, releasing a high-velocity wall of debris-laden water that rushes downstream, damaging or destroying everything in its path. An additional hazard concern is the cascading effect of one dam failure causing multiple dam failures downstream due to the sudden release of flow (Rhode Island Emergency Management Agency, 2014).

Intense storms may produce a flood in a few hours or even minutes for upstream locations. Flash floods occur within six hours of the beginning of heavy rainfall, and dam failure may occur within hours of the first signs of breaching. Other failures and breaches can take much longer to occur, from days to weeks, as a result of debris jams or the accumulation of melting snow (Rhode Island Emergency Management Agency, 2014).

While dam failures that occur during flood events compound an already tenuous situation and are certainly problematic, the dam failures that occur on dry days are the most dangerous. These "dry day" dam failures typically occur without warning, and downstream property owners and others in the vicinity are more vulnerable to being unexpectedly caught in life threatening situations than failures during predicted flood events (Rhode Island Emergency Management Agency, 2014).

Dams are classified by size and hazard ratings. The size classification provides a relative description of small, medium, or large, based on the storage capacity and height of the impounded water (RIDEM, 2012). The hazard classification relates to the probable consequences of failure or misoperation of the dam; however, it does not relate to the current condition or the likelihood of failure of the dam. The hazard classifications are defined in the Rhode Island Dam Safety Regulations as follows:

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

- Significant Hazard – means a dam where failure or misoperation 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.

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

Jamestown's water supply is dependent on surface and ground water for drinking water and was designated by the EPA as a sole source aquifer in 2008 (Town of Jamestown, 2002; USEPA *a*). This designation means that no commitment for federal financial assistance may be provided for any project which the EPA determines may contaminate the aquifer so as to create a hazard to public health (USEPA *b*). Additionally, a sole source aquifer designation has the added benefit of increasing public awareness about the importance of ground water resources (USEPA *b*). Approximately 57% of island residents

live outside of the area serviced by the public Jamestown Water District and rely solely on private water supply wells (USEPA *a*). The other 43% of residents rely on municipal water provided by town water district, which is supplied by two reservoirs, North Pond (also known as Carr Pond) and South Pond (also known as Watson Pond) as well as a portion of groundwater from the island's aquifer (USEPA *a*). The North Pond reservoir is the primary drinking water supply for the Jamestown Water District and has a watershed approximately 210 acres in size and the water body itself measures 28 acres (Joubert et al., 2003). The South pond reservoir has a watershed of approximately 450 acres and a water body of only seven acres; due to the small size and limited capacity, South Pond is used only as a secondary public water supply source (Joubert et al., 2003).

Since just under half of the island's residents rely on municipal water supplies from the reservoirs, the structural integrity of the dams is critical both from a water supply standpoint and a physical safety perspective. In 2003 the Jamestown Water Supply Committee considered raising the North Pond dam height by one foot to increase the capacity of the reservoir (Town of Jamestown, 2003). This proposal was dismissed however when it was discovered that the structural integrity of the impoundment dam was deemed only marginal, thus making the dam raising project too costly and unsafe (Town of Jamestown, 2003).

RIDEM has the responsibility to inspect dams and determine their condition (RIDEM, 2012). A 'significant hazard dam" means a dam where failure or misoperation 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. In accordance with Dam Safety Regulations, visual inspections of significant hazard dams are required every five years (RIDEM, 2012). As part of each visual inspection, the condition of the major components of the dam are subjectively rated as good, fair or poor. The major components of a dam are the embankment, the spillway and the low level outlet (RIDEM, 2012).

According to the 2012 Annual Report to the Governor on the Activities of the Dam Safety Program, dams of both the North and South pond reservoirs (ID # 574 and 575) are designated as significant hazards, thus classifying the dams as unsafe with conditions that bear unreasonable risks of failure (RIDEM, 2012). In 2008 Section nine of Chapters 46-18 and 46-19 of the Rhode Island General Laws were amended to require that a city or town where a significant or high hazard dam is located complete an Emergency Action Plan (EAP) for the dam (RIDEM, 2012). Jamestown completed and adopted an updated EAP in July 2014. The EAP is a formal document that identifies potential emergency conditions and specifies pre-planned actions to be followed to minimize loss of life and property damage (RIDEM, 2012).. RIEMA is responsible for coordinating development of EAPs and granting final approval of the plans (RIDEM, 2012). The Jamestown EAP:

- Establishes a monitoring system which can activate the plan

- Identifies the officials, organizations, agencies, and their respective responsibilities for implementing the plan
- Identifies those areas, structures, facilities, and roads which might be affected by dam failure

In January 2013, Pare Corporation prepared a Dam Inspection & Evaluation report for the Jamestown Reservoir and South Pond Dams. This report captured the results of a visual assessment of the dams and the results of hydrologic and hydraulic modelling. In general the inspection results and conclusions were similar to assessment done by the same contractor for RIDEM in 2012. The report provides some general and several specific recommendations for improving the function and safety of the dams. The most recent state inspections for the other four dams in Jamestown, Rainbow Upper and Lower (ID # 651 and 652), Tefft Pond (ID # 738), and West Reach Drive Pond (ID # 739), were performed in 2008 and determined that these dams were low hazards.

Extent

Safety, liability and environmental hazards of aging dams are issues for ever community in Rhode Island (Save the Bay, 2010). Most of the dams in Rhode Island were constructed before 1900 for water supply, industrial mill use, power supply and recreation (Save the Bay, 2010). This aging infrastructure has costs for cities, towns, the state, and private landowners. Most of these structures do not fulfill their original purpose, but have become a permanent fixture in the landscape (Save the Bay, 2010). Depending on the location and population density around a dammed area, a dam failure can cause loss of life in addition to the inevitable economic damages associated with dam failure. Those who live downstream from a significant or high risk dam should be aware of designated evacuation routes and preplanned actions that can be taken in the event of a dam failure. Jamestown maintains an approved Emergency Action Plan (EAP) for the Jamestown Reservoir and Lower Reservoir Dams. The EAP establishes a monitoring system which can activate the plan; identifies officials, organizations, agencies, and their respective responsibilities for implementing the plan; and identifies those areas, structures facilities and roads which might be affected by dam failure.

Previous Occurrence, Disasters, and Probability of Future Events

Rhode Island has experienced many dam failures, mainly resulting from major flood events (Rhode Island Emergency Management Agency, 2014). There have been over 111 dam incidents recorded in Rhode Island from as early as 1889, seven of which have included some degree of dam failure (National Performance of Dams Program). Jamestown has no recorded history of dam failure; however with two of their critical reservoir dams designated as significant hazards the potential for failure is deemed unreasonable (RIDEM, 2012).

A notable dam failure in Rhode Island is the collapse of California Jim's dam in Peace Dale in 1998 (Town of South Kingstown, 2006). The failure caused a total draining of the 12.8 acre pond and the resultant flooding cost $400,000 in property damages and $250,000 in repairs to the dam (Damsafety.org). This incident highlighted the lack of dam maintenance and emergency preparedness related to dam failure in Rhode Island and created an impetus for the revised dam safety regulation promulgated in 2007 (Save the Bay, 2010).

The probability of future dam failure events is not easily measured, but correlates to some extent with the probability of future major flood events coupled with preventative measures, including the routine inspection, maintenance, repair, and proper operation of dams by their owners, and as regulated by Rhode Island dam safety (Rhode Island Emergency Management Agency, 2014).

3.2.2. Geologic Related Hazards: Earthquake

Description

An earthquake is caused by a sudden displacement within the earth. Strong and destructive earthquakes usually result from the rupturing or breaking of great masses of rocks far beneath the surface of the earth. The ultimate cause of these deep ruptures has not been established. All earthquakes produce both vertical and horizontal ground shaking. This ground movement begins at the focus or hypocenter, deep in the earth, and spreads in all directions. The felt motion is the result of several kinds of seismic vibrations. The primary, or P, waves are compressional. The secondary, or S, waves have a shear motion. These body waves radiate outward from the fault to the ground surfaces where they cause ground shaking.

The fast moving P waves are the first waves to cause the vibrations of a building. The S waves arrive next and may cause a structure to vibrate from side to side. Rayleight and Love waves (surface waves), which arrive last, cause low-frequency vibrations and are more likely than P and S waves to cause tall buildings to vibrate. Surface waves decline less rapidly than body waves, so as the distance from the fault increases, tall buildings located at relatively great distances from the epicenter can be damaged

Geologists have found that earthquakes tend to reoccur along faults, which reflect zones of weakness in the Earth's crust, a theory known as plate tectonics (Kafka, 2013). A fault is a fracture in the Earth's crust along which two (2) blocks of the crust have slipped with respect to each other. Faults are divided into three main groups, depending on how they move. Normal faults occur in response to pulling or tension; the overlying block moves down the dip of the fault plane. Thrust (reverse) faults occur in response to squeezing or compression; the overlying block moves up the dip of the fault plane. Strike-slip (lateral) faults occur in response to either type of stress; the blocks move

horizontally past one another. Most faulting along spreading zones is normal, along subduction zones is thrust, and along transform faults is strike-slip. Even if a fault zone has recently experienced an earthquake there is no guarantee that all the stress has been relieved.

The focal depth of an earthquake is the depth from the Earth's surface to the region where an earthquake's energy originates (the focus). Earthquakes with focal depths from the surface to about 70 kilometers (43.5miles) are classified as shallow. Earthquakes with focal depths from 70 to 300 kilometers (43.5 to 186 miles) are classified as intermediate. The focus of deep earthquakes may reach depths of more than 700 kilometers (435 miles). The focuses of most earthquakes are concentrated in the crust and upper mantle. The depth to the center of the Earth's core is about 6,370 kilometers (3,960 miles), so even the deepest earthquakes originate in relatively shallow parts of the Earth's interior. The epicenter of an earthquake is the point on the Earth's surface directly above the focus. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.

Earthquakes beneath the ocean floor sometimes generate immense sea waves or tsunamis. These waves travel across the ocean at speeds as great as 960 kilometers per hour (597 miles per hour) and may be 15 meters (49 feet) high or higher by the time they reach the shore.

Liquefaction, which happens when loosely packed, water-logged sediments lose their strength in response to strong shaking, causes major damage during earthquakes.

Location

Rhode Island is located in a region of the North American plate and falls within seismic zone 2A with 8-16% ground acceleration, which translates to a "moderate" seismic hazard (Petersen et al. 2008 USGS; UBC Seismic Zone Map). This means that people may experience moderate intensity shaking that can lead to slight damage during an earthquake event (FEMA Earthquake Hazard maps). There are no significant geologic fault lines in Rhode Island or New England, and the USGS Earthquake Hazards Program identifies all of Rhode Island as occurring in a low seismic risk area (<2%g peak acceleration). Earthquakes that occur in the northeast, which is considered an intraplate area, do not meet the assumptions of the plate tectonic theory since there is no obvious relationship between earthquake occurrence and fault lines in intraplate areas (Kafka, 2013).

A commonly accepted explanation for the occurrence of earthquakes in the northeast is that "ancient zones of weakness" are being reactivated by the present stress field (Kafka, 2013). This theory hypothesizes that pre-existing faults and other geologic features formed during ancient geological episodes persist today and that earthquakes occur when present-day stress is released along these zones of weakness (Kafka, 2013). Earthquakes occur infrequently

in Rhode Island and surrounding New England, but historically earthquakes originating in other states have been felt in various parts of Rhode Island.

Extent

The severity of an earthquake can be expressed in terms of both intensity and magnitude. Intensity is based on the observed effects of ground shaking on people, buildings, and natural features. It varies from place to place within the disturbed region depending on the location of the observer with respect to the earthquake epicenter. Although numerous intensity scales have been developed over the last several hundred years to evaluate the effects of earthquakes, the one currently used in the United States is the Modified Mercalli Intensity (MMI) Scale. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It does not have a mathematical basis; instead it is an arbitrary ranking based on observed effects. Magnitude is related to the amount of seismic energy released at the hypocenter of the earthquake. It is based on the amplitude of the earthquake waves recorded on instruments which have a common calibration. The magnitude of an earthquake is thus represented by a single, instrumentally determined value. The magnitudes of seismic waves are recorded on instruments called seismographs, using the Richter Magnitude Scale. The Richter scale is not used to express damage. An earthquake in a densely populated area which results in many deaths and considerable damage may have the same magnitude as a shock in a remote area that does nothing more than frightens the wildlife. Large magnitude earthquakes that occur beneath the oceans may not even be felt by humans.

Earthquakes with magnitude of 2.0 or less are usually called micro earthquakes. They are not commonly felt by people and are generally recorded only on local seismographs. Events with magnitudes of 4.5 or greater are strong enough to be recorded by sensitive seismographs all over the world. Great earthquakes, such as the 1964 Good Friday earthquake in Alaska, have magnitudes of 8.0 or higher. On the average, one (1) earthquake of such size occurs somewhere in the world each year. Although the Richter scale has no upper limit, the largest known shocks have had magnitudes in the 8.8 to 8.9 range. Recently, another scale called the moment magnitude scale has been devised for more precise study of great earthquakes. Only a couple earthquakes of MMI Scale V or greater have been centered in Rhode Island, including the 1951 South Kingstown earthquake of magnitude 4.6 on the Richter scale.

Impacts from earthquakes can be severe and cause significant damage. Ground shaking can lead to the collapse of buildings and bridges and disruption of gas and electric lines, phone service, and other critical utilities. Death, injuries, and extensive property damage are possible vulnerabilities from earthquakes. Some secondary hazards caused by earthquakes may include fire, hazardous material release, landslides, flash flooding, avalanches, tsunamis, and dam failure.

Earthquakes can cause flooding due to the tilting of the valley floor; dam failure and seiches in lakes and reservoirs. Flooding can also result from the disruption

of the rivers and streams. Water tanks, pipelines and aqueducts may be ruptured or canal and streams altered by ground shaking surface faulting, ground tilting and land sliding.

Earthquake-caused fires are generally the result of broken natural gas lines. These types of fires were very evident in the 1906 and 1989 San Francisco earthquakes. Other types of fires may include oil refineries, electrical, gasoline stations and chemical spills. Earthquakes may also result in a hazardous materials spill.

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

1. Hard Rock: Due to the geological makeup of New England's base rock, seismic energy is conducted on a greater scale (four (4)-10 times that of an equivalent Richter magnitude earthquake in California)

2. Soft Soil: Many coastal regions of New England are made up of soft soils. These soils can magnify an earthquake as much as two times.

3. Structures: The New England region, being one (1) of the first settled areas of the United States, has an abundance of older, unreinforced masonry structures that are inherently brittle and very vulnerable to seismic forces.

4. Low Public Awareness of Vulnerability: Little public recognition of earthquake threat, and no established system of educating or informing the public of the threat or how to prepare for or respond during an earthquake. Therefore, higher losses will occur here than in other regions of the country.

Table 3-8. Richter Magnitude Scale

Richter Magnitude Scale	Modified Mercalli Intensity Scale
1.0 - 3.0	I
3.0 - 3.9	II - III
4.0 - 4.9	IV - V
5.0 - 5.9	VI - VII
6.0 - 6.9	VIII - IX
7.0 and higher	X and higher

Table 3-9. Modified Mercalli Intensity Scale

Defined MMI Rating	Description
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake.

	Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors, disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Previous Occurrence, Disasters, and Probability of Future Events

European settlers in Rhode Island noted the effects of a number of earthquakes beginning in the mid-17th century. Between 1776 and 2007, 38 earthquakes were recorded in Rhode Island, far fewer than any New England state. Most of these earthquakes measured low on the intensity scale, and are believed to have originated elsewhere, some as far away as Quebec. In 1883 an earthquake believed to have been centered on Rhode Island was felt (Intensity V effects) from Bristol to Block Island. On December 20 and 24 in 1940 there were strong

earthquakes centered around Lake Ossipee, New Hampshire that caused some damage in the epicentral area and caused Intensity V effects on the MMI scale in Newport, Rhode Island (USGS Rhode Island Earthquake History). The largest earthquake recorded in Rhode Island occurred on June 10, 1951 and was centered in Kingston with a 4.6 Richter Scale rating (North Kingstown NHMP, 2002).

Seismologists and geologists agree that earthquakes are impossible to predict with any degree of accuracy. Rhode Island is located in an area of "moderate" seismicity and "high" risk. Seismic risk applies to the seismic hazard, location demographics, and regional economics to the vulnerabilities of the structure or lifeline on the site. Seismologists have estimated that there is about a 50% probability of a very damaging magnitude 5.0 earthquake occurring anywhere in New England, in a 50-year period. Using the hazard ranking criteria, probability of future occurrence has been related to a Medium-Low probability of occurrence based on previous occurrences of earthquakes in Rhode Island. Vulnerability of property to seismic hazards is determined by the prevalence of earthquake-resistant construction (FEMA – Your earthquake risk).

Table 3-10. Earthquakes Felt in Rhode Island

Date	Epicenter	Richter Scale	Effects in RI
February 28, 1925	St. Lawrence River, Canada	7.0	Intensity V effects felt on Block Island and in Providence; intensity IV in Charlestown.
November 19, 1929	Grand Banks, Newfoundland	7.2	Moderate vibrations were felt on Block Island and in Chepachet, Newport, Providence, and Westerly.
November 1, 1935	Quebec	6.2	Intensity IV effects felt on Block Island and in Providence and Woonsocket.
December 20 & 24, 1940	Lake Ossipee, New Hampshire	N/A	Intensity V effects felt in Newport, Intensity IV effects in Central Falls, Pascoag, Providence, and Woonsocket, and Intensity I - III effects in Kingston, New Shoreham, and Wakefield.
September 4, 1944	Massena, New York		Intensity I - III effects reported in Kingston, Lonsdale, Providence, Wakefield, and Woonsocket.
October 16, 1963	Coast of Massachusetts	4.5	Intensity V effects in Chepachet, less intense effects in northern RI.
December 7, 1965	N/A	N/A	Windows and doors rattled and trees and bushes were shaken slightly (Intensity V effects) in Warwick. Small objects and furnishings shifted at Bristol.
February 2, 1967	N/A	2.4	Intensity V effects in Middleton, Newport, and North Kingstown, but no damage was sustained; also felt in Adamsville and Jamestown.
February 3, 1973	N/A	N/A	Noises like an explosion or sonic boom shook houses and rattle windows throughout Rhode Island and eastern Massachusetts, but seismographs recorded nothing.
June 14, 1973	Western Maine	5.2	Intensity IV effects in Charlestown, and Intensity I - III in Bristol, East Providence, Harmony, and Providence.
March 11, 1976	N/A	3.5	Intensity VI effects felt from Oakland south to Newport.

Source: USGS, Earthquake History of Rhode Island, http://earthquake.usgs.gov/earthquakes/states/rhode_island/history.php

Table 3-11. New England States Historic Earthquakes

State	Years of Record	# of Earthquakes
Connecticut	1568-1989	137
Maine	1766-1989	391
Massachusetts	1627-1989	316
New Hampshire	1728-1989	270
Rhode Island	1766-1989	32
Vermont	1843-1989	69
Total number of earthquakes within New England: 1215 Total number of earthquakes in the Northeast, 1538-1989: 4498		
Information in this table has been reproduced in tabular form, and comes from the NESEC publication (to 1989)		

3.2.2. Wildfire Hazard

Description

Wildfires are fueled by natural cover, including native and non-native species of trees, brush and grasses, and crops along with weather conditions and topography. While available fuel, topography, and weather provide the conditions that allow wildfires to spread, most wildfires are caused by people through criminal or accidental misuse of fire (Rhode Island Emergency Management Agency, 2014).

Wildfires pose serious threats to human safety and property in rural and suburban areas. They can destroy crops, timber resources, recreation areas, and habitat for wildlife. Wildfires are commonly perceived as hazards in the western part of the country; however, wildfires are a growing problem in the wildland/urban interface of the eastern United States, including Rhode Island (Rhode Island Emergency Management Agency, 2014).

Wildfires are dependent upon the quantity and quality of available fuels. Fuel quantity is the mass per unit area. Fuel quality is determined by a number of factors, including fuel density, chemistry, and arrangement. Arrangement influences the availability of oxygen. Another important aspect of fuel quality is the total surface exposed to heat and air. Fuels with large area-to-volume ratios, such as grasses, leaves, bark and twigs, are easily ignited when dry (Rhode Island Emergency Management Agency, 2014).

Climatic and meteorological conditions that influence wildfires include solar insulation, atmospheric humidity, and precipitation, all of which determine the moisture content of wood and leaf litter. Dry spells, heat, low humidity, and wind increase the susceptibility of vegetation to fire. In Rhode Island, common

factors leading to large fires include short-term drought, humidity below 20%, and fuel type (Rhode Island Emergency Management Agency, 2014).

Various natural and human agents can be responsible for igniting wildfires. Natural agents include lightning, sparks generated by rocks rolling down a slope, friction produced by branches rubbing together in the wind, and spontaneous combustion (Rhode Island Emergency Management Agency, 2014).

Human-caused wildfires are typically worse than those caused by natural agents. Arson and accidental fires usually start along roads, trails, streams, or at dwellings that are generally on lower slopes or bottoms of hills and valleys. Nurtured by updrafts, these fires can spread quickly uphill. Arson fires are often set deliberately at times when factors such as wind, temperature, and dryness contribute to the fires' spread (Rhode Island Emergency Management Agency, 2014).

The U.S. Forest Service has established the National Fire Danger Rating System (NFDRS) to determine the daily risk to fire experienced by different regions of the country (Table 3-12). The system uses mathematical formulas including wind speed and fuel type to determine a fire index. The fire indexes are grouped into five groups based on severity, and each group has an associated class rating (Classes 1 through 5) and an associated fire risk level. A fire index of zero occurs when there is snow on the ground or there has been a prolonged period of substantial rain (Rhode Island Emergency Management Agency, 2014).

Table3-12. National Fire Danger Rating System

Fire Index	Rating	Description
0	Class 1	No rating
1-30	Class 2	Low danger
31-60	Class 3	Medium danger
61-80	Class 4	High danger
81+	Class 5	Extreme

Source: Rhode Island Department of Environmental Management, http://www.dem.ri.gov/programs/bnatres/forest/pdf/firewthr.pdf

Location

Jamestown has an abundance of open space thanks to its active conservation and land preservation program (Open space, agriculture, and recreation Part E of town plan). Approximately 1,493 acres comprising 25% of Jamestown's land is protected either permanently or temporarily as open space (Town of Jamestown, 2002). Although this large area of open space in Jamestown contributes to its pleasant, rural character, it also translates to available fuel that can raise the potential risk of wildfires. Wildfires that occur in undeveloped, natural areas may be less accessible to fire protection services, thus further increasing the risk of wildfire.

Like the rest of Rhode Island, Jamestown generally exhibits a humid continental climate, with hot, rainy summers and cold, snowy winters, and thus often has a low or medium (Class 1 or 2) fire class rating (USGS, 1989). However, wildfires can and do occur at any time of year (RIDEM *a*). Dry, windy weather does occur, and fire conditions can be exacerbated by drought. The peak fire season in Rhode Island is typically between March and May (RIDEM *a*). During this time of year there is no leaf canopy so the sun dries out grasses and fallen leaves (considered one hour fuel sources) and dormant brush, dead twigs, and small branches (ten hour fuels) (RIDEM *a*). Windy conditions and the low humidity of the spring (typically less than 40%) further contribute to increased fire risk (RIDEM *a*). Although less common, wildfires may be a risk during the summer and fall months particularly if drought conditions occur (RIDEM *a*).

Open air burning, the act of any fire in the outdoors or in a structure not completely enclosed by walls and a roof, require a written permit from the Jamestown Fire Department when risk of wildfires is low. Open air burning can increase the risk of wildfires and if the risk of wildfires is heightened the decisions of permit issuance is superseded by state law (RIDEM *a*).

Extent

Wildfires, commonly called "forest fires" or "brush fires" have the potential to destroy valuable natural resources, damage real estate property, and threaten people's lives and livelihoods (RIDEM *a*). The accurate prediction of the potential risk of a wildfire, and the forewarning of dangerous wildfire conditions can help reduce the incidence and seriousness of wildfires (RIDEM *a*). It can also provide firefighters the critical time needed for important preparation and readiness for wildfire suppression, as well as assist decision makers in the appropriate uses and activities for the public at large during times of extreme fire danger to aid in the prevention efforts (RIDEM *a*). RIDEM's Division of Forestry is responsible for predicting the risk of wildfires using a modified NFDRS to account for local conditions (RIDEM *a*).

Vulnerability to wildfire is influenced by a variety of factors, such as land cover conditions, weather, and the effectiveness of land management techniques RIDEM *a*. Highly urbanized areas are less vulnerable to wildfire, but suburban neighborhoods located at the state's Wildland Urban Interface (WUI), the area where structures and human development meet and intermingle with undeveloped wild land, are very vulnerable to wildfire. Individual buildings may be more or less vulnerable to damage from wildfire based on factors such as the clear distance around the structure, and the structure's construction materials. Wildfire primarily impacts timber and forest ecosystems, although the threat to nearby buildings is always present.

Previous Occurrence, Disasters, and Probability of Future Events

While wildfires are not especially common in Rhode Island, they have happened and their effects have been devastating. In 1894 an immense woodland fire burned along Post Road (Route 1) between Wakefield and Westerly and destroyed timber supplies and Charlestown as well as several farmhouses (New York Times, 1894). In 1930 and 1942 major forest fires swept through western Rhode Island burning tens of thousands of acres of timber (University of Rhode Island Cooperative Extension).

3.2.2.10 Drought and Extreme Heat

Description

Drought is characterized as a continuous period of time in which rainfall is significantly below the norm for a particular area. The American Meteorology Society defines drought as a period of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance. Drought differs from other natural hazards in that it is not something that occurs suddenly. Rather, a drought evolves over months or even years and, while causing very little structural damage, can have profound economic, environmental, and social impacts (Rhode Island Emergency Management Agency, 2014).

Four methods are used to define the severity of drought: meteorological, hydrological, agricultural, and socioeconomic. Meteorological drought refers to a reduction in the normal rainfall for a given geographic area. This needs to be area-specific, as the average rainfall can vary greatly in different areas (Rhode Island Emergency Management, 2014).

Hydrological drought is based on the amount of surface and groundwater relative to normal levels. Agricultural drought deals with the amount of moisture in soils available for plants. The last, socioeconomic drought, measures the impact that any or all of the first three have on people and businesses (Rhode Island Emergency Management, 2014).

Characteristics and impacts of drought differ in many ways, so it is difficult to quantify drought. An existing index called the Palmer Drought Severity Index (PDSI Table 3-13) that used temperature and precipitation levels to determine dryness, measuring a departure from the normal rainfall in a given area. The PDSI uses temperature and precipitation levels to determine dryness. The advantage of the PDSI is that it is standardized to local climate, so it can be applied to any part of the country to demonstrate relative drought or rainfall conditions. A monthly PDSI value below -2.0 indicates moderate drought, and a value below -3.0 indicates severe drought (Rhode Island Emergency Management, 2014).

Table 3-13. Palmer Drought Severity Index

Severity	Index Value
Extreme Drought	-4 or less
Severe Drought	-4 to -3
Moderate Drought	-3 to -2
Mild Drought	-2 to -1
Incipient Dry Spell	-1 to -0.5

Rhode Island, as with most states within the United States, use both the PDSI and the Crop Moisture Index (CMI) as indices for a drought occurrence. The CMI (a derivative of the PDSI) provide information on the short-term or current status of purely agricultural drought or moisture surplus. The PDSI is most effective for determining long-term drought conditions, while the CMI is effective at helping determine short-term droughts (Rhode Island Emergency Management, 2014).

Drought levels are measured using several major hydrologic indices; precipitation, groundwater, and surface water are evaluated in terms of departure from normal. Normal is defined as the statistical average of the data for the period of record. It is important to note that time of year may influence the process considerably. In the fall and winter months, the CMI and PDI may react slowly but decline rapidly once the spring "green-up" occurs. The lag between surface water levels and groundwater levels could similarly skew the relative importance and number of indicators that are critical to determining the level of drought. In the final two stages, groundwater and reservoir data particular to the supplier will be used in conjunction with statewide data to determine drought levels (Rhode Island Emergency Management, 2014).

1. Palmer Drought Index (PDI): is an index that reflects soil moisture and weather conditions, including temperature. It is compiled by the NWS and the NCDC.

2. CMI: is an index that reflects short-term soil moisture conditions, particularly as it pertains to agriculture. The agricultural sector is usually the first to be affected because of its heavy dependence on stored soil water, which can be rapidly depleted in extended dry periods.

3. Precipitation: data is collected by the NWS at eight (8) data points and reported by county. A drought phase determination is based on conditions relative to normal in three (3), six (6), and 12-month intervals.

4. Groundwater levels: are monitored by the USGS from 38 observation wells. A drought phase determination is based on the number of months groundwater levels are below normal (lowest 25% of period of record). Local water suppliers also monitor public wells in order to make seasonal water availability comparisons.

5. Stream flow: conditions are monitored by the USGS from 21 near-real-time stations with 30 or more years of record. A drought phase determination is based on the number of months that stream flow levels are below normal compared to historical trend data.

6. Surface water reservoir levels: data is typically reported by water suppliers, relative to normal conditions or percent "full". A drought phase determination considers historic monthly averages of small, medium, and large index reservoirs.

The Rhode Island Drought Steering Committee assigns drought levels, for the seven (7) designated drought regions in the state, based on hydrological indices such as precipitation, groundwater, stream flow, and the PDI as well as local supply indices such as static groundwater levels and reservoir levels (Table X). The Normal, Advisory, and Watch levels are issued statewide. The Warning and Emergency levels are issued on a regional basis and consider local conditions, source of water supply, and water storage capacity issues (Rhode Island Emergency Management, 2014).

Location

Jamestown's largest land use issue is meeting demand for potable water (Town Comprehensive Plan, part B). Although not recently the island has experienced consistent seasonal droughts for decades, increasing concern for maintaining water quantity as growth and development have steadily increased on the island over the last several decades (Town of Jamestown, 2002).

The principal water catchment area on Conanicut Island is the Jamestown Brook Watershed, which provides run off for both the North and South Reservoirs (Town of Jamestown, 2003). The watershed area of North Reservoir is 192 acres and the area of the reservoir is 25.4 acres with a usable depth of ten feet with a usable storage capacity of 60 MG (Town of Jamestown, 2003). North Reservoir usually fills to capacity in March and from May to November the water level declines until the filling cycle begins again (Town of Jamestown, 2003).

The watershed that feeds the South Reservoir is larger than that of the North Reservoir at 449 acres, however the storage capacity of the South Reservoir is limited to 8 million gallons due to its small size (4.7 acres). The municipal system rarely draws from this reservoir because the water contains high levels of colloidal organic material (Town of Jamestown, 2003). Due to these water quality limits, the South Reservoir is used only as a secondary public water supply (Joubert et al., 2003).

In addition to issues of the town meeting the water demands of those residents tied into the public water supply, the residents that rely on private water wells also periodically face water shortages. The Jamestown Shores neighborhood on the west side of the island, which has evolved from a summer cottage colony to

a high density development area of 2.8 dwellings per acre, sometimes reports dry wells and saltwater intrusion (Joubert et al., 2003).

Extent

The average annual precipitation Jamestown receives (40-43 inches/years) is generally lower than what the rest of the state receives as a whole (45-50 inches/year), which likely contributes in part to Jamestown's seasonal drought issues (Town of Jamestown, 2003). Town records indicate that average annual precipitation over the last 34 years is 43.4 inches (Town of Jamestown, 2003).

The town delivers water to 43 percent of its residents (and all of its businesses) from the North Pond reservoir, which has a capacity of 60 million gallons. The other 57 percent of Jamestown residents, those living in the northern and southern areas of the island, rely entirely on the island's sole source aquifer for their water. (A portion of the water delivered by the Town Water District is also extracted from the aquifer.)

The South Pond reservoir serves as a supplementary water source for the North Pond reservoir. South Pond has a 7-million-gallon capacity, but its water has a high concentration of organic sediments which precludes its use as drinking water until it is pumped into, and diluted by, the waters of North Pond (Town of Jamestown, 2003).

Based on the pumping record of the Jamestown municipal water system, the water system demand has stayed relatively constant since the late 1970s with an average consumption of 230 thousand gallons/day. However, this rate is 36,000 gallons in excess of the safe day yield (SDY) capacity of the North Pond reservoir (Town of Jamestown, 2003). Water use in Jamestown fluctuates seasonally, with a near doubling of 5 million gallons/month in the winter to over 9 million gallons/month in the summer (Town of Jamestown, 2003). This peak water demand coincides with the peak evapotranspiration rate when water loss from the surface of the reservoir is high and the recharge rate is at its lowest level (Town of Jamestown, 2003).

Because a large percentage of Jamestown residents are dependent on town-supplied drinking water, a prolonged drought would pose a major health hazard if its effects on the water supply were not mitigated with preventive measures. Additionally, economic impacts can result from a drought itself or, more indirectly, through conservation measures implemented because of a drought. Farmers can lose livestock or crops or pay substantially more to produce a year's crop. Jamestown, which was colonized as an agricultural community, still has a handful of working farms that can become vulnerable to drought and extreme heat. Jamestown also supports a tourist industry in the summer months. Use restrictions on water dependent uses at beaches and restrictions on fishing and canoeing in rivers or on golf courses could reduce the town's appeal to visitors causing reduced revenues from tourism. A drought also increases the risk of wildfires.

Previous Occurrence, Disasters, and Probability of Future Events

Extended droughts are rare in Rhode Island with a record of six major droughts (those lasting for more than one year) since 1929 (**Table 3-10**; Walker, 1990). The longest and most severe drought occurred in 1963-67 and affected most of the northeast (Walker, 1990). Water shortages affected most communities in Rhode Island and several municipal-supply wells were drilled to augment declining public supplies (Walker, 1990).

Jamestown suffered a highly unusual seasonal rainfall variation in 1993. Although the total accumulation for the year was 40.64 inches, only slightly below the long-term mean, the summer months were the driest on record, receiving a cumulative total of only 2.64 inches in May, June, and August (Town of Jamestown, 2003). This water shortage resulted in the depletion of North and South reservoirs and consequently the public water system was not able to meet local needs (Town of Jamestown, 2003). To meet demand, water had to be imported by National Guard tanker trucks for several months. An emergency water supply connection with the town of North Kingstown water supply system was also installed across the former Jamestown Bridge and water conservation measures were enacted (Joubert et al., 2003; Town of Jamestown Water, 2006). This system was replaced with a deployable hose system after the Jamestown Bridge was demolished. Although the island did not suffer any wildfires during the drought, the risk of wildfire was extremely high throughout this period. Currently, Jamestown maintains an emergency interconnection with North Kingstown's water system across the Jamestown Verrazano Bridge (Town of Jamestown, 2006).

Water shortages were also experienced in the following years of 1994 and 1995, and in response the town formed the Water Study Committee to improve the quality and quantity of potable water in Jamestown (Town of Jamestown, 2003). Since the committee's formation, Jamestown has developed a framework to manage the conservation and use of its water supply as well as emergency management plans in the event of another water shortage.

The current and future demand for water in Jamestown is a function of the population growth (Town of Jamestown, 2003). In the thirty year period from the 1960s to the 1990s Jamestown experienced nearly a doubling of its population, which mounted further pressure on water needs and spurred private well development in addition to increased demand from the Jamestown public water system (Town of Jamestown, 2003). In recent years however, the population growth of Jamestown has slowed with a decrease of 2.1% between 2005 and 2010, and modest projections of an average population growth of 0.8% from 2015-2040 (Rhode Island Statewide Planning Program, 2013). Therefore, with Jamestown's modest population projections and its proactive water management plans, the town is minimizing its risk for future droughts.

Table 3-14. Rhode Island historical droughts and locations

Date	Area Affected	Notes
1930-1931	Statewide	Estimated stream flow about 70% of normal.
1941-1945	Statewide – Particularly severe in Pawtuxet & Blackstone Rivers	Estimated stream flow about 70% of normal.
1949-1950	Statewide	Estimated stream flow about 70% of normal.
1963-1967	Statewide	Water restrictions and well replacements common.
1980-1981	Statewide – Groundwater deficient in eastern part of state	Considerable crop damage in 1980.
1987-1988	Southern part of state	Crop damage, $25 million.

Source: Rhode Island Hazard Mitigation Plan, 2014

3.3 Vulnerability

Vulnerability includes all populations and assets (environmental, economic and critical facilities) that may be at risk from the natural hazards. Vulnerability analysis measures the level of assets, populations, and resources within Jamestown. The vulnerability is a function of the built environment, local economy, demographics, and environmental uses of a given region.

The Town of Jamestown has updated their Natural Hazard Mitigation Plan to outline resources that address vulnerabilities and pressures the town faces: increasing development pressure, economic stability, open space preservation, public infrastructure and public facilities. Updating the plan will help facilitate a reduction in the actual or potential loss of life or property from a natural disaster. The town acknowledges that incorporating this plan and its mitigation initiatives (both pre-and post-disaster) into the Comprehensive Plan not only benefits the community by reducing human suffering, damages, and the costs of recovery, but will also help build and maintain the sustainability and economic health of the town over the long run.

3.3.1 Community Assets (exposure to loss)

Jamestown's community assets include its population, natural and cultural resources, the local economy, public infrastructure and public services and facilities. By examining and outlining the vulnerabilities of each of these assets, the town will be better prepared to respond to natural hazards that may affect them and therefore better protect their community assets.

3.3.1.1 People

As of 2010 Jamestown's population stood at 5,405, and is projected to increase modestly to 5,674 by 2040 (Rhode Island Population Projections, 2013). In contrast, the statewide population is expected to experience a slight decline from 2035-2040 (Rhode Island Population Projections, 2013). This decline will be accompanied by a shift in the state's age distribution towards older ages (Rhode Island Population Projections, 2013). The slight increase projected for Jamestown's population growth is anticipated to come from in-migration, however, Jamestown's age demographic appears to be shifting in a direction similar to the state's population (Jamestown Comprehensive Plan, 2014). According to the 2010 census the median age of Jamestown residents has increased 5.3 years from 44.2 in 2000 to 49.5 in 2010. As of 2010 there were approximately 845 children under the age of 15 in Jamestown, accounting for 15% of the population, and approximately 1,000 individuals 65 and older, accounting for 18% of the population (Table 3-15). If the aging trend of Jamestown residents continues it will have implications for how the town should respond to certain age demographics in an emergency.

Jamestown is home to a number group homes throughout the island that service the needs of the town's disabled population. According to 2000 census data Jamestown was home to 826 residents with a disability. Additionally, there are three elderly housing complexes on Pemberton Avenue in the downtown area, which comprise the only elderly housing community on the island. Residents with disabilities, as well as the elderly population, may need assistance in case of an evacuation order. To expedite assistance response, each group home will be identified and evaluated in terms of its capacity and access to evacuation routes, thereby ensuring that any residents of those facilities can be assisted in the event of a natural disaster or evacuation. In addition to this town-wide initiative, high-risk residents, which include those with disabilities, chronic conditions, and special healthcare needs are encouraged to enroll in the Rhode Island Special Needs Emergency Registry (RIDOH). This registry provides a reliable system for the identification of Rhode Islanders who may require special assistance during emergencies (RIDOH). It is important to know the number of people that are considered to be at a higher risk in a natural hazard event in order to plan for their needs and safety.

Table 3-15. Age Distribution of the Population of Jamestown, 2010

Age range	Number	Percent of population
Under 5 years	187	3.5
5 to9 years	266	4.9
10 to 14 years	355	6.6
15 to 19 years.	333	6.2
20 to 24 years	159	2.9
25 to 29 years	138	2.6
30 to 34 years	155	2.9
35 to 39 years	244	4.5
40 to 44 years	344	6.4
45 to 49 years	448	8.3

50 to 54 years	586	10.8
55 to 59 years	607	11.2
60 to 64 years	589	10.9
65 to 69 years	373	6.9
70 to 74 years	224	4.1
75 to 79 years	140	2.6
80 to 84 years	147	2.7
85 years and over	110	2.0
Median Age (male)	49.9	
Median age (female)	51.3	

3.3.1.2 Economy

Approximately 83 percent of the town's revenue is generated from property taxes (80 percent residential and 3 percent commercial). Should any of the tax bases be destroyed as a result of a natural disaster, the immediate effect would be that remaining property owners would carry an increased property-tax burden. It is therefore very important to protect property as well residents from natural disasters. However, as Jamestown's population continues to grow, so does the financial burden of this protection. Drafting new codes and regulations will help reduce the potential damage from a natural disaster and the interruptions of local commerce. These codes range from building codes and design standards to subdivision regulations. The March 1, 2010 adoption by the Town Council of a Community Flood Plain Ordinance for Special Flood Hazard Areas is an example of the protective regulations enacted by the town.

Jamestown's economy is constrained by is island geography; small land mass, finite commercially zoned property, high land costs, relatively small population, and close proximity to regional shopping areas. At the same time, the town's easy accessibility offers greater off-island employment opportunities for residents of Jamestown (Jamestown Comprehensive Community Plan, Economic Development, 2002).

In recent years, the main components of the economy have been businesses serving residents and visitors to the town, including recreation and leisure services, boating and marine services, retail shops, restaurants, and home-based businesses. The Rhode Island Economic Development Corporation (EDC) lists the largest private industry employment sector in Jamestown as the service industry, accounting for 44 percent of private industry employment. Retail trade is the second largest, containing 25 percent of private industry employment. The average business in Jamestown employs four persons. The Town of Jamestown is the largest single employer on the Island, with over 100 municipal employees and 89 (20+ hours per week) school department employees (Jamestown Comprehensive Community Plan, Economic Development, 2002).

The commercial area of Jamestown most vulnerable to a natural disaster is the downtown area. Any disruption to this area would have serious ramifications for town residents. Due to Jamestown's geography, this becomes a concern

when a storm event occurs. The bridges are closed when wind speed reaches approximately 68 miles per hour. When the bridges closed, people are dependent upon those services provided within the town, including McQuade's Market, Baker's Pharmacy, Bank of Newport, the gas/convenience marts and Jamestown Family Practice Center. Damage to these businesses could cause major economic and social hardship.

The summer season boosts Jamestown's economy and benefits many local service and retail businesses (Jamestown Comprehensive Community Plan, Economic Development, 2002). A number of factors have contributed to the development and success of the downtown commercial district in the past ten years. Access to the Island has improved with the completion of the Jamestown-Verrazano Bridge in 1992 and the John Eldred Parkway (Route 138) in 1994, which connected the two bridges. The Chamber of Commerce, working with volunteers, provided signage to help direct visitors from the limited access highway to the village commercial district. In addition, the State and National economies have improved, providing visitors and residents with more income to spend locally (Jamestown Comprehensive Community Plan, Economic Development, 2002).

3.3.1.3 Built Environment

The damage to and destruction of the built environment, particularly in the critical lifeline sectors (Communications, Emergency Services, Energy, Healthcare and Public Health, Transportation, Water) represents enormous economic, social, and general functional costs to a community, while also impeding emergency response and recovery activities. Since Jamestown is a coastal community, it has increased vulnerability to extreme weather events like hurricanes. To better prepare for natural hazard events this report examines elements of Jamestown's built environment and addresses vulnerabilities in the action section.

Existing structures

Jamestown's local government is dependent on its existing structures to carry out its municipal functions. Without these existing structures, the town would face a limited capacity in fulfilling its administrative and departmental responsibilities. Essential town structures are as follows:

- Town Hall: The Town Hall is located at 93 Narragansett Avenue in a two-story wood structure built in 2007 containing 10,000 square feet plus a Town Council Chambers and full basement. The Town Hall houses the Town Clerk, Tax Assessor, Building Inspector, Finance Department, Board of Canvassers, Town Planner, Town Administrator, and the Council Chambers. The Town Hall building has been well maintained. At the present time, numerous historical archives/records are stored in the vault, which is also utilized as an active public-records research area. An additional vault is located in the basement and is

actively used by the Jamestown Historical Society for storage of Town historical archives.

- Town Parks and Recreation: The Town's Parks and Recreation office is located at the East Ferry area at 41 Conanicus Avenue. This building houses the Parks and Recreation Department office, equipment storage room, game room, two rest rooms, gymnasium, and platform. The Recreation Center was built by the federal government in 1939 and functioned as a United Services Organization building during the Second World War. The building was donated to the town during the 1950's.

  The Parks and Recreation building serves as a community center for Jamestown. Activities that take place here include aerobics, volleyball, junior and senior open recreation, community theatre, community art show, crafts show, basketball and voting. Other activities include the Substance Abuse Prevention Task Force functions, dances, musical productions, gymnastics, weight training, meetings, exercise for physically and mentally challenged, winter baseball training, teen center, and road race and bicycle race headquarters. Hundreds of people utilize this facility weekly. Additionally, this department services three town recreational areas: Fort Getty Park, Pavilion and Campground; Mackerel Cove Town Beach; and Shores Beach "Head's Beach".

- Educational Facilities: The Town of Jamestown provides educational services on the Island for preschool through grade 8. For grades 9 through 12, students are transported to the North Kingstown High School where the town contracts for educational services. The school facilities consist of two schools, the Lawn Avenue School and the Melrose Avenue School. The Melrose Avenue School was constructed in 1991 and serves pre-school through grade 4. The Lawn Avenue School serves Grades 5 through 8.

- Philomenian Town Library: The Philomenian Library is located on North Road near the center of town. The facility is approximately 10,500 square feet and is in excellent condition. The original library was constructed in 1971 entirely from private funds. The Philomenian Library meets and reflects the needs of the community by providing all ages with relevant and appropriate library materials and services. The Library seeks to educate, inform, entertain and enlighten through both tradition and new technologies and also provides a center for meeting and learning.

- Senior Center: The Senior Center was funded with the help of the Senior Citizen Study Commission's finding plans. State grants and donations from non-profit foundations were also used to develop the facility. The Senior Center completed renovation of the Grange on West Street in 1997.

- Police Station: The Jamestown Police Department is located on 250 Conanicus Avenue, located across the street from the municipal golf course. It is the mission of the Jamestown Police Department to protect and to provide for the public safety of the general public, and to enforce the laws of the State of Rhode Island and the ordinances of the Town of Jamestown. The Police Department's mission is also to create a proactive partnership with the residents of the Town of Jamestown that best serves the needs of the community and to attain a high quality of life for all. The police station houses a radio room, office space, three cells, confidential office area, locker rooms, photo lab, with filing and storage space. The space is approximately 5,000-square feet.

- Fire Department: The town's fire station is located on 50 Narragansett Avenue in the center of the downtown. Fire protection in Jamestown is provided to its residents through a volunteer fire department of over 100 persons. The fire station houses the fire rescue equipment, a dispatch room, and a large meeting area on the second floor. The department has aging equipment that is replaced on an as needed basis. Two tank trucks have a capacity of 1800 gallons each. The Oil Skim boat, received from the DEM in 1999, handles minor incidents in the bay. The department also has its own air purification system which allows the Department to compress their own air. A new rescue boat was added to the fleet in 2004 which participates in the Rhode Island Marine Task Force that services Narragansett Bay and the waters of Rhode Island.

- Ambulance Barn: Jamestown provides Basic Life Support service to its residents via a volunteer Jamestown Fire Department Emergency Medical Services. The Ambulance Barn is located on 11 Knowles Court and provides space for the 2 ambulance vehicles. They have plans to upgrade service to Advanced Life Support service as of January 2015.

- Wastewater Treatment Plant: The towns Wastewater Treatment Plant is located on a 7-acre parcel at Taylor's Point in the central area of Jamestown. This facility purifies approximately 500,000 gallons of wastewater daily and has greatly improved environmental quality and alleviated potential health problems in the town (Jamestown Comprehensive Community Plan, Public Services and Facilities, 2002; RIDEM News Release, 1-27-2010). The treatment facility employs extended aeration and chlorination treatment systems and serves approximately 2,100 residential and commercial customers (RIDEM Wastewater Treatment Facilities, 2014).

- Water Treatment Plant:

- Public Works Highway Garage: The new highway garage facility occupied in 2008 provides the Town Highway Department and its employees ample indoor storage space with three heated bays, as well as a sign shop, male and female locker rooms, a meeting and lunch room and office space for the superintendent.

Infrastructure

Public Water Supply

The Jamestown public water system dates back to the 1890s, when it was operated as a private company. In 1969, the town purchased the system, which consists of two reservoirs, and a water treatment facility (Jamestown Comprehensive Community Plan, Public Services and Facilities, 2002). The North Reservoir has a watershed of approximately 192 acres and a water body of 28 acres with a net usable water volume of 51 million gallons. The South Reservoir has a watershed of approximately 448 acres and a water body of 7.3 acres with a net useable volume of 8 million gallons. The two reservoirs are interconnected and deliver water to the treatment facility through a 10-inch PVC main. The total maximum safe day yield for the North Reservoir is 194,000 gallons and 89,000 for the South Reservoir (Jamestown Water Supply Management Plan, 2006). Additionally, Two bedrock wells, JR-1 (installed 1996) and JR-3 (installed 2004) are used to supplement available water supply at a rate of approximately 50,000 gpd, each (Jamestown Water Supply Management Plan, 2006). Additionally, the town has a one million-gallon capacity steel standpipe for water storage (Jamestown Comprehensive Community Plan, Public Services and Facilities, 2002). It was constructed in 1974 and refurbished in 1998 and stores approximately 950,000 gallons. It is located at the highest point in the system and distributes water through gravity supply (Jamestown Comprehensive Community Plan, Public Services and Facilities, 2002).

The water system employs a pretreatment facility located at South Reservoir (Jamestown Water Supply Management Plan, 2006). This facility pretreats between 180,000 to 350,000 gallons per day. Pretreatment consists of pH adjustment, chlorine dioxide (ClO2) bleaching for odor, color, and taste, and flow monitoring. A new water treatment and filtration plant with automated controls was constructed in 1991 (Jamestown Water Supply Management Plan, 2006). The water treatment process is upflow "clarafloculator" filtration package units, pH adjustment, disinfection, and corrosion control (Jamestown Water Supply Management Plan, 2006).

The transmission and distribution system consists of upwards of 20.5 miles of asbestos cement, cast iron, and polyvinyl chloride (PVC) pipeline, the majority of which is less than 20 years in age and ranges in size from 6 to 12-inch. New and replacement main sections consist predominantly of PVC pipe (Jamestown Water Supply Management Plan, 2006).

Jamestown began purchasing water from North Kingstown in 1993 on an emergency basis through a pipeline laid by the National Guard and Jamestown Public Works across the former Jamestown Bridge (Jamestown Comprehensive Community Plan, Public Services and Facilities, 2002). When the Jamestown bridge was demolished in 2006, the town purchased, with the

assistance of the Rhode Island Department of Transportation (RIDOT), three hose reels with 8,000 linear feet of six-inch flexible piping that can be deployed on the walking area of the new bridge on an as-needed basis. The interconnection has the capability of supplying the Jamestown Water Department (JWD) with up to 200,000 gallons daily (Jamestown Water Supply Management Plan, 2006).

In 2008 Jamestown's aquifer was designated a sole source aquifer by the EPA under the Safe Drinking Water Act (EPA Sole Source Aquifer Program). This designation means that no commitment for federal financial assistance may be provided for any project which the EPA determines may contaminate the aquifer so as to create a hazard to public health (Sole Source Aquifer Program, EPA). Additionally, a sole source aquifer designation has the added benefit of increasing public awareness about the importance of ground water resources (Sole Source Aquifer Program, EPA). Approximately 57% of island residents live outside of the area serviced by the public Jamestown Water District and rely solely on private water supply wells (Petition for Sole Source Aquifer). The other 43% of residents rely on municipal water provided by the Jamestown Water District (Federal Register Vol. 73 No. 158, Conanicut Island Sole Source Designation).

The source and distribution system is 100% metered. The water department staff is responsible for the daily operation and maintenance of the water system that also includes metering and billing of customers (Jamestown Water Supply Management Plan, 2006). The JWD is operated as an "Enterprise Fund Agency" within the municipal corporation of the Town of Jamestown (Jamestown Water Supply Management Plan, 2006). The town has established enterprise funds for operations that are organized to be self-supporting through user charges (Jamestown Water Supply Management Plan, 2006). It is the intent that all costs of providing the services to the general public on a continuing basis be financed or recovered fully through user charges (Jamestown Water Supply Management Plan, 2006).

Wastewater Treatment Plant

The Towns Wastewater Treatment Plant is located on a 7-acre parcel at Taylor's Point in the central area of Jamestown. The Plant was constructed in 1978 and in 2000 the town passed a bond referendum for $5,500,0000 to upgrade the facility (Jamestown Comprehensive Community Plan, Public Services and Facilities, 2002).

The Plant receives sewage from the existing sanitary sewers that previously discharged into Narragansett Bay. This facility purifies approximately 500,000 gallons of wastewater daily and has greatly improved environmental quality and alleviated potential health problems in the town (Jamestown Comprehensive Community Plan, Public Services and Facilities, 2002; RIDEM News Release, 1-27-2010). The treatment facility employs extended aeration and chlorination treatment systems and serves approximately 2,100 residential and commercial customers (RIDEM Wastewater Treatment

Facilities, 2014). In 2010 the EPA awarded the town's wastewater treatment facility staff with a regional excellence award for their overall excellence in managing the complex operations and maintenance of the treatment facility during facility upgrade construction (RIDEM News Release, 1-27-2010). Additionally, Jamestown's facility is one of only two plants in Rhode Island that recycle a portion of its treated effluent for reuse; Jamestown's treated effluent assists in the irrigation of the Jamestown Golf Course (RIDEM News Release, 1-27-2010). The receiving waters of the remaining treated effluent are Dutch Island Harbor and the East Passage of Narragansett Bay (RIDEM Wastewater Treatment Facilities, 2014).

Roads

The Town of Jamestown has 77.6 miles of road; the State has jurisdiction over 21.6 miles of the Island's roads and the municipality owns 56 miles (Jamestown Comprehensive Plan, Circulation 2002). The major commuter roadway is John Eldred Parkway (Route 138), which runs across the island from bridge to bridge (Jamestown Comprehensive Plan, Circulation 2002). Access from the mainland portion of southern Rhode Island is achieved via the Jamestown Verrazano Bridge, which is maintained by RIBTA. Jamestown is connected to Aquidneck Island and the rest of the east bay area via the Newport Claiborne Pell Toll Bridge that is owned and operated by the RI Turnpike and Bridge Authority. Generally, the state roads are in good condition; the local roads are in fair condition and are being upgraded by the schedule described in the Department of Public Works Pavement Management Plan. The town is responsible for paving local roads (Jamestown Comprehensive Plan, Circulation 2002).

Jamestown residents depend heavily upon private automobiles for off island travel due to the limited amount of commercial, employment, and public transportation opportunities on the Island (Jamestown Comprehensive Plan, Circulation 2002).

Bridges

Because Jamestown is an island, bridge access and safety is an important issue to the town. Jamestown's western shore is accessed by the Jamestown-Verrazano Bridge, a fairly new bridge constructed in 1992. Jamestown's eastern shore is accessed by the Newport Bridge, which was opened in 1969 (Jamestown Comprehensive Plan, Circulation 2002). Each bridge is four lanes wide, with two lanes in each direction. The Jamestown Verrazano Bridge is in very good condition. The Newport Bridge, being significantly older, is currently being repainted and is expected to be completed within the 2014 season (RITBA Construction Updates). On-call maintenance work, such as patching existing roadway, is carried out on an on-going basis (RITBA Construction Updates). The bridges are vital for the safety and transportation needs of Jamestown residents, and it is imperative for the state/RIBTA to maintain them to ensure that, in the event of a disaster

residents have an escape route off the island. The bridges are closed to traffic during storm events when there are sustained winds greater than 68 miles per hour. This has significant impact on Jamestown's emergency preparedness and action.

Electrical Network

Jamestown's electrical supply is provided via underwater cable from Newport. On June 11, 2000, a cruise ship anchor damaged the two submarine electricity supply cables and disrupted service to more than 3,000 Jamestown residents for 17 hours to 5 days in some cases. The older of the two cables had irreparable damage. The cables were in close proximity to each other, which made them vulnerable to additional damage in a single incident. The incident demonstrated the vulnerability of the electrical network servicing Jamestown and provided the impetus to investigate the installation of a new second cable along an alternative route. The damage cable was replaced by 2001 and a new cable in 2003 (VHB Jamestown Electrical Supply Study). The two cables are 38K21 and 38K23. Both cables have two submarine cable segments, one in Newport Inner Harbor and one in the East Passage of Narragansett Bay. None of the submarine cables are buried (all are bottom lay). The East Passage has long stretches of rocky bottom, and burial is impractical.

Critical Facilities

Currently, the Melrose Ave. School, which is certified by the American Red Cross, serves as the principal emergency shelter for the Town of Jamestown. (The Lawn Avenue School is equipped to shelter pets during natural disasters.) The town is capable of providing public shelter for 1,100 individuals in the event of a natural disaster.

Property and roads:

- North Road/Zeek's Creek
- Beavertail Road at Mackerel Cove
- Route 138
- High-density residential property in downtown area
- Local roads subject to flooding/ seawall at Conanicus Ave
- East Shore Road at Toll Plaza
- Local bridges/overpasses subject to flooding
- Homes along coastline

Bridges/Dams:

- Bridge on North Road at Zeek's Creek
- Newport Bridge
- Jamestown-Verrazano Bridge
- South and North Pond Dams

Public Facilities:

- Police station
- Fire station
- Water treatment facility

- Wastewater treatment facility
- Highway garage/Public works
- Electric substation
- RIDEM Division of Marine Fisheries
- Phone substation at Watson and Pemberton
- Melrose Avenue School in its capacity as a Red Cross approved shelter

Necessary Goods/Services Providers:

- Banks
- McQuade's Market
- Baker's Pharmacy
- Food Bank Farm (Ceppi)
- Doctors' offices
- Restaurants – to the extent that they have food and supplies
- Gas stations with mini marts

Marinas and Boatyards:

- East Ferry
- West Ferry
- Fort Wetherill Boat Basin
- Jamestown Boat Yard
- Clark Boat Yard

Schools/Day Care Centers:

- Lawn Avenue School
- Melrose Avenue School
- Jamestown Early Learning Center

Elderly/Special Needs Housing:

- Pemberton Avenue Senior Housing (three complexes)
- Senior Center, West Street
- Special Needs Facilities at Hammett Court, Pemberton Ave. and Stanchion St.

Parks and Beaches

- Beavertail State Park
- Fort Wetherill Park
- Mackerel Cove, Jamestown Shores, Potter's Cove, Fort Getty, East and West Ferry
- Fox Hill Marsh, Sheffield Cove Marsh, Hull Cove Swamp, Racquet Road Thicket, Great Creek Marsh
- Fox Hill Pond
- Fort Getty Campground

Various Cultural and Historical Resources:

- Great Creek Archeological Resources
- Windmill Hill Historic District
- Beavertail Lighthouse

- Conanicut Battery
- Joyner Archeological Site
- Keeler Archeological Site
- Fort Dumpling Site
- Artillery Park and Town Cemetery
- Jamestown Windmill
- Friends Meeting House
- Dutch Island Lighthouse
- Conanicut Island Lighthouse
- Archeological Resources
- Native American Burial Grounds
- Ferry Landing
- Town Historic Records/Archives
- Historic Cemeteries
- Stone wall

Historic and Cultural Resources[LB1]

Jamestown's cultural and historical resources are equally as important to preserve as its natural resources (Jamestown Comprehensive Community Plan, Natural and Cultural Resources). The cultural and historical resources include the community's Native American, agricultural, and military past influences (Jamestown Comprehensive Community Plan, Natural and Cultural Resources). Preservation of these resources is a step toward retaining the Island's rural character and remembering its past (Jamestown Comprehensive Community Plan, Natural and Cultural Resources). Also important was the steam ferry and its role in the development of Jamestown as a summer resort (Jamestown Comprehensive Community Plan, Natural and Cultural Resources).

Jamestown’s historic and archeological resources are well documented to allow the town and private individuals to make optimal decisions about property management and preservation. Some of the town's cultural and historical resources have been placed in the National Register of Historic Places. The Department of Interior maintains the register as a record of structures, sites, areas and objects significant in American history, architecture, archeology, and culture. Listing in the National Register allows certain benefits, including national recognition as an historic area, limited protection from federally funded projects and matching grants-in-aid for restoration purposes. However, the register does not guarantee permanent protection for a site.

Cultural Resources on the National Historic Register:

Great Creek Archeological District: Narragansett Avenue borders the Great Creek Archeological District to the south, Route 138 to the north, North Road to the east, and Narragansett Bay to the west. This site is listed on the National and State Registers. The Archeological District also includes a portion of the Windmill Hill Historic District.

Archaeologists believe that an ancient village may have existed here. Indian artifacts recovered have been dated up to 5,000 years ago. A major discovery is the existence of the largest known Native American burial ground in New England on the site of the existing Jamestown School. Only limited excavations have occurred to date. The Rhode Island College Archeological Study entitled RIHPC (RI Historical Preservation Commission) Report on Jamestown indicates that Conanicut Island was a summer settlement for prehistoric Narragansett Indians.

Windmill Hill Historic District: This 772-acre historic district is located at Weeden Lane and North Main Road and is listed on the National and State Registers. The site includes six farmsteads, 18th century burial grounds, an 18th century Quaker Meetinghouse, an 18th century windmill and miller's house. As mentioned earlier, there exist archeological remains of several Indian settlements included in the Great Creek Archeological District. The Windmill Hill Historic District includes preserved 18th century and 19th century architecture and the last example of an 18th century Quaker-farming community extant in Rhode Island. This District also contains Cedar Hill Farm, founded by Governor Caleb Carr's descendants, as well as some of the few buildings built after the British evacuation in 1779.

The Windmill Hill Historic District is one of the finest rural landscapes in Rhode Island. This district is one of the largest contiguous acreage of agricultural land in coastal Rhode Island and contains a wealth of archaeological resources. However, in this District only structures that are individually recognized as historic are protected. Protected sites include the Windmill, Quaker Meeting House, Burying Ground, and the Joyner Farm archeological site. Both the Windmill and the Quaker Meeting House are overseen by the Jamestown Historical Society.

Beavertail Lighthouse: Beavertail Point has been the site of beacons and lighthouses since the early 18th century. Records refer to a watch house at Beavertail as early as 1705. Orders for building a beacon and maintaining regular watch are recorded in document from 1712. In 1749 a 58-foot wooden tower was designed by Peter Harrison, architect of the Redwood Library, Touro Synagogue and Brick Market in Newport. This was the third lighthouse built in the colonies. In 1753, the building burned and was replaced by a 64- foot fieldstone tower that was completed in 1755. The tower was burned by the British in 1779 and the lighthouse was repaired in 1783-1784 and was used until 1856. The present tower was constructed in 1856 and is of a unique granite work construction. Now a museum and part of the State Park System, the lighthouse is maintained by the Beavertail Lighthouse Association. The lighthouse resident is appointed by the Town Council.

Conanicut Battery National Historic Park: An archeological investigation was conducted in 1975 of this Revolutionary War earthwork fortification. The Rhode Island colonial forces erected this fort in 1776 to guard the west passage into Narragansett Bay. Eventually, six fire control stations were constructed at this site. The Battery was placed on the National Register of Historic Places in

May of 1973. This site was in the custody of the John Eldred Chapter of the Daughters of the American Revolution. The town acquired the site in 1963. The park is open to the public and provides trails with information on the history of the site and the earthen fortifications (Jamestown RI Parks and Recreation).

Joyner Archeological Site: The Joyner Site is identified as site 706 on the State Map and is a prehistoric Narragansett Indian site. Joyner is listed on both the National and State Registers. This site was found to be a heavily occupied location and yielded large quantities of prehistoric artifacts. Artifacts range in age from 2,500 BC to 1,000 AD. The site was utilized as an episodic logistical residential base camp from late summer through late fall.

Keeler Archeological Site: Members of the Carr family occupied this site from the late 18th century through the 19th century. Artifacts include possessions of this locally prominent Quaker family.

Fort Dumpling Site: The Fort Dumpling Tower was built about 1800 and throughout the 19th century it stood as a spectacular and romantic landmark of the lower Bay. It was destroyed in 1898 when the Fort Wetherill complex was begun.

Artillery Park and Town Cemetery: This site was set aside as a burial ground in 1656 and contains a number of old gravestones.

Jamestown Windmill: Included in the Historic Windmill Hill District, this post-revolution structure is overseen by The Jamestown Historical Society who is responsible for its care and maintenance. During the summer months, the Historical Society gives tours of the structure (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Horsehead: Horsehead, named after one of its most prominent cliffs and built in 1882-1884, is a large, private summer home on the promontory of Southwest Point. A significant example of Jamestown's earliest development as a summer colony, it was designed for the Philadelphia industrialist Joseph Wharton by Charles L. Bevins, architect (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Friends Meeting House: This 1786 structure was built by the Quaker fellowship of Conanicut. The Jamestown Historical Society oversees the care and maintenance of this structure (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Dutch Island Lighthouse: Located on the 110-acre Dutch Island, the lighthouse was built in 1857 replacing the original lighthouse of 1827 at the southern end of the Island. Land use on Dutch Island has ranged from a trading post in the 1600s to sheep pasturage throughout the 1800s to a training camp and fortification for the military through Civil War, Spanish-American War, and World War I. The lighthouse is the only remaining structure on Dutch Island

(Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Conanicut Island Lighthouse: Established in 1886, the light was manned by a keeper who lived in the attached residence. No longer in use, the lighthouse has been converted into a private residence (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Archeological Resources: The archeological significance of the Island dates back to over three thousand years ago when the community was the summer residence of the prehistoric Native Americans. There are presently 25 archeological test excavations (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Native American Burial Grounds: The discovery of large Native American Burial Grounds in Jamestown has enabled tribal members and historians an opportunity to view life as it was in the beginning in Jamestown. A large Narragansett Indian burial ground is identified on the state map and is included in the Jamestown Archeological District. These archaeological projects have made significant contributions to our understanding of the Native American history of Conanicut Island in particular and southern New England in general (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Town Historic Records/Archives: The town's archives include historic records dating back to 1640 that include the official records and maps of the town. These records have endured for centuries, through fires and hostilities, and are expected to be maintained ad infinitum. Archives are currently stored in both the Town Hall and the Jamestown Historical Society Museum and although many of the documents are recorded on microfilm, the original documents are important to the preservation of our right to information and the documentation of our heritage (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Ferry Landing: The old ferry landing at East Ferry is reminiscent of the impact of the ferry system on Jamestown's economy and growth. Ferry service on the East Passage lasted close to one hundred years, from 1873 to 1969 when the Newport Bridge was opened. Steam ferries ran from West Ferry from 1896-1940; sail ferries ran from 1600 to 1896. Today, there remains very little at this site to remind us of the role of the ferry in the past. The Historical Society of Jamestown, however, has a permanent ferry exhibit at the Museum on Narragansett Avenue that captures the essence of this era and its importance in the Island's history (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Historic Cemeteries: The Town of Jamestown has nine historical cemeteries recorded with the State of Rhode Island Historical Preservation Register. The registered cemeteries are as follows: Governor Carr Lot, East Shore Road; Town Cemetery, North Road; Cottrell & Green Lot, Fort Getty Road; Arnold

Lot, Fort Getty Road; Cedar Cemetery, Eldred Avenue; Friends Cemetery, Eldred Avenue; Tew Cemetery, North Road; Paine Cemetery, East Shore Road; St. Mark Roman Catholic Cemetery, East Shore Road (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Stone Walls: Jamestown's agricultural heritage is exemplified by the presence of numerous stone walls. As farmers cleared stones from their land to create fields, the stones were piled along the edges of the field and the property boundaries. The stone walls were used to delineate field crops and also to contain livestock. Significant stone walls run along the town's major roadways, including North Road and Beavertail Road (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Scenic Sites and Landscapes: Various scenic sites, including farmland and open landscapes, reflect the Island's heritage. In January of 1990, the RI Department of Environmental Management (RIDEM) conducted an inventory of the State's scenic resources. The Rhode Island Scenic Inventory lists six significant scenic landscapes in the Town of Jamestown (see SCENIC AREAS Map). These scenic landscapes account for 1,473 acres (23 percent of land area) in Jamestown. The following are recognized as scenic sites and landscapes in Jamestown:

1. Jamestown Brook/Windmill Hill - Interesting topography and vegetation. Noteworthy Landscape - 595 acres.
2. North Road - Views to Newport Bridge across marsh. Noteworthy Landscape - 149 acres.
3. Windmill Hill/Round Swamp - Interesting swamp makes excellent focal point. Noteworthy Landscape - 149 acres.
4. Fox Hill Pond - Well-sited farms and excellent views to ocean. Distinctive Landscape - 228 acres
5. Beavertail Pont - Varied vegetation; rocky shoreline; views. Distinctive Landscape - 215 acres.
6. Eldred Avenue/Route 138, The John Eldred Parkway – Undulating topography; views to the bridge. Noteworthy Landscape - 80 acres.

Future Development

According to a 2010 Community Survey, Jamestown residents overwhelmingly agree that the main goal for Jamestown is to maintain the island's "rural character" (90%) and feel that the "natural environment" is the most desirable quality (90%) of living in Jamestown (Jamestown Community Survey 2010). Other results from the survey indicated that survey respondents agreed with the goals of the Comprehensive Community Plan (Jamestown Comprehensive Community Plan, Community Survey Summary 2014).

In the summer of 2010, the Town of Jamestown conducted a buildout analysis. A buildout analysis is a method of determining the maximum potential future population under current rules and regulations of a community and environmental conditions. After the maximum population is calculated, the

community can plan long-range goals and policies to protect natural resources and provide services and facilities (Jamestown Comprehensive Community Plan, Community Survey Summary 2014).

According to the buildout analysis, if current building activity is maintained at the present rate of approximately 22.5 new housing starts per year, the town could be fully developed in 35 years or about the year 2045. This number could drastically change if the rate of building were to increase or decrease significantly. The average number of new homes built in the 1980s was 48 and it was 46 in the 1970s. Total buildout would increase the population to 7,084 persons, an increase of 32% over the current estimated population.

Areas, which would experience the highest rate of growth, are the northern end of Jamestown and Beavertail peninsula as well as the center island south of the John Eldred Parkway. These areas have the least current development and are predominately open space, woodlands, farmland and wetland areas. These areas are also very scenic and ecologically sensitive. Current zoning regulations require a minimum lot size of 80,000 square feet for development on the majority of the North End, 200,000 square feet minimum lot size in the center island area and 40,000 square feet minimum lot size in Jamestown Shores. Public water service is available to lots that have frontage along Beavertail Road.

Another projected area of high growth is the Jamestown Shores neighborhood, which could increase approximately 23%. An increase of this magnitude in the Jamestown Shores neighborhood under current conditions will result in the potential for groundwater pollution from numerous ISDS in close proximity to private wells. During drought conditions, there is a risk of wells running dry and salt-water intrusion. To avoid these potentially hazardous situations, local regulation and control over development is necessary.

The buildout analysis predicts that the Dumplings area could increase up to 33% over its current population. Large lot zoning of 80,000 square feet minimum lot requirement protects the Dumplings area, and public water service is available to lots with frontage along a portion of Highland Avenue, Walcott Avenue, Fort Wetherill Road and Racquet Road.

The Village area is likely to experience the least amount of future growth because of the limited amount of developable land available. A maximum population increase of 18% may be realized in this area.

3.3.1.4 Natural Environment

Water Resources, Watershed

Coastal Resources

The coast is one of Jamestown's most valuable resources. The value of the coast is economic, recreational and aesthetic. The shore offers opportunities for a

multitude of active and passive recreational pursuits as well as commercial and residential development. Jamestown residents and visitors as well as boaters on Narragansett Bay enjoy the Island's scenery and water related activities. The coast is also important as wildlife habitat and serves as a buffer to prevent property damage from flooding and erosion (Jamestown Comprehensive Community Plan Natural and Cultural Resources 2002).

The Narragansett Bay surrounds Conanicut Island on all sides. The Island separates the Bay into the East and West Passages. As the desire to live and recreate at the shoreline has increased over time, Jamestown's location has significantly contributed to the community's growth and development (Jamestown Comprehensive Community Plan Natural and Cultural Resources 2002).

In Jamestown, all residents live less than half of a mile from the shoreline. Waterfront access is available through town and State beaches, parks, and piers. Neighborhood waterfront access is provided by undeveloped public and private rights-of-way (Jamestown Comprehensive Community Plan Natural and Cultural Resources 2002).

Jamestown's waterfront is an asset to the economy as it relates to tourism, fishing and recreational boating. To protect this asset, it is vitally important that the quality of the Narragansett Bay is maintained and improved (Jamestown Comprehensive Community Plan Natural and Cultural Resources 2002).

There are twenty-three miles of shoreline around Conanicut Island not including Dutch and Gould Islands. The majority of the coastline is in private ownership and not publicly accessible. There are over five miles of publicly owned shore, not including Dutch and Gould Islands. The Town of Jamestown owns about one and three-quarter miles of coastline, the State of Rhode Island owns about three and one-quarter miles and the Federal Government own approximately three-quarters of a mile on Beavertail Point. Special public waterfront areas in Jamestown include:

- Beavertail State Park
- Fort Wetherill State Park
- The beaches of Mackerel Cove, Jamestown Shores, Potter's Cove, Fort Getty, and East and West Ferry
- Fox Hill Marsh, Sheffield Cove Marsh, Hull Cove Swamp, Racquet Road Thicket, and Great Creek Marsh (Jamestown Comprehensive Community Plan Natural and Cultural Resources 2002).

Freshwater and Estuarine Resources

Conanicut Island's water resources are particularly important because of the town's exclusive reliance on surface and ground water for drinking water. No reasonable alternatives currently exist for permanent connections to other water supply systems. Local water resources must, therefore, be protected to ensure a continued source of drinking water (Jamestown Comprehensive Community

Plan Natural and Cultural Resources 2002). Jamestown's water resources include the Jamestown Brook watershed and reservoirs (North and South Ponds), freshwater and coastal wetlands, ground water, streams, and ponds (Jamestown Comprehensive Community Plan Natural and Cultural Resources 2002).

There are slightly over 1000 acres of wetlands on Conanicut Island. This accounts for over 16 percent of the Island's area. There are 420 acres of freshwater wetlands and 585 acres of coastal wetland (including the entire intertidal zone around the Island). Students at the University of Rhode Island conducted a preliminary classification of all of the Island's wetlands in 1986. The most significant wetlands on the Island and their acreage are:

- Jamestown Brook & reservoirs: 176 acres
- Hull Cove Swamp: 104 acres
- Round Swamp & Great Creek Marsh: 94 acres
- Fox Hill Marsh: 58 acres
- Carr Creek: 32 acres
- Sheffield Cove Marsh: 22 acres

The wetlands associated with Jamestown Brook are of great importance because they comprise part of the center island watershed. The watershed is about one square mile; approximately one-third is the North Reservoir watershed from which the town currently draws its water. The remainder is the Jamestown Brook and South Reservoir watershed that is now used as a backup source of potable drinking water. The South Reservoir watershed has increased in importance as the demand for public water has frequently outstripped supply. At the present time, over 80 percent of the watershed area is either wetlands or publicly owned. Wetlands, however, may be subject to development dependent upon regulations and their enforcement. In total, over 100 acres of open land in the watershed have the potential to be developed.

Other than the Jamestown Brook and reservoirs, Jamestown has a number of perennial and intermittent streams and ponds located throughout the Island. Ponds include Hammond Pond, Crusher Pond, Rosamund Pond, Tefft Pond, and Rainbow Pond. Hammond pond is a natural pond that acts as a holding area for runoff. Rosamund, Tefft, and Rainbow Ponds were constructed for drainage purposes as part of the development of the West Reach and East Passage subdivision projects. All of these ponds have wildlife, aesthetic and recreational value (Jamestown Comprehensive Community Plan Natural and Cultural Resources 2002).

The majority of marine waters around Conanicut Island are classified as SA. A small area on the West Passage side of the Island, known as West Ferry, is classified as SA {b} to denote the marina and mooring fields which preclude shell fishing in that area during the summer. On the East Passage side of the Island, the area around the Wastewater Treatment Facilities discharge is classified as SB1 and SB. The area around east Ferry is classified as SB and SA {b}. The area north of Gould Island is classified as SB.

The SA and SA {b} portions of the Bay along Conanicut Island on the East Passage side of the Bay are also fully supporting the shell fishing and swimming and aquatic life uses. The SB and SB 1 areas are not designated for shell fishing use. The data indicate the area as fully supporting swimming and aquatic life uses.

The Island's major fresh water bodies are the Jamestown Public Water Supply, which consists of North (Carr) Pond, South (Watson) Pond and Jamestown Brook. The State Department of Health monitors the North Pond for several parameters including turbidity, color, total suspended soils, sodium, pH, chloride, nitrate and total coliform. North Pond is in full compliance with the Class A drinking water standards. South Pond and Jamestown Brook are assessed as impaired for Class A drinking water due to high color and pathogens, respectively.

Table 3-16. Water Quality Standards

Water Quality Standards	
Freshwater	
Class A	These waters are designated as a source of public drinking water supply, for primary and secondary contact recreational activities and for fish and wildlife habitat. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These waters shall have good aesthetic value.
Class B	These waters are designated for fish and wildlife habitat and primary and secondary contact recreational activities. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These waters shall have good aesthetic value.
Class B1	These waters are designated for primary and secondary contact recreational activities and fish and wildlife habitat. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These waters shall have good aesthetic value. Primary contact recreational activities may be impacted due to pathogens from approved wastewater discharges. However all Class B criteria must be met.
Class C	These waters are designated for secondary contact recreational activities and fish and wildlife habitat. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These waters shall have good aesthetic value.
Saltwater	
Class SA	Those waters are designated for shellfish harvesting for direct human consumption, primary and secondary contact recreational activities, and fish and wildlife habitat. They shall be suitable for aquacultural uses, navigation and industrial cooling. These waters shall have good aesthetic value.
Class SB	These waters are designed for primary and secondary contact recreational activities; shellfish harvesting for controlled relay and depuration; and fish and wildlife habitat. They shall be suitable for aquacultural uses, navigation, and industrial cooling. These waters shall have good aesthetic value.
Class SB1	These waters are designed for primary and secondary contact recreational activities and fish and wildlife habitat. They shall be suitable for aquacultural uses, navigation, and industrial cooling. These waters shall have good aesthetic value. Primary contact recreational activities may be impacted due to pathogens from approved wastewater discharges. However all Class SB criteria must be met.
Class SC	These waters are designated for secondary recreational activities, and fish and wildlife habitat. They shall be suitable for aquacultural uses, navigation, and industrial cooling. These waters shall have good aesthetic value.

Groundwater Resources

The geology of Conanicut Island is largely responsible for determining the amount of groundwater available to the town. The Island is underlain by very irregular consolidated rocks, over two hundred million years old, which are classified as Pre-Pennsylvania and Pennsylvania in age. In most places, unconsolidated deposits left behind by glacial ice that covered the area during the ice age overlie this rock. The unconsolidated earth deposits are mostly till, which ranges in thickness from less than one foot near the surface to over forty feet.

In general, Jamestown's geology yields the lowest quantity of groundwater in the State of Rhode Island. Jamestown's groundwater is contained in fractures of consolidated bedrock. A limited quantity of water is stored in the saturated zones of the glacial deposits overlying bedrock. In efforts to meet the town's needs, wells were installed in the north end to supplement the north reservoir's water supply.

All Island water, both surface and groundwater, is derived from precipitation. There is a hydrologic connection between the saturated glacial till and the bedrock levels of groundwater. Island wells are located in both water reserves. Excessive, constant pumping will drop both levels. However, a significant amount of groundwater is returned through septic system infiltration and precipitation. Only a small amount of water, approximately 15 percent, is lost through consumption and evapotranspiration, especially in the summer. It is important to recognize the need for the return of groundwater to the system. If groundwater were not returned via ISDS, the groundwater supply would quickly diminish.

Ground water quality in Jamestown is generally good. This can be attributed to the fact that there is no major industrial development in Jamestown and all commercial areas and most high-density residential land is serviced by the public water and sewer system. The greatest threat to groundwater quality is presented by the utilization of ISDS on small residential lots with poor soils and with minimal separation from private drinking water wells.

Protected Natural Areas

The environs of Conanicut Island have a diversity of natural ecosystems that include upland hardwood forests, streams, wooded swamps, meadows, fresh water and salt water marshes, streams, rocky shores, beaches, coastal estuaries and a variety of marine habitats (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002). Each of these ecosystems is characterized by specific flora and fauna, all of which play an essential role in contributing to the quality and enjoyment of the Island's natural environment. In addition to its role as wildlife habitat the Island's vegetation plays an important role in social buffering, erosion and flood control, filtering of waterborne pollutants, production of oxygen, the absorption of air pollution and as an important aesthetic amenity that gives the Island it's rural character. The

community of plants and animals that live on Conanicut Island form a complex "web of life" where each is dependent upon the other for survival. Each species fills a unique niche in the natural environment. The loss of a single species has the potential to adversely impact the Island's ecosystem (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Due to its Island environment, Jamestown has some exemplary natural communities (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002). The Rhode Island Natural Heritage Program has identified four significant habitat areas on Conanicut Island: Great Creek/Round Swamp, Gould Island, Beavertail Park, and Jamestown Brook and Wetlands. These areas support species that may become lost to the State if their habitat is not protected and carefully managed (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Great Creek/Round Swamp: Great Creek/Round Swamp and the wetlands that make up this important ecosystem provide nursery area for many species of fin fish and shellfish. This area is also an important nesting and feeding area for many species of waterfowl and large wading birds. The area also contains several unique plant species. The Audubon Society of Rhode Island, The Nature Conservancy and the town jointly own this area. A portion of the privately owned saltmarsh area and adjacent upland is protected under the provisions of a conservation easement held by the Conanicut Island Land Trust. The RIDEM owns the development rights to a large portion of the contiguous Hodgkiss Farm. The Conanicut Island Sanctuary in the southeast corner of the Great Creek area is jointly managed by the Jamestown Conservation Commission and Conanicut Island Land Trust as a wildlife sanctuary. A trail system and a wildlife observation platform overlooking the saltmarsh provide public access to the Sanctuary. These improvements provide limited and controlled access while reducing the human impact to the flora and fauna of the area (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Gould Island: Gould Island is an important rookery for wading birds due to its isolation and vegetative community. At least seven rare bird species nest here, among other more common birds. The State of RI owns the southern third of the Island and the U.S. Navy owns the northern two thirds. The State portion is managed as a nesting area for wading birds, gulls, terns and American Oystercatchers. The bird colonies are monitored annually by the RI. Division of Fish and Wildlife. Access to portions of the Island are restricted during the nesting season (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Beavertail Park: Beavertail Park has a variety of habitats that support many species of plants and animals both terrestrial and marine. Year round residents include gray fox, cottontail rabbit, a growing white tail deer population and many species of land and sea birds. As a peninsula jutting into Rhode Island Sound it is a stopover point for many migratory bird species during the fall. The point has also been host to thousands of Monarch butterflies during their fall migration south. Migrating sea birds can also be observed offshore during both

spring and fall. The rocky shoreline is noted for tidal pools, a great diversity of marine algae species, extensive submarine kelp beds, and an occasional fossil. Beavertail Park is maintained by the RIDEM and is part of the RI. State Park system. When the property was acquired from the Federal government, it was largely cleared land. Since acquisition, natural succession has changed many of the previously mowed fields into a scrub/shrub habitat and its wildlife value has decreased. Human impact has also taken its toll on the natural features of the park. This is especially evident in the extensive shoreline erosion of the banks and bluffs. A more aggressive approach to people control and vegetation management is necessary to maintain habitat and wildlife diversity and preserve the natural beauty of the park (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

Jamestown Brook and Wetlands: The extensive wetland system surrounding Jamestown Brook that flows south from Jamestown's North Pond Reservoir to the South Reservoir is one of the most important wildlife habitats on the Island. This wetland is also habitat for a State-listed rare amphibian, the Leopard Frog. The entire wetland system was classified as "outstanding" by the Golet Wetland Classification System indicating that it is unique in the State and has a very high value as wildlife habitat. In addition this wetland provides a number of important functions for the residents of Jamestown. This large wetland filters pollutants from water traveling between the North and South Reservoirs, it serves as a "giant sponge" storing enormous amounts of water and slowly discharging it to the south, and finally the wetland recharges the groundwater in the area. Protection of this wetland system should be a high priority for the town (Jamestown Comprehensive Community Plan, Natural and Cultural Resources 2002).

3.4 Risk Analysis & Assessment Matrix

The JNHMC assessed the town's risks to natural disasters in terms of population, property, economic resources, and probability of occurrence. The committee considered public health/safety, structural damage, area or town-wide evacuation, and structures that house people with special needs. The committee began by identifying specific areas and structures that are vulnerable to natural hazards.

3.4.1 Methodology

Vulnerable areas were determined by considering past and potential natural hazards that pose a threat to the population, property, and economic resources of the town. For example, the town's population, residential/commercial properties, schools, bridges and historical buildings were identified as vulnerable areas to natural hazardous events.

Evaluating the number of times that the natural hazard has impacted Jamestown or a region within Rhode Island in the past provides a measure of the likelihood

of the event occurring again in the future. This rating is derived from an investigation of trends in the long-term (30 years at least) data. Examination of past events helps to determine the probability of similar events occurring in the future.

Table 3-17. Frequency Score

Approximate Recurrence (years)	Approximate Annual Probability	Subjective Description	Frequency Score
1	100.0%	Frequently recurring hazards, multiple recurrences in one lifetime	5
50	2.0%	Typically occurs at least once in lifetime of average building	4
250	0.40%	25% chance of occurring at least once in lifetime of average building	3
500	0.20%	10% chance of occurring at least once in lifetime of average building	2
1000	0.10%	Highly infrequent events, e.g. maximum considered earthquake	1
25000	0.004%	Unlikely event	0

The committee also determined the objective or benefit that would be realized by implementing an appropriate mitigation action. Objectives or benefits included protection of the public, economic stability, historical preservation, and areas were identified and assigned: a natural hazard, primary problem, and mitigation benefit. A Risk Assessment Matrix was constructed that ranked the vulnerable areas.

3.4.1.1 Exposure Analysis

A second criteria used in evaluating the risk of Jamestown to natural hazards is to determine the area of impact. Some hazard events impact only a small region, while others can affect the entire area. The area of impact determination indicates how much of the immediate area is impounded by a single event. Again, historical data is used to investigate damage and loss records of previous hazard events to develop an estimate of the amount of property damage that may occur from future events.

Mean Affected Area (sq. miles)	Subjective Description	Area Score Impact
0	No affected area	0
1	Highly localized (city block scale)	1
10	Single zip code impact	2
50	City scale impact	3
100	County scale impact	4
500	Regional impact (e.g. statewide)	5

3.4.1.2 Historical Analysis

The rankings were determined by considering the historical or potential occurrence of natural disasters, the primary threat to the town, and the mitigation benefit that would be received if an appropriate mitigation action was implemented. For example, it became apparent to the Committee that flooding of property and critical roads are the most vulnerable to natural disasters. Considering historical occurrence of damage, the primary problem experienced is economic and social hardship, the benefit of public safety and the disruption of evacuation, roads and properties subject to flooding became the highest ranked vulnerable area. **Table X** summarizes the town's risks to natural disasters as a Risk Assessment Matrix and the worksheet used by the Committee is included as Appendix D.

Repetitive & Severe Repetitive Loss Properties

The Severe Repetitive Loss (SRL) grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, which amended the National Flood Insurance Act of 1968 to provide funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss structures insured under the National Flood Insurance Program. Under this program the riskiest SRL properties could be targeted and owners would be offered financial help to get their buildings high and dry: either moved to a safer location or elevated well above the flood elevations. However, the SRL program was eliminated by July 2013 based on the Biggert Water Flood Insurance Reform Act of 2012. The 2012 Flood Insurance Reform Act made the following changes:

- The definitions of repetitive loss and severe repetitive loss properties have been changed to the following:
    - Repetitive loss properties: a structure covered by a contract for flood insurance made available under the NFIP that 1) has incurred flood related damage on 2 occasions, in which the cost of the repair, on average, equaled or exceeded 25% of the market value of the structure at the time of each flood event; 2) at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage,
    - Severe repetitive loss properties is a structure that 1) is covered under a contract for flood insurance made available under the NFIP; and 2) has incurred flood related damage for which four of more separate claims payments have been made under flood insurance coverage with the amount of each such claim exceeding $5,000 and with the cumulative amount of such claims payments exceeding $20,000; or for which at least two separate claims payments have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

- There is no longer a state cap of $10 million or a community cap of $3.3 million for any five-year period;
- There is no longer a limit on in-kind contributions for the non-Federal cost share (previously limited to one-half of the non-Federal share);
- Mitigation reconstruction is an eligible activity;
- Cost-share requirements have changed to allow more Federal funds for properties with repetitive flood claims and severe repetitive loss properties;
- The development or update of mitigation plans shall not exceed $50,000 Federal share to any Applicant or $25,000 Federal share to any sub applicant; and,
- There is a no longer a restriction that a planning grant can only be awarded not than once every five years to a State of Community

The Town of Jamestown has 1 repetitive loss property. Although the SRL program has been terminated, applicants with eligible properties are still able to apply for assistance under the Federal Management Assistance Program. Residential or non-residential properties currently insured with the NFIP are eligible to receive FMA funds and must meet the definitions of either a repetitive loss property or severe repetitive loss property.

3.4.2 Vulnerability Summary

Hurricanes

Jamestown, as with the rest of Rhode Island and other New England states, is particularly vulnerable to tropical storms. One reason is due to the geography of southern New England in relation to the Atlantic seaboard. Historically, most tropical storms which have struck the New England region re-curved northward on tracks which paralleled the eastern seaboard maintaining a slight north-northeast track direction. The fact that the States of Connecticut, Rhode Island, and Massachusetts geographically project easterly into the Atlantic and have southern exposed shorelines place them in direct line of any storm which tracks in this manner. Therefore, even though New England is a relatively far distance from the tropics, its susceptibility to hurricane strikes can statistically be greater than other states closer to the tropics.

Another explanation giving evidence to New England's unique vulnerability to hurricanes is the fact that hurricanes which eventually strike the region undergo significant increases in forward speed. Historically, it can be shown that hurricanes tend to lose their strength and accelerate in a forward motion after pasting the outer banks of Cape Hatteras, North Carolina. The increase in forward speed that usually occurs simultaneously as the hurricane weakens with further northward movement can often compensate for any discounting in hurricane intensity. Surge flooding, wave effects, and wind speeds accompanying a faster moving, weaker hurricane may exceed conditions caused by more intense hurricanes. This means that for some locations, depending on

the meteorology of the storm, the affects from a Category 2 hurricane traveling at 60 MPH might be worse than that from a Category 4 hurricane moving at 20 MPH.

There are primarily three components of vulnerability from the impact of a hurricane: storm surge (coastal flooding); ability to evacuate in a timely manner; and shelter capacity. Storm surge has the potential to create a very serious problem in Jamestown because the waters can rise to high levels with the potential to cover roads and bridges completely with water. If roads are inundated with water then it can eliminate evacuation routes; this can be of particular concern in frequently flooded areas such as Beavertail Road.

Electrical utilities and communications as well as transportation infrastructure are vulnerable to significant coastal events. 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.

Human vulnerability is based on the availability, reception and understanding of early warnings of coastal hazard events (i.e., Hurricane Watches and Warnings issued by the NWS) as well as access to substantial shelter and a means and desire to evacuate if so ordered. In some cases, despite having access to technology (computer, radio, television, outdoor sirens, etc.) that allows for the reception of a warning, language differences are sometimes a barrier to individuals understanding them. Once warned of an impending significant coastal hazard event, seeking shelter in a substantial indoor structure, that is wind resistant and outside of storm surge zones, is recommended as the best protection against bodily harm.

Tornadoes

Tornadoes are high-impact, low-probability hazards whose effect is dependent on its intensity and the vulnerability of development in its path. Tornado vulnerability is based on building construction and standards, the availability of shelters or safe rooms, and advanced warning capabilities. Even well-constructed buildings are vulnerable to the effects of a stronger (generally EF-2 or higher) tornado. Due to the relatively low incidence and risk for tornado, traditional “Tornado Alley” mitigation methods such as tornado safe rooms may not be economically feasible in Rhode Island to appear in the NCDC database.

In the twenty tornadoes that have touched down in Rhode Island since 1950, none have made landfall in Jamestown. However, it should be noted that the entire state population is considered uniformly vulnerable to tornadoes. The type and age of construction plays a role in vulnerability of facilities to tornadoes. In general, concrete, brick and steel-framed structures tend to fare better in tornadoes than older, wood-framed structures.

High Wind and Thunderstorms

The impact of wind can be measured in financial terms as well as fatalities and injuries. Wind vulnerability is based in large part on building construction and standards. Other factors, such as location, condition, and maintenance of trees also plays a significant role in determining vulnerability. All facilities within Rhode Island are considered evenly vulnerable to thunderstorms. The location and construction of a facility plays a role in how it will be affected by lightning and hail incidents. If a structure is located on a hilltop, is tall or has other tall structures around it, or has large exposed windows, it may be damaged during a storm. Communications and power supplies may be compromised during thunderstorms, and some critical facilities might not be equipped with a backup power source.

Annualized property damages from wind, lightning and hail can be very costly; between 1956 and 2012 in Newport County are $26,105 with total damages amounting to $1,540,188. As previously described, the NCDC loss estimates are only available at the county level and are believed to be an underrepresentation of the actual losses experienced due to hazards as losses from events that go unreported or that are difficult to quantify are not likely to appear in the NCDC database; this is especially true with crop damages.

Winter Related Hazards

In general, Jamestown does not experience winter weather of the same significance and frequency with which it affects the northwestern areas of Rhode Island. However, effects from winter storms can still be severe. Electrical utilities and communications as well as transportation infrastructure are vulnerable to damages from winter storms. 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 have been known to spark fires.

Based on NCDC data, Rhode Island can expect approximately six (6) events and damages upward of $808,098 annually in winter weather related damages. The current facilities dataset does not contain attribute information to accurately quantify facility vulnerability due to winter weather. Facility data necessary for vulnerability assessment would include, but not limited to, roof type, building construction type, building and contents values, and use. For example, type of roof would help to determine whether or not it is a flat roof and therefore more susceptible to heavy snow loads. To address the vulnerability of infrastructure to the impacts of ice storms, it would be important to complete an inventory of utility lines as they are very susceptible to breakage when ice forms on the lines, and this of course results in power failure. It would also be important to describe this potential impact in terms of the direct impact (such as a power failure) on Rhode Island's economy.

Transportation structures are at great risk from winter storms. In addition, building construction type, particularly roof span and construction methods,

support the capacity of a building to withstand severe stress weights from snow. Winter storms, ice storms and extreme cold can adversely affect people, some more than others. Infants and those persons 65 years of age or more are especially vulnerable.

Human vulnerability is based on the availability, reception and understanding of advanced warnings of impending significant winter weather events (i.e. Winter Storm Watches and Warnings issued by the NWS) and heeding the advice of local officials. In some cases, despite having access to technology (computer, radio, television, etc.) that allows for the reception of a watch or warning, language differences are sometimes a barrier to individuals understanding and responding to them.

Flood Related Hazards

All areas of Rhode Island continue to be vulnerable to flooding and the impacts associated with this natural hazard. Rhode Island is a water-rich state, in that it has many rivers, streams and brooks flowing within and between its boundaries and other states. Past land use patterns and the continued use of structures within areas vulnerable to flooding will continue to promote future risk and vulnerability of flood impacts to structures and people. Local land use regulations and ordinances have done much to curb unregulated development within flood hazard areas.

Coastal Erosion

New development along coastal areas in Jamestown is regulated by CRMC and the town. One regulation requires a Coastal Buffer Zone, or a "land area adjacent to a Shoreline (Coastal) Feature that is, or will be, vegetated with native shoreline species and which acts as a natural transition zone between the coast and adjacent upland development," on property within 200 feet of the inland edge of a coastal feature. The benefits of the Coastal Buffer Zone include protection of water quality, protection of coastal habitat, protection of scenic and aesthetic quality, erosion control, and flood control.

Dam Breach

RIDEM has the responsibility to inspect dams and determine their condition (Dam Safety Program report 2012). In accordance with Dam Safety Regulations, visual inspections of significant hazard dams are required every five years (Dam Safety Program report 2012). As part of each visual inspection, the condition of the major components of the dam are subjectively rated as good, fair or poor. According to the 2012 Annual Report to the Governor on the Activities of the Dam Safety Program, dams of both the North and South pond reservoirs (ID # 574 and 575) are designated as significant hazards, thus classifying the dams as unsafe with conditions that bear unreasonable risks of failure (Dam Safety Program report 2012).

Wildfire

Portions of Jamestown are designated as intermix areas, where Wildland Urban Interface (WUI) areas intermix with housing and vegetation. These areas are considered at-risk for wildfires.

Geologic Related Risks

An earthquake risk assessment is difficult because it is challenging to monetize the potential damages accurately. FEMA has developed a software suite, HAZUS-MH, for estimating potential losses to natural disasters. The HAZUS-MH earthquake model was utilized to estimate damages and losses to buildings, lifelines, and essential facilities from deterministic (scenario-based) and probabilistic earthquakes. Estimates for the annualized losses in Newport County were based on the historic earthquakes of 1755 in Cape Ann with a magnitude 6.5 and the 1951 North Kingstown with a magnitude 5.0. The annualized economic losses based on these earthquakes for Newport County are projected as $183,329. Though the projected economic impacts resulting from these simulations may appear low, the results do indicate that attention does need to be given to potential economic impacts as a result of earthquakes.

Currently, the Rhode Island Building Code follows the Building Official & Code Administration (BOCA) code which has very basic earthquake provisions. Thus, an even moderate earthquake could cause severe damage to aged structures and unreinforced masonry buildings. In addition, these codes are only for new structures and do not take into account past structures like the "classic mill building". So, although New England is considered to have a moderate seismic risk, in general it has a high seismic vulnerability because of the built environment.

In addition to the physical characteristics of the soil and built environment, one of the most critical factors of vulnerability is low public awareness. In Rhode Island, there is little public recognition of earthquake threat, and no established system of educating or informing the public of the threat or how to prepare for or respond during an earthquake. Therefore, higher losses will occur than in other regions of the country.

Although Rhode Island has not suffered a major quake in modern times, seismicity is occurring and any strong earthquake, in the northeast region, may affect the area to some degree. Inherent risks to life and property are: the increase in population since the Cape Ann earthquake (magnitude 6.25) of 1755, buildings which were built prior to seismic building code regulation, older infrastructure which is vulnerable to any ground shaking, and any construction in "filled areas" which would be victim to liquefaction.

Drought and Extreme Heat

The entire state is susceptible and vulnerable to the occurrence of a drought event. Jamestown is particularly sensitive to the effects of drought due to its sole aquifer designation and the increased demand for water in the summer that

accompanies the larger summer population. The vulnerability of the State to drought is increasing as water use and land use change. People tend to assume that plentiful water is the norm for Rhode Island, when, in fact, occasional droughts of at least moderate intensity and duration have occurred in the State. Impacts from droughts can be moderated through mitigation planning and preparedness. Because droughts are a normal part of any climate, it is important to have a plan in place providing for response actions.

Rhode Island is highly vulnerable to a drought occurrence, whether short- or long-term in duration. Impacts will be costly in both social and economic terms. The responsibility for drought planning lies with the Rhode Island Water Resources Board.

3.4.2.1 Identified Risk in the Community

Like most Rhode Island coastal communities, the greatest risks in the Jamestown community are related to flooding and storm surge. The risk matrix rates flood as the natural event with the highest score. Natural events that spur flooding, such as tropical cyclones and nor'easters also received high rankings.

3.4.2.2 Hazard Scoring Matrix

Hazard	Frequency	Area Impact	Magnitude	Total
Storm Surge	5	3	3	24
Hurricane	5	5	3	30
Tornado	2	2	3	12
High Wind and Thunderstorms	5	2	1	7
Severe Winter Storms	5	3	2	16
Temperature Extremes	2	5	1	7
Flood	5	3	3	24
Coastal Erosion	5	3	3	24
Dam Failures	2	2	3	12
Earthquake	1	5	2	12
Wildfire	2	1	1	3
Drought	1	5	1	6

(Frequency + Area Impact) X Magnitude = Total

Table X Risk Assessment Matrix

Rank	Vulnerable Areas	Location	Ownership	Hazard	Primary Effects	Mitigation Benefits	Risk H=Historical P=Potential
1	Flooding of property and critical roads	• Low-lying areas town- wide • Sewage/drainage system	Private/State Public	Flooding Hurricane Nor'easters	• Loss/damage of lives and property • Disruption of evacuation/emergency response • Flooding of major roads- North Rd at Zeeks Creek, Beavertail Road at Beach and Conanicus @seawall • Costs of cleanup • Public health	• Public Safety • Maintain evacuation routes • Upgrade/Maintain • Infrastructure i.e.: bridges/seawalls • Decrease costs of cleanup • Prevent or minimize economic and social damage	H
2	Structures subject to wind damage	• Town-wide	Private Public	Wind Hurricane Nor'easters Ice Storm	• Tree damage causes downed power lines • Costs of cleanup • Lack of power and communication • Loss of drinking water and heat • Downed trees may block evacuation routes • Disruption of evacuation • Loss/damage of lives and property • Downed power lines may pose fire hazard	• Maintain constant power during/after events • Maintain communication systems • Maintain drinking water and heat during/after events • Maintain evacuation routes • Public safety	H
3	Bridges/Infrastructure/Dams	• Newport & Jamestown Bridges • Bridge at Zeek's Creek • North & South Reservoir Dams	Public	Flooding Hurricane Nor'easters Windstorm Ice Storm Tornado Earthquake	• Loss/damage of lives and property • Disruption of Evacuation/Emergency response • Economic Hardship	• Public safety • Maintain evacuation routes • Decrease cost of cleanup • Prevent or minimize economic and social damage	H
4	Public Facilities	• Police and Fire Stations • Sewerage Treatment Plant • Water Treatment Facility • Town Offices/Town Hall • Clark Street Substation • Library • RIDEM Division of Marine Fisheries • Highway Garage/Public Works • Lawn Avenue School • Telephone Substation	Public	Flooding Hurricane Nor'easters Windstorm Ice Storm Tornado Earthquake Lightning Fire Drought	• Disruption of public services • Loss/damage of public records • Environmental concerns • Economic and social hardship • Costs of cleanup • Lack of power and communication • Lack of public water	• Public safety • Decrease cost of cleanup • Prevent or minimize economic and social damage • Maintain agreement to buy water from North Kingstown • Maintain and regularly test the emergency hose and reels that supply water from North Kingstown	P
5	Necessary Goods/Services	• Bakers Pharmacy • McQuade's Market • Gas Stations w/mini-marts • Banks • Jamestown Family Practice Center	Private	Flooding Hurricane Nor'easters Windstorm Ice Storm Earthquake Lightning	• Economic and social hardship • Disruption of access to goods, services and medical care	• Public safety • Maintain access to goods and services • Prevent or minimize economic and social damage	P
6	Marinas and Boatyards	• Along coastline	Private	Flooding Hurricane Nor'easters Windstorm Lightning Fire	• Loss/damage of lives and property • Costs of cleanup • Economic and social hardship	• Public safety • Decrease cost of cleanup • Prevent or minimize economic and social damage	H

Rank	Vulnerable Areas	Location	Ownership	Hazard	Primary Effects	Mitigation Benefits	Risk H=Historical P=Potential
7	Schools/Daycare Centers	• Jamestown Early Learning Center • Lawn Avenue School • Melrose Avenue School	Private Public	Flooding Hurricane Nor'easters Windstorm Ice Storm Lightning Fire Earthquake	• Loss/damage of lives and property • Loss of shelters • Economic and social hardship • Need additional time for evacuation	• Public safety • Maintain shelters • Protect economic and social well-being • Expedite evacuation	P
8	Elderly Housing and Special Needs Facilities	• Senior Center – West Street • Pemberton Avenue • Stanchion Street • Hammett Court	Private	Flooding Hurricane Nor'easters Windstorm Ice Storm Lightning Fire Earthquake	• Loss/damage of lives and property • Need additional time for evacuation • Elderly population dependent on electricity	• Public safety • Prevent or minimize economic and social damage • Expedite evacuation	P
9	Fort Getty Campground Seasonal/Summer Campground	• Fort Getty	Public	Flooding Hurricane Windstorm Lightning Fire Tornado Earthquake	• Loss/damage of lives and property • Cost of cleanup • Economic and social hardship • Need additional time for evacuation	• Public safety • Decrease cost of cleanup • Prevent or minimize economic and social damage • Expedite evacuation	P
10	Parks and Beaches	• Various locations	Public	Flooding Hurricane Windstorm Lightning Fire Tornado Earthquake	• Loss/damage of lives and property • Cost of cleanup • Economic and social hardship	• Public safety • Prevent of minimize damage to property • Protect economic and social well-being	P
11	Various Cultural and Historic Resources	• Town-wide	Public	Flooding Hurricane Windstorm Lightning Fire Tornado Earthquake	• Economic and social hardship	• Prevent or minimize economic and social damage	P

4.0 Capability Assessment

4.1 Purpose – Capabilities for both existing and future risk

The following section details the different programs and departments the town has to aid in hazard mitigation. The town will have the capability to implement and institutionalize hazard mitigation through its human, legal and fiscal resources, the effectiveness of intergovernmental coordination and communication, and with the knowledge and tools at hand to analyze and cope with hazard risks and the outcomes of mitigation planning.

4.2 Types & Evaluation of Capabilities

Jamestown has a variety of planning and support capabilities to apply towards hazard mitigation activities. Most importantly is an active community base. The business owners, residents and visitors all contribute to promote growth and stability in town. The following sections provide an overview of the critical capabilities within the town and how they play a role in the mitigation effort.

4.2.1 Local Government & Program Areas

Local town plans and policies were consulted for the creation of this Natural Hazard Mitigation Plan. Among them include the Jamestown Comprehensive Harbor Management Plan by the Jamestown Harbor Commission (2014). Additionally, policies and action plans outlined in the updated Comprehensive Community Plan include steps taken to plan for natural hazard vulnerability (Jamestown Comprehensive Community Plan 2014).

Additionally, the public services and facilities provided by the town of Jamestown are crucial resources for the preparation of natural hazard events, as well as the response to and mitigation of such events.

There are also several state agencies that share responsibility for natural hazard preparation and response.

4.2.1.1 Form of government

By Charter, the Town of Jamestown is governed by a five (5) member elected council who each serve for a term of two (2) years or until a successor is elected and qualified. The town council elects one member to serve as president to preside over all meetings. The town council appoints a town administrator to serve as the chief administrative officer and be responsible to the town council for the administration of all town affairs.

The town council has the authority to adopt emergency ordinances "to meet a public exigency affecting life, health, property or the public peace…" Every emergency ordinance is automatically repealed on the 61st day following adoption.

The town administrator is responsible for the appointment of department heads and with overall supervision of the town departments.

Town Boards, Commissions, and Committees

In addition to the town employees serving in the town departments, a number of boards and commissions are active in mitigation activities.

- Planning Commission
- Zoning Board of Review
- Harbor Management Commission
- Board of Assessment Review
- Conservation Commission
- Tree Preservation and Protection Committee
- Water and Sewer Commission

4.2.1.2 Planning, Building, Housing - Community Development

Jamestown Planning Department

Under the direction of the Town Administrator, the Planning Department provides professional planning and community development services for the town in the following areas:

- Administration of land use regulations
- Administration of on-going planning programs
- Coordination with federal and state agencies
- Coordination with town boards, departments, and agencies

Plans and Programs

As part of the Action Plan policies outlined in the updated 2014 Jamestown Comprehensive Community Plan, the Natural and Cultural Resources Action Plan outlines a policy to proactively plan for natural hazard vulnerability. The

Town Planning Department is responsible for the initiation of this policy. The policy will be carried out by 1) Developing natural hazard vulnerability mapping in coordination with RI SeaGrant; and 2) Assisting in the completion of a RIEMA and FEMA approved Hazard Mitigation Plan (i.e. this plan) (Jamestown Comprehensive Community Plan, 2014).

Funding/Resources

The Planning Department is comprised of a Town Planner and a part time Planning Assistant. The Planning Department provides direct staff support to four permanent town boards; Town Council, Planning Commission, Affordable Housing Committee, and Buildings and Facilities Committee, in addition to serving other committees and special groups as required such as the Ad-hoc bikeway Committee and the Ft. Wetherill Committee, Ft. Getty Committee and Water Resources Protection Committee (Jamestown Comprehensive Community Plan, 2002).

Rhode Island Historic Preservation and Heritage Commission

The Commission identifies and protects historic and prehistoric sites, buildings, and districts in the State. RI's historic buildings are an important resource and are major attractions for the State's billion dollar tourism industry. The Commission identifies and protects historic and prehistoric sites, buildings, and districts by nominating significant properties to the National Register of Historic Places (NHRP) and the State Register; administering grants, loans, and tax credits for rehabilitation of historic buildings; reviewing federal and State projects that affect cultural resources; and regulating archaeological exploration on State land and under State territorial waters. The Commission also develops and carries out programs to document, support, and celebrate the ethnic and cultural heritage of Rhode Island's people.

In the event of destruction and damage resulting from a natural disaster, a Memorandum of Understanding (MOU) is established in which RIEMA would defer to the State Historic Preservation Office (SHPO) policies when repairing historic structures and other structures. The MOU provides a mechanism whereby damaged buildings will be repaired utilizing mitigation measures while also following the guidance as set out in the State Historic Preservation regulations.

Plans and Programs

In the event of destruction and damage resulting from a natural disaster, a Memorandum of Understanding (MOU) is established in which RIEMA would defer to the State Historic Preservation Office (SHPO) policies when repairing historic structures and other structures. The MOU provides a mechanism whereby damaged buildings will be repaired utilizing mitigation measures while also following the guidance as set out in the State Historic Preservation regulations. The SHPO provides assistance when repairing and mitigating historic structures following a disaster. The SHPO also reviews approximately

State and federal projects to identify and avoid harmful effects to historic resources.

Funding/Resources
Detailed information on funding capabilities and staffing resources for mitigation activities was not provided at this time.

United States Army Corps of Engineers (USACE)
In the past USACE has assisted the State and communities by conducting investigations related to dam breach failure analysis, public awareness and outreach related to potential flooding, wetland restoration opportunities, and the effects of SLR.

Plans and Programs
Flood Control Projects, built by the USACE, such as dams, groins, breakwaters, hurricane barriers and seawalls, protect many municipalities in Rhode Island from riverine and tidal flooding. Flood Control Projects have prevented flood damages in major Rhode Island urban areas estimated at saving millions of dollars.

The Habitat Restoration Program helps to repair the original condition of the natural area which, in the case of a coastal wetland, restores it back to its natural and beneficial use and helps to control flooding and acts as a natural buffer prior to the onset of coastal storms.

The Habitat Restoration Program has been very beneficial to RI because the Army Corps and the CRMC have been working together on one of the largest habitat restoration programs in the south county coastal lagoons in order to repair decades of damage to this environmentally fragile area. The negative result of using hard structures is that they require continual maintenance, which is a challenge to state and local governments. There may be future opportunities to work with USACE on floodplain management planning initiatives such as inundation mapping for high hazard dams.

In 2011, USACE began flood risk management investigations in the Blackstone, Woonasquatucket, Pawtuxet, and Pawcatuck watersheds. The USACE completed Reconnaissance level reports for the Wonnasquatucket, Pawtuxet, and Pawcatuck watersheds in 2012. It was determined that there is a federal interest in pursuing cost-shared feasibility studies for flood risk management in all three of these watersheds. The feasibility studies are cost shared 50/50. The USACE is currently waiting to hear from the federal sponsor on the status of non-federal funding that will be needed to begin these efforts.

Funding/Resources

Floodplain Management Services (FPMS) funding is requested annually and can be used to investigate flooding or floodplain related issues. Studies are 100%

federally funded. Planning Assistance to States (PAS) studies can address any water resource related problem and are cost shared on a 50/50 basis. Detailed information on staffing resources for mitigation activities was not provided at this time.

4.2.1.3 Transportation, Public Works, Utilities

Jamestown Public Works Department

The Jamestown Public Works Department is responsible for maintaining the Town's infrastructure and contributes to the Town's mission by providing superior public services that include maintaining and improving the condition of our streets, ensuring new development is constructed properly, excellent delivery and management of capital projects, maintaining roadways, public access rights-of-way, storm drains.

Plans and Programs

The Jamestown Public Works Department has the following plans and programs:

- Paving and Roadway Maintenance
- Public Water and Wastewater Treatment
- Snow and Ice Removal
- Roadside Mowing and Street Sweeping
- Waste and Stormwater Management
- Street and Regulatory Signs, installation and maintenance
- Tree Management on public property
- Town Building and Property Management
- GIS and Computer Based mapping
- On-Site Wastewater Management

Funding/Resources

Funding for the Public Works Department is currently provided by Annual Operating and Capital Budget and Special Area Wastewater Management Assessment which runs the Town's Wastewater Management programs for un-sewered areas. In addition, bonding is available for large expenditure items or projects.

Jamestown Harbor Commission

The Jamestown Harbor Commission, established in 1989 as the Jamestown Harbor Management Commission, has the primary responsibility under the authority of the town council and the Jamestown harbor management ordinance for regulating and managing the waters of the town of Jamestown--which includes Dutch, Gould, and Conanicut Islands (Jamestown Comprehensive Harbor Management Plan 2011).

Plans and Programs

The JHC policy for storm preparedness and emergency management is to assist the emergency management agency in improving emergency procedures so as to provide the greatest safety possible for people and property on the island and on adjacent waters. The JHC is committed to assist the emergency management agency in whatever way the agency may find useful to improve and publicize hazard mitigation plans for storms and for other emergencies that fall within the commission's area of concern (Jamestown Comprehensive Harbor Management Plan 2011).

Funding/Resources

The chief of police, as executive director, supervises the harbor staff and reports both to the commission and to the town administrator. The harbor staff consists of a harbormaster, a harbor clerk, and additional personnel as needed. The executive director is nominated by the town administrator and appointed by the town council. The harbormaster is nominated by the town administrator and appointed by the Town Council. The harbormaster reports to the executive director and, under the executive director's supervision, enforces the policy guidance of the harbor management ordinance and of the commission.

Funding for the harbor commission is currently provided by: 1) private and commercial mooring fees, town-owned dockage, and outhaul fees; 2) beach permits; 3) leases of town-owned waterfront property; 4) investment income; 5) fines; 6) occasional specific or non-specific grants or subsidies from the town and from other public and private funding sources. Under the 2004 ordinance, commission revenues are divided between harbor management and capital facilities improvement, with the latter account going into the town's capital facilities accounts fund.

National Grid

National Grid is an international electricity and gas company and strives to deliver safe and reliable energy to 487,000 electric and 250, 000 gas customers throughout Rhode Island.

Plans and Programs

The Company maintains lists of contact persons for emergency events, with names, titles, addresses, phone/cell numbers, emails and other pertinent data. During an emergency event, the Company provides a representative to the RIEMA EOC to provide Emergency Support Function (ESF) 12 support as well as facilitate communications between the Company and other response agencies. The RIEMA liaison will:

- Liaise with state EMA during the emergency.
- Provide outage information on a regular basis.
- Support ESF 12.
- Assist with the coordination of additional of requests of other responding agencies as required.

Since Hurricane Irene, National Grid has expanded the Community Liaison program to directly communicate with the towns and their Emergency Management Agencies (EMA). They coordinate the town's priorities and provide updates to town officials on our progress.

Upon request during major events the company may allocate dedicated resources (strike force teams) to assist state police, RI DOT, National Guard, and local DPW teams to assist with removal of electrical hazards in order to clear roads and facilitate other public safety activities.

Funding/Resources

National Grid is an investor-owned energy companies in the world. Funding is made available for pre- and post- disaster assistance. National Grid has a core staff of operations and support personnel staffed in Rhode Island on a normal full time basis. This staff is capable of handling day to day operations and small scale emergencies on a standalone basis. During emergency events which require additional support, the company has the ability to allocate additional operations and support resources from Massachusetts and New York service territory. Additionally the company maintains relationships with utilities and contractors from across the U.S. in order to obtain additional support and operations resources on an as needed basis (RINHMP 2014).

Rhode Island Department of Transportation (RI DOT)

The mission of RI DOT is to provide, maintain, and secure a safe intermodal transportation network that increases mobility opportunities for the movement of people and goods with the goals of enabling economic development and improving quality of life.

Plans and Projects

The RIDOT conducted the first ever collaboration among cities and towns and the State to develop a comprehensive approach to creating statewide evacuation routes. RIEMA provided the RIDOT with local evacuation routes for hurricanes. The RIDOT digitized these routes and put them up on the RIEMA website. This benefits communities in knowing where their evacuation routes are and where abutting communities are directing evacuees. Critical resource needs were also inventoried through collaboration with towns, State Police, and the RIDOT. RIDOT is currently working on Phase II of the emergency evacuation routes.

All roads in the State except rural minor collectors and local roads and streets are eligible for federal highway aid, and must adhere to federal design regulations. These include standards for the location and hydraulic design of roads and bridges that encroach on floodplains. It is the stated policy of the Federal Highway Act (FHA) to "prevent uneconomic, hazardous or incompatible use and development" of floodplains. RIDOT conducts hydraulic analyses for all new and rebuilt roadways over water bodies, including emergency construction when

feasible. While there is no set rule, it is DOT policy to build bridges to the 100-year flood standard wherever appropriate from an engineering standpoint.

RIDOT is conducting a preliminary study to determine which infrastructure throughout the state is potentially vulnerable to SLR. Information from the SHMP may be considered for incorporation into the study and data obtained through the vulnerable infrastructure study will be incorporated into the next update of the SHMP.

Funding/Resources

RIDOT receives $399.8 million dollars a year, $248 million from Federal, $49 million from State bonds, and $91.8 million from the State Gas Tax. The Division of Highway & Bridge Maintenance receives approximately $41 million per year from the State Gas Tax and the remainder of the Gas Tax pays debt services and provides funding to RIPTA. Roughly $10 million per year goes to Winter Operations. In response/recovery to federally declared disasters, capital repairs along the Federal Aid System of Highways are eligible for funding through Federal Highway Administration (FHWA).

The Department is allotted 772 full time employees comprising four (4) major divisions: Highway & Bridge Maintenance, Transportation Development, Planning & Finance, and Administrative Services.

Rhode Island Public Utilities Commission and Division of Public Utilities and Carriers

The Commission and Division execute laws relating to public utilities and carriers which govern the conduct and rates of public utilities. The commission maintains statutorily mandated annual gas and electric Infrastructure, Safety and Reliability (ISR) dockets for National Grid Gas and Electric. Projects, like flood mitigation work at substations, are taken up in those proceedings.

Plans and Programs

The Commission is the final authority for approving the ISR plan and its funding through utility rates.

Hazard mitigation programs for electric service:

- National Grid is engaged in a flood mitigation program at several substation locations.
- The Company is engaged in an Enhanced Hazard Tree Mitigation Program in addition to its cycle pruning programs.
- Inspection and maintenance program methodologies have been incorporated into annual ISR filings.

Funding/Resources

The Commission and Division review and annually approve National Grid's ISR plans, which are funded by ratepayers. The three (3)-member Commission has a staff of eight (8). The Division has a staff of 36.

Rhode Island Water Resources Board

The Water Resources Board (WRB) regulates the proper development, protection, conservation, and use of the state's water resources and manages the withdrawals and use of the waters of the state, while providing for economic development and protection of the environment.

Plans and Programs

The WRB implements capital projects that result from their plans and studies, including the 2012 Strategic Plan, managing the Water Supply System Management Plan program (WSSMP). These programs help strengthen water resources and supply in the state and prepare the state for emergency drought conditions, the ongoing effects of climate change, and the future water supply needs based on growth and water availability. Statewide strategic planning and risk evaluation assist in identifying risk, capacity, and mitigation and response strategies. Allocation research supports mitigation efforts and future allocation programs will consider the potential impacts of climate and hydrologic variability. They also administer the Drought Steering Committee, which assigns drought stages, engages in public communication, and coordinates with suppliers. One (1) policy that the WRB oversees is the Water Use and Efficiency Act, which was passed to assure reasonable, needed, and adequate water supplies through managing demand, reinvesting in water supply infrastructure and water supply resources, and protecting and preserving the health and ecological function of the water resources in the state.

Early warning of drought conditions allows for reductions in water use and preserving storage and groundwater levels. A thorough understanding of the hydrology, water use, and projected demand is a necessary first step to assessing risk and mitigating impacts of drought emergencies. Several models are publicly available and could assist in developing planning scenarios and identifying solutions

Funding/Resources

The WRB administers two (2) separate funds, the WRB's Water Quality Protection Surcharge ($4.2 million/year), and the WRB Corporate's Water Quality Protection Surcharge ($1 million/year). These surcharges are collected by major water suppliers and deposited by the WRB for water resource and water supply programs and administrative expenses. The WRB staff were reduced from six (6) to three (3) FTE's in 2011 and the board is prioritizing work in order to keep up with their statutory responsibilities.

State Building Code Commission

Rhode Island administers a State Building Code through the Building Code Commission. The Building Code is implemented statewide and enforced through

the building official in each municipality. The Code consists of uniform regulations to control construction, reconstruction, repair, removal, demolition, and inspection of all buildings. The NFIP standards, wind, and snow loads are all an integral part of the State Building Code, ensuring that all new construction and substantial improvements meet national flood resistant standards through consistent statewide application of the NFIP minimum criteria.

Plans and Programs

The Building Commission distributes a brochure entitled Rebuilding After a Storm. This brochure, sponsored by the RI Flood Awareness and Climate Change Taskforce, includes a checklist of the types of items residents should have available in their homes to prepare for hurricanes and nor'easters. It also outlines the process property owners should take if their homes have been damaged after a storm event and special procedures if their home is located in a CRMC or if they have a septic system.

The Building code has been effective in addressing structural issues as they relate to potential damage and safety issues in regard to natural disasters. The Building Commission has also been very proactive in minimizing the granting of variances to the NFIP criteria

4.2.1.4 Floodplain Management/Stormwater, Open Space, Land Conservation, Local Forestry

Rhode Island Coastal Resources Management Council (CRMC)

The CRMC plans for and manages the coastal resources of the State. Within the State Coastal Plan, there are numerous policies and programs for the protection of coastal and tidal wetlands. CRMC has statutory authority to restrict the alteration of coastal wetlands in order to preserve them. The preservation of wetlands from development and destruction will provide for the natural and beneficial use of wetlands as related to flood retention and natural buffers from coastal storms.

Plans and Programs

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

- Partnering with URI and RISG to develop a Shoreline ChangeSAMP.
- Partnering with RISG and The Nature Conservancy to examine sea level rise (SLR) impacts to coastal wetlands throughout Rhode Island.
- Working with Federal, state and local agencies for post-Sandy recovery.
- Partnering with statewide and local planners, URI, GIS coordinators, and Sea Grant to develop tools for determining vulnerability to future coastal flooding scenarios.

- Partnering with the RIEMA, the State Building Commission, and Sea Grant to develop regulations for adaptation to SLR for new and substantially improved buildings within the coastal zone.
- Developing regulations for beneficial reuse of dredged sediment for beach and dune restoration.
- Developing "living shoreline" regulations for alternatives to structural shoreline protection.

In addition, CRMC staff give numerous presentations to professional groups and the general public on coastal hazards, climate change and other topics. The CRMC has initiated a new Shoreline Change (Beach) SAMP to assess flood inundation and SLR scenarios and shoreline erosion to better inform planning efforts and decision-making to enhance community resilience. The CRMC and partners received a federal grant to evaluate SLR impacts to coastal wetlands and plan for future preservation.

Funding/Resources

The CRMC receives federal and state funds for its annual operational costs, most of which supports its staff. CRMC employs 28 staff members including 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.

Rhode Island Sea Grant College Program and University of Rhode Island Coastal Resources Center (RISG/CRC)

The RISG/CRC conducts research, training, and public outreach on priority issues of importance to coastal communities and the marine environment with the goal of providing the best available information to decision makers and the public. The program is a partnership between RISG, which is a NOAA funded program, and CRC, which is a center within the URI, with links to network of 30 Sea Grant university programs nationwide. It supports research on issues such as resilient coastal development, healthy coastal ecosystems, and safe and sustainable seafood.

Plans and Programs

RISG/CRC has done extensive research on SLR and coastal hazards in RI. They are part of several interagency work groups and have a history of working with communities and businesses to minimize impacts of coastal and riverine flooding. RISG/CRC works closely with various state agencies, including the CRMC, with a specific focus on the development of coastal policy and SAMPs.

RISG/CRC is working with communities to pilot climate adaptation planning and incorporate this information into hazard mitigation plans and local comprehensive plans. Linking planning and policy, the team has facilitated the development of SAMP with CRMC, which integrate coastal hazards into state

policy and permitting. These efforts include the Metro Bay SAMP and Shoreline Change (BEACH), SAMP. RISG funded research over the years has provided a foundation for policy development (CRMC SLR policy) and is a means to understand coastal processes (erosion mapping). In addition, maps depicting SLR have been developed for communities. RISG/CRC has a series of fact sheets and summary reports for stakeholders and decision makers on the science, issues, and actions related to flooding, SLR and other climate related risks.

Funding/Resources

RISG/CRC receives core funding from NOAA to conduct outreach activities, all other funding for the organization is supported through federal, state, or private foundation grants. RISG competitively awards research grants on a biannual basis to support priority themes. RISG/CRC has a total of eight (8) team members working on projects within Rhode Island. A portion of this team works primarily on hazard mitigation planning, SLR and climate change related issues.

University of Rhode Island Environmental Data Center (URI EDC)

The URI EDC offers a wide range of professional geospatial technology services that are available on a contractual basis to partners, including RI state and municipal governments. Services include production of risk and vulnerability maps for RI municipalities that highlight local hazard and critical facility locations.

Plans and Programs

In its role as the public distributor for data by the Rhode Island Geographic Information System (RIGIS) consortium, the URI EDC maintains the primary source for geospatial data in RI for supporting local hazard and mitigation efforts, including mapping. Hazard and risk mapping provides a critical spatial component to hazard mitigation and is critical to improving the effectiveness of mitigation programs and the broader understanding of RI risks and vulnerabilities.

Funding/Resources

The URI EDC is a professional services provider, and does not have direct funds for mitigation activities at this time. The URI EDC is staffed by six (6) to eight (8) full-time grant-funded professionals, as well as hosts a dynamic group of graduate and undergraduate student research assistants.

United States Department of Agriculture – Natural Resource Conservation Service (NRCS)

The NRCS is a federal agency that works with the people of RI to improve and protect their soil, water, and other natural resources. Private landowners have worked with NRCS specialists to prevent soils erosion, improve water quality, and promote sustainable agriculture. NRCS employees include soil conservationists and scientists, engineers, geologists, and resource planners. These experts help develop conservation plans, create and restore wetlands and

other natural ecosystems as well as provide advice on stormwater remediation and watershed planning.

Plans and Programs

The objective of the Emergency Watershed Protection Program (EWP) is to undertake emergency measures, including the purchase of floodplain easements for runoff retardation and soil erosion prevention, in order to safeguard lives and property from floods, drought, and erosion within watersheds when fire, flood, or any other natural occurrence is causing or has caused a sudden impairment of the watershed. This allows for immediate action to be taken to stabilize storm damages in watersheds following a federal declared natural disaster.

Through the Watershed and Flood Prevention Operations Program, NRCS provides technical and financial assistance to States, local governments and Tribes to plan and implement watershed project plans for the purpose of:

- watershed protection
- flood mitigation
- water quality improvement
- soil erosion reduction
- rural, municipal and industrial water supply
- irrigation
- water management
- sediment control
- fish and wildlife enhancement
- wetlands and wetland function creation and restoration
- groundwater recharge
- wetland and floodplain conservation easements

Funding/Resources

NRCS may bear up to 75% of the construction cost of emergency measures under the EWP. The remaining 25% must come from local sources and can be in the form of cash or in-kind services. Detailed information on staffing resources for mitigation activities was not provided at this time.

4.2.1.5 Emergency Management

Jamestown Police Department

The mission of the Jamestown Police Department is to protect and provide for the safety of the general public. They pursue this mission by enforcing laws of the State of Rhode Island and the Ordinances of the Town of Jamestown and by creating a proactive partnership with the residents of the town of Jamestown that best serves the needs of the community (Jamestown Police Department Annual Report, 2012).

Plans and Programs

The Jamestown Police Department has enacted three measures to serve the needs of the town in the event of an emergency. The first is a state-of-the-art emergency notification system. The community notification system is used to alert citizens about emergencies and other important community news. The community notification system, provided by Code Red, enables the town to provide essential information quickly in a variety of situations, such as severe weather, fires, floods, unexpected road closures, or evacuation of buildings or neighborhoods (Jamestown Police Department Website). Secondly, the police department ensures the proper functioning and staffing of emergency shelters in the event of emergencies. The emergency shelter is located at the Melrose School and will be operational and staffed in partnership with the Rhode Island Red Cross at any time that residents may be required to leave their homes. The occupancy capacity of this shelter is 600-1,000 persons. The staff at the shelter is trained to provide basic needs including food, water and medical treatment. Pets may also be sheltered at the Lawn Avenue School during these events. Emergency generators are installed at both schools and at the Fire Station, which, although not a certified Red Cross Shelter, may serve as a secondary shelter and can accommodate approximately 50 people (Jamestown Comprehensive Community Plan, 2014).

Lastly, the police department oversees emergency distribution of critical supplies. Jamestown EMA staff is trained to distribute medical supplies, food and water at times when it may be required. In most case this distribution will occur from the Melrose Avenue School. Additionally, the police department has completed a number of initiatives related to Medical Points of Distribution (MPOD). These include the re-writing of the town's response plan and establishing the distribution of the Pertussis (whooping cough) vaccination. The Department has modified its town-wide Emergency Operations Plan and it has received approval from the Rhode Island Emergency Management Agency in 2012.

Funding/Resources

The police department has 14 sworn police officers. Among them there are four sergeants, one lieutenant, and one detective. In addition to the chief, there are eight patrolmen, four civilian dispatchers, and one administrative assistant/secretary. The fleet consists of both four-wheel drive vehicle and patrol cars. The total public safety budget, which includes the police, the fire department and Emergency Medical Services, has increased from 22% in 1990 to 31% in the 1999/2000 and 36.5% in the 2010/2011 budget.

Jamestown Fire Department Emergency Medical Services

Jamestown Fire Department Emergency Medical Services (EMS), is an organization of volunteers that operates under the Fire Department and provides fire protection and emergency medical services to the town's residents. The Fire Department and the Emergency Medical Services were separate organizations until 2011, when the two merged (Jamestown Comprehensive Community Plan, 2014).

Plans and Programs

Jamestown Emergency Management wrote the town's Emergency Operations Plan. This plan describes the town's response to all manmade and natural disasters. The Town Council appoints the Director of Emergency Management, who is also the Chief of Police. Responsibilities of other town personnel who will be on duty to respond to a disaster are clearly delineated in the plan. In the event of an emergency or impending disaster, local officials will gather at the Police Station to mobilize resources and report on operations. All emergency responders are required to be certified through the Incident Command System (ICS). Town personnel involved in emergency management are the Public Works Department including the highway department, the Fire Department, Emergency Medical Services, the Police Department, the Town Administrator and the Finance Director.

The Fire Department has three pumpers, a ladder truck, a rescue vehicle, two tankers with a capacity of 2,500 gallons each, a portable air/cascade trailer, a bucket truck, and a rescue boat. The Emergency Medical Services facility houses ambulances space for personnel during shifts.

Funding/Resources

The Fire Department budget is included in the total public safety budget. In an effort to utilize new and innovative strategies to promote volunteerism in the Department, a financial incentive program was developed, and has been amended as recently as 2009, to encourage but not "pay" for the participation and dedication of volunteer members. It provides tax relief as well as a stipend for consistent participation in runs and training sessions. Today they have a successful 130 person volunteer Department. The Department is very fortunate to have dedicated volunteers with varied skills and talents such as electronics repair, fire alarm expertise, and truck maintenance (Jamestown Comprehensive Community Plan, 2014).

Rhode Island Emergency Management Agency (RIEMA)

The mission of RIEMA is to protect life and property in the event of a disaster or crisis situation through an emergency management program of mitigation, preparedness, response, and recovery.

Plans and Programs

Numerous hazard mitigation and disaster preparedness and recovery programs and policies are administered by RIEMA.

Critical Facilities and Infrastructure Management

The RIEMA Infrastructure Protection Program enhances critical infrastructure protection on a state wide basis across the mission areas of prevention, protection, response, recovery, and mitigation. The program, developed in December of 2010, supports the intent of Homeland Security Presidential Directive 8 "National Preparedness Goal" as well as the recent Presidential

Preparedness Directive 21 "Critical Infrastructure Security and Resiliency". The program may be extremely useful in supporting agency goals and objectives when deciding where to invest resources and grant allocations to enhance asset protection and resiliency.

To support the program, RIEMA is an accredited Department of Homeland Security (DHS) agency for the Protected Critical Infrastructure Information program. The Protected Critical Infrastructure Information (PCII) Program is an information-protection program that enhances voluntary information sharing between infrastructure owners and operators and the government. PCII protections mean that homeland security partners can be confident that sharing their sensitive security information with the government will not expose sensitive or proprietary data. DHS and other Federal, State, tribal, and local analysts use PCII to:

- Analyze and secure critical infrastructure and protected systems,
- Identify vulnerabilities and develop risk assessments, and
- Enhance recovery preparedness measures.

In addition, RIEMA maintains access to the DHS Automated Critical Asset Management System (ACAMS) to provide a secure, online database as a management and analysis platform that allows for the collection and management of critical infrastructure asset data.

State Emergency Operations Center (SEOC)

RIEMA's SEOC provides a central location from which all state government at any level can provide interagency coordination and executive decision-making in support of any regional incident or local response. This is done by: Information Collection and Evaluation, Executive Decision-Making, Priority Setting, Management, Coordination and Tracking of Resources, and Interoperable Communication Facilitation to support any overall response efforts. RIEMA's SEOC operates under the guidance of the National Response Framework (NRF) and National Incident Management System (NIMS). This is done by using the Incident Command System (ICS) and 15 predetermined ESFs.

SEOC can assist the Local Emergency Operation Centers (EOCs) or Local Incident Commanders by:

- Creating a Common Operating Picture from Informative Collection
- Evaluating information for Executive Policy Decision Making
- Creating static plans and priority setting
- Managing, coordinating and tracking resources
- Provide Interoperable Communications Support
- Manage Public Information

Rhode Island Statewide Communications Network (RISCON)

The RISCON system serves public safety agencies at the local, state, military, and federal levels. There are approximately 9,200 radios in the system, some of

which are used heavily during incidents and planned events to coordinate agencies from across the state and country. There are 29 radio sites spread throughout RI, linked by microwave. Seven (7) sites have no generator, the others have a combination of diesel and propane generators. RISP, RI DEM, and the City of Providence are the largest users of the system.

Risk MAP

Map Modernization for RI was completed in 2010 and is now included in a new FEMA initiative called Risk MAP (Mapping, Assessment and Planning). Flood Insurance Rate Maps (FIRMs) and the accompanying FIS data are used in the administration of the minimum requirements of NFIP. Rhode Island cities and towns are dependent upon the flood hazard information contained in the FIRMs and FISs for review of proposed development. As part of the NFIP, the federal government provides FIRMs to communities that agree to regulate development in high risk flood areas. The maps identifying the flood prone areas would then form the basis for the federally backed flood insurance rates. Risk MAP is designed to help increase the purchase of flood insurance and increase the public's awareness of flood prone structures and potential mitigation measures.

CRS

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 and 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 State of Rhode Island currently has five (5) communities participating in CRS, although Jamestown is not one of them. The State anticipates that the total enrollment of communities will double by the end of the 2014 due to the overwhelming interest in the program and the recent changes of BW-12. As of October 1, 2013, 49 communities within Region 1participate in CRS.

4.2.1.8 GIS (including database, modeling abilities of HAZUS, SLOSH, planning scenarios)

RI Statewide Planning Program

The RI Statewide Planning Program is tasked with preparing, adopting, and amending strategic plans for the physical, economic, and social development of the state (RIGL 42-11-10 (b) (1)), also known as the State Guide Plan, and overseeing the local comprehensive planning process, which is governed by the Rhode Island CPR and Land Use Act (RIGL 45-22.2).

Plans and Programs

The RI Statewide Planning Program provides technical planning, GIS, and community engagement assistance to municipalities, state agencies, and non-governmental organizations as requested.

Rhode Map RI: Building a Better Rhode Island is currently underway within the RI Statewide Planning Program and will have implications for hazard mitigation and resiliency. Rhode Map RI will be used to 1) produce new economic development and housing State Guide Plan elements, 2) assist municipalities in determining where local growth centers may be appropriate, and 3) incorporate equity into this and future planning processes. This plan is expected to be completed in 2015. Results of the Rhode Map RI effort will be incorporated into the next SHMP update.

The RI Statewide Planning Program, in conjunction with the RI DOT, is in the final stages of releasing LiDAR data. This data will be extremely useful in assisting the state and municipalities in preparing for natural hazards and climate change impacts as it will provide exact elevations from which to plan risk reduction measures for flood events. This data is expected to be available for general use by the end of 2013.

The program is currently managing a project to identify specific bridges, roads, rail segments, airports and other intermodal facilities that will be exposed to specific SLR scenarios. The project will use new LiDAR data generated through the support of the USGS. The first stage of the project will produce a map atlas of impacted transportation facilities. The second stage will pilot vulnerability and risk assessment methodology for a selected subgroup of assets. The project will culminate in a report that includes adaptation strategies for transportation assets and case studies.

Funding/Resources

Rhode Map RI is Funded by the US Department of Housing and Urban Development's (HUD) Sustainable Communities program.

4.2.1.9 Dam Safety

RIDEM has the responsibility to inspect dams and determine their condition (Dam Safety Program report 2012). In accordance with Dam Safety Regulations, visual inspections of significant hazard dams are required every five years (Dam Safety Program report 2012). As part of each visual inspection, the condition of the major components of the dam are subjectively rated as good, fair or poor. The major components of a dam are the embankment, the spillway and the low level outlet (Dam Safety Program report, 2012). According to the 2012 Annual Report to the Governor on the Activities of the Dam Safety Program, dams of both the North and South pond reservoirs (ID # 574 and 575) are designated as significant

hazards, thus classifying the dams as unsafe with conditions that bear unreasonable risks of failure (Dam Safety Program report 2012). In 2008 Section nine of Chapters 46-18 and 46-19 of the Rhode Island General Laws were amended to require that a city or town where a significant or high hazard dam is located complete an Emergency Action Plan (EAP) for the dam (Dam Safety Program report 2012). An EAP is a formal document that identifies potential emergency conditions and specifies pre-planned actions to be followed to minimize loss of life and property damage (Dam Safety Program report, 2012). RIEMA is responsible for coordinating development of EAPs and granting final approval of the plans (Dam Safety Program, 2012).

The most recent inspections for the other four dams in Jamestown, Rainbow Upper and Lower (ID # 651 and 652), Tefft Pond (ID # 738), and West Reach Drive Pond (ID # 739), were performed in 2008 and determined that these dams were low hazards.

4.2.2 National Flood Insurance Program, CRS

Floodplain management begins at the community level with operation of a community program of corrective and preventative measures for reducing flood damage. These measures take a variety of forms; for inclusion in the NFIP, communities adopt their flood hazards maps and the community Flood Insurance Study (FIS). In addition, a FEMA-compliant floodplain management ordinance that regulates activity in the floodplain is adopted and enforced.

A community's agreement to adopt and enforce floodplain management ordinances, including regulation of new construction in the SFHA, is a requirement for making flood insurance available to home and business owners. Currently more than 24,624 communities nationwide voluntarily adopt and enforce local floodplain management ordinances that provide flood loss reduction building standards for new and existing development. To address the threat of flood damage, many communities and residents participate in the NFIP. Homeowner insurance policies do not cover damage from flood. As of July 31, 2013, all 39 communities in Rhode Island were participating in the NFIP. Currently, there are 218 NFIP policies in Jamestown, with coverage totaling $62,611,600 with an annual premium of $199,430.

The Community Rating System (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 (3) goals: the reduction of flood losses, facilitating accurate insurance rating and 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. Currently, five Rhode Island communities participate in the CRS and receive flood insurance premium discounts, but the Town of Jamestown is not one of them.

NFIP

A major objective for floodplain management is to continue participation in the NFIP. Jamestown has been a participant in the National Flood Insurance Program since 1978.

NFIP, established by Congress in 1968, provides flood insurance to property owners in participating communities. This program is a direct agreement between the federal government and the local community that flood insurance will be available to residents in exchange for the community's compliance with minimum floodplain management requirements such as the adoption of a floodplain management or flood damage prevention ordinance. Since homeowners' insurance policies do not cover flooding, a community's participation in the NFIP is vital to protecting property in the floodplain and ensuring that federally backed mortgages and loans can be used to finance property and improvements within the SFHA (RIHMP 2014)

Pursuant to the Flood Disaster Protection Act of 1973, many forms of federal financial assistance, including disaster assistance and federally-insured loans, related to structures located in the SFHA are contingent on the purchase of flood insurance. Such federal assistance includes not only direct aid from agencies, but also products and assistance from federally insured institutions.

Because Jamestown maintains compliance with the minimum floodplain management requirements, property owners are able to purchase insurance through the NFIP. There is no requirement that the property be located within an identified SFHA. Instead, any property in the town can be insured through the NFIP as long as Jamestown maintains its good participant standing.

In 2013 there was a nationwide project underway to update the FEMA Flood Insurance Rate Maps (FIRMs). As new data became available, many of the old FIRMs were outdated (RIEMA 2014). The maps were completed by FEMA contractor, STARR, through extensive modeling using new transects, surveys, and coastal analyses (RIEMA 2014). New FRIMs for Newport County were adopted by the Jamestown in 2013. Adopting the FIRMs kept Jamestown in good standing with NFIP.

4.4 Capability Needs/Challenges – Summary

TBD

5.0 Mitigation Strategy

5.1 Goals

The Jamestown Natural Hazard Mitigation Committee (JNHMC) developed the original (2001) draft of this Natural Hazard Mitigation Plan for the purpose of protecting residents and property. The plan is also intended to maintain quality of life to the greatest extent practicable in the event, and aftermath, of natural disasters. To address the potential hazards and their impact on the town, the JNHMC established mitigation goals and objectives. As part of the development process, each goal and objective was reviewed to validate relevancy. To facilitate consistency, each goal, objective and mitigation action was reviewed in relationship to the goals and objectives provided in the State of Rhode Island 2014 Hazard Mitigation Plan. Additionally, goals and objectives were reviewed to ensure they support the long-term vision of the town and support a sustained program of hazard reduction and/or elimination. The goals established by the JNHMC are:

- **Goal 1:** Reduce impacts from flooding and erosion
- **Goal 2:** Protect essential services and infrastructure
- **Goal 3:** Protect and preserve historic records
- **Goal 4:** Establish conditions for improved post-disaster recovery

Objectives have been crafted to support the achievement of the above goals. These objectives are intended to guide the strategy used in goal achievement. The JNHMC prioritized the selection of objectives that support multiple goals. The selected objectives are:

- **Objective 1:** Incorporate hazard mitigation review in all development projects.
- **Objective 2:** Repair and maintain coastal areas susceptible to erosion.
- **Objective 3:** Enhance Geographic Information Systems (GIS) capabilities to support assessment and planning activities.
- **Objective 4:** Maintain and improve critical infrastructure durability to include instituting protective measures for systems and facilities.
- **Objective 5:** Continue to manage property development and land use through creation and enforcement of appropriate zoning ordinances.
- **Objective 6:** Develop and implement public outreach programs to improve individual preparedness.
- **Objective 7:** Develop and maintain debris management plans to improve post-disaster recovery efforts.

- **Objective 8:** Develop and maintain sufficient shelter capacity to support residents and visitors in the event transportation routes become untenable.

5.2 Development & Update of Strategy & Actions – Methodology

These mitigation actions serve as project objectives for the town staff and will be implemented according to priority, time frame and availability of funding. For all recommended actions, the lead department or agency responsible for that action is listed first and is followed by other relevant departments/agencies.

5.2.1 Identifying Types of Mitigation Actions

Based on the risk and vulnerability analysis, the Jamestown Natural Hazard Mitigation Committee has recommended several mitigation actions that will help lessen Jamestown's vulnerability to natural hazards. These actions help guide funding decisions for both pre- and post-disaster mitigation projects. Well thought-out mitigation actions will also receive priority status for FEMA 404 project money that is distributed through RIEMA. For an explanation of various financing options, see Appendix A and B.

The Risk Assessment Matrix is the foundation for the recommended mitigation actions outlined in Section 4.2. The LHMC prioritized the 11 vulnerable areas on the matrix based on historical damage, safety of the population, new development in high-risk areas, value of property at risk, and consistency with town-wide goals and objectives. Issues that were considered include health risk, structural damage, access/egress for evacuation, structures that house people with special needs and structures that house a large portion of the town's population.

Mitigation actions have been identified for the following categories:

- Planning and Regulations
- Property Protection, Structural Projects and Maintenance
- Public Information, Outreach and Incentive Programs
- Emergency Services (Protection of critical facilities)
- Post-disaster Opportunities

The time frames for the mitigation actions that are identified in this section indicate the initiation of the project and assume that several projects will be ongoing. The time frames used for this Plan are as follows:

- Near-term - 1-2 years

- Medium-term- 2- 3 years
- Long-term - > 4 years

5.2.1.1 Existing Activities That Support Mitigation

Flood Hazard Mitigation

The Town of Jamestown has implemented a wide range of measures to mitigate its flooding hazards. They include the following:

Early Flood Hazard Preparations. When RIEMA informs the Town of Jamestown that a hurricane or Nor'easter is likely to .hit the island, the local Emergency Operations Team (which is comprised of JNHMC members) holds the first in a series of meetings- typically five days before the storm's arrival- to prepare response plans. (The Team will keep meeting throughout the storm event) The Team is comprised of the Police Chief, who also serves as the town's Emergency Management Director, along with the Fire Chief, the Public Works Director and the Town Administrator. Early preparations enable the town to assess potential flooding hazards to residents living in flood-prone areas.

Early Notification. The Jamestown Police Department has implemented a state-of-the-art Emergency Notification System which alerts residents to imminent emergencies. The system sends automated alerts to the phone numbers and email addresses provided by residents to the Police Department, which transmits weather-related hazard warnings, such as flooding threats, to residents of the island. (Disabled residents requiring registration assistance for the Department of Health at Risk Registry are provided assistance by the Police Department.) The system is also used to issue evacuation orders. Moreover, in some cases- such as the run-up to Hurricane Irene – Police and Fire Department personnel delivered weather warnings on a personal, door-to-door basis, as well.

Shelter. The Emergency Notifications from the Police Department advise residents that the town has an emergency shelter for residents whose dwellings are, or may be, flooded. Currently, the town is capable of providing public shelter for approximately1,000 individuals, The Melrose School, which serves as the town shelter, is certified by the American Red Cross. Town shelter staff have been trained to provide such basic needs as food, water, and medical treatment. Pets may be sheltered at the Lawn Avenue School.

Backup Generators. Both the Melrose and Lawn Avenue Schools are equipped with backup generators. The other town facilities with backup generators are: the Fire Department; the Police Station; the Highway Garage; the Wastewater Treatment Plant; and each of the four wastewater pump

stations. Town Hall has a backup generator switch installed that is capable of connection to a portable generator in case of emergency in advance of every serious weather event. Additionally, the Public Works Department has a trailer-mounted standby generator whose voltage would be suitable to power any of the town utility sites.

East Ferry and Dumplings Seawall Repairs. The East Ferry seawall – the only structure protecting Conanicus Ave. and a portion of downtown Jamestown from an East Passage storm surge -had deteriorated to the point where its integrity could not be assured over the long term. The Town Council in 2012 agreed to proceed with repair of both seawalls which is now complete.

Mackerel Cove Beach Restoration. The dunes separating Mackerel Cove from Southwest Ave. were severely damaged by Superstorm Sandy. The dunes are an essential barrier against flooding from Narragansett Bay, and the town intends to re-vegetate the dunes to ensure they are not gradually dissipated by wind. A shortage of beach grass forced the town to abort the near-term planting initiative, but it remains a high priority.

North Pond Dam Management. The state Department of Environmental Management has designated the North Pond dam, which retains the waters of the town's main reservoir, as a "Significant Hazard Dam." The designation means that a breach of the dam would have significant impacts on downstream infrastructure; which, in the case of this dam, would be North Road. Because the dam is regularly maintained, the structure is in good shape. Nevertheless, the town's Emergency Management Plan includes response measures for a potential dam failure.

Road Debris Management. The Department of Public Works has no formal plan but employs debris management strategies when necessary which are designed to promptly gather and dispose of any debris and tree limbs which accumulate on roads during, or in the aftermath, of high winds. Ensuring that culverts and storm drains are clear of debris reduces road and property flooding during heavy rainfall. In the event that a combination of floodwaters and strong winds topple trees, the Fire Department is equipped with chain saws to clear a path for fire and rescue vehicles. A formal Plan will soon be formalized.

Toppled Utility Poles. If flooding and strong winds topple a utility pole(s) as well as trees, the Fire Department would have to wait until National Grid personnel shut off power to the toppled lines before attempting to clear a path. Until Grid personnel reach the scene, the Fire Department blocks off the area with their trucks. National Grid now deploys a maintenance truck in Jamestown before a serious storm strikes the island, which is a critical step

because a drenching storm with extremely high winds would force a closure of both bridges leading into and out of Jamestown.

Flood Hazard Mapping. Ascertaining the location of floodhazard areas as accurately as possible is a vital piece of flood hazard mitigation. To this end, RIEMA, FEMA, the U.S. Army Corps of Engineers and Rhode Island communities are engaged in a cooperative effort to update Rhode Island flood maps. The revised flood maps are designed to view on computers; to use in the Geographic Information System (GIS); and to print as paper maps. The flood maps are composites of a photographic base map, topographic data, and flood layers. The layers can be used to, among other purposes, more easily determine if a specific building or site is in a Special Flood Hazard Area or Floodway.

R**egulatory Natural Hazard Mitigation.** The town's present Building Code allows construction in flood hazard areas (where permitted by zoning), provided that the building is structurally flood-proofed and the first floor elevation is above the base flood elevation. Special flood hazard insurance is available through the Federal Government to property owners who build in flood hazard areas if the builder takes these structural measures.

Open Space Acquisition. Of Jamestown's 6,034 acres, 893 are available for development. Hard surfaces in developed land will shed, instead of absorbing, rainfall and floodwater. In a sustained effort to mitigate flooding hazards, and preserve the largely rural character of the town, Jamestown has purchased the development rights to a large amount of land, much of which is open space. All told, over 1,700 acres of Jamestown land have been permanently protected,, including the farmland surrounding the South Pond reservoir and the inland salt marsh. The farmland was purchased in 2007 at a cost of $6.5 million, with $3.5 million of the cost borne by the state and the rest financed by a Jamestown bond issue. In 2011, the town acquired, and has permanently protected, 100 tax-delinquent lots in the Shores Area (northwest Jamestown), thereby enhancing groundwater protection for well-dependent residents in those subdivisions.

Wind Hazards Mitigation

The Town of Jamestown has implemented a number of programs and measures to mitigate the hazards from hurricane- and gale-force winds.

Early Wind Hazard Preparations. When RIEMA informs the Town of Jamestown that a hurricane or Nor'easter is likely to strike the island with heavy wind, the local Emergency Operations Team (which is comprised of JNHMC members) holds the first in a series of meetings- typically five days before the storm's arrival- to prepare response plans. (The Team will keep meeting throughout the storm event.) The Team is comprised of the

Police Chief, who also serves as the town's Emergency Management Director, along with the Fire Chief, the Public Works Director and the Town Administrator. Early preparations enable the town to assess potential wind hazards to residents and vulnerable structures.

Early Notification. The Jamestown Police Department has implemented a state-of-the-art Emergency Notification System which alerts residents to imminent emergencies. The system sends automated alerts to the phone numbers and email addresses provided by residents to the Police Department, which transmits weather-related hazard warnings, such as flooding threats, to residents of the island. (Disabled residents requiring registration assistance are provided assistance by the Police Department.) The system is also be used to issue evacuation orders. Moreover, in some cases – such as the run-up to Hurricane Irene – Police and Fire Department personnel delivered weather warnings on a personal, door-to-door basis, as well. Such alerts would warn residents that Jamestown is in the path of a storm with extremely dangerous winds.

Shelter. The Emergency Notifications from the Police Department advise residents that the town has an emergency shelter for residents who have been evacuated from their homes; residents whose dwellings have been severely damaged by heavy wind; and residents for whom a loss of electrical power would pose a health and safety. Currently, the town is capable of providing public shelter for 1,100 people at The Melrose School, which serves as the town shelter, and is certified by the American Red Cross. Staff at the Melrose Shelter have been trained to provide such basic needs as food, water, and medical treatment. Pets may be sheltered at the Lawn Avenue School.

Backup Generators. Both the Melrose and Lawn Avenue Schools are equipped with backup generators. The other town facilities with backup generators are: the Fire Department (which is replacing its backup with a new generator); the Police Station; the Highway Garage; the Wastewater Treatment Plant; and each of the four wastewater pump stations. Town Hall does not have a backup generator (as a result of budgetary constraints); however, the town rents a backup generator for Town Hall in advance of every serious weather event. Additionally, the Public Works Department has a trailer-mounted standby generator whose voltage would be suitable to power any of the town utility sites.

Condemnation. The Town of Jamestown may, upon the recommendation of the Town Engineer and Building Official, condemn a deteriorating structure which is unlikely to survive high winds. The Town of Jamestown recently took this step with its Golf Course Building, which- despite the many municipal functions it served – was deemed unlikely to withstand either high winds or substantial snow accumulation.

Tree Trimming. A key element of the plan to mitigate wind hazards is Jamestown's Tree Damage Mitigation program, which targets for trimming or elimination any trees or tree branches which could break and bring down power lines in high winds. The work is performed by the Department of Public Works as well as National Grid.

Debris Removal. The Department of Public Works has implemented a Debris Management Plan, which is designed to promptly gather, and dispose of, any debris and tree limbs which accumulate on roads during, or in the aftermath, of high winds.

Snow and Ice Hazard Mitigation

Early Winter Storm Preparations. When RIEMA informs the Town of Jamestown that a winter Nor'easter is likely to strike the island with some combination of heavy wind and snow or ice, the local Emergency Operations Team (which is comprised of JNHMC members) holds the first in a series of meetings- typically five days before the storm's arrival- to prepare response plans. (The Team will keep meeting throughout the storm event.) The Team is comprised of the Police Chief, who also serves as the town's Emergency Management Director, along with the Fire Chief, the Public Works Director and the Town Administrator. Early preparations enable the town to assess potential snow or ice accumulations and their associated hazards to residents and structures.

Early Notification. The Jamestown Police Department has implemented a state-of-the-art Emergency Notification System which alerts residents to imminent emergencies. The system sends automated alerts to the phone numbers and email addresses provided by residents to the Police Department, which transmits weather-related hazard warnings, such as blizzard and ice storm threats, to residents of the island. (Disabled residents requiring registration assistance are provided assistance by the Police Department.) The system is also be used to issue evacuation orders. In some cases – such, as the run-up to Hurricane Irene – Police and Fire Department personnel deliver severe-weather warnings on a personal, door-to-door basis, as well.

Shelter. The Emergency Notifications from the Police Department advise residents that the town has an emergency shelter for residents who have been evacuated from their homes; those whose dwellings have been severely damaged by snow or ice; and those for whom a loss of electrical power would pose a health and safety risk. Currently, the town is capable of providing public shelter for 1,100 individuals. The Melrose School, which serves as the town shelter, is certified by the American Red Cross. Shelter staff are trained to provide such basic needs as food, water, and medical treatment.

Pets may be sheltered at the Lawn Avenue School during serious winter storms.

Backup Generators. Both the Melrose and Lawn Avenue Schools are equipped with backup generators. The other town facilities with backup generators are: the Fire Department (which is replacing its backup with a new generator); the Police Station; the Highway Garage; the Wastewater Treatment Plant; and each of the four wastewater pump stations. Town Hall does not have a backup generator (as a result of budgetary constraints); however, the town rents a backup generator for Town Hall in advance of every serious weather event. Additionally, the Public Works Department has a trailer-mounted standby generator whose voltage would be suitable to power any of the town utility sites.

Snow Plowing. The Town of Jamestown is well equipped to mitigate the snow accumulation from a snowstorm or blizzard. The town has 10 vehicles which can be equipped with plowing blades: six of them are heavy dump trucks; the others are light-duty trucks. The town prepares for the winter storm season by storing enough road salt for three, average snowstorms.

Drought Hazard Mitigation

The Town of Jamestown has taken many steps to avoid a repetition of the water crisis of 1993. Those steps include:

The North Kingstown Connection. In the event that a serious drought recurs, and reservoir levels drop precipitously, Jamestown now has the ability to draw water directly from the North Kingstown water system. Both of the towns have installed pern1anent connections to their reservoirs via pipeline valves positioned at each end of the Jamestown Bridge. To reach North Kingstown's water supply, Jamestown purchased 8,000 linear feet of flexible water piping; in a drought emergency, the Jamestown Public Works Department would unspool the piping along the Jamestown Bridge to the valve on the North Kingstown side of the bridge.

Regulatory Restrictions. In the aftermath of the 1993 drought, Jamestown imposed strict prohibitions to reduce water use during summer months. All lawn irrigation is prohibited from June 1 through Aug. 31; when the North Pond water levels drops 42 inches below the top of the spillway, all other outdoor water uses are prohibited, as well.

Water Resources Protection. Given its vulnerability to a water-supply crisis, Jamestown has taken major steps to protect, and shield from development, the watersheds around the two reservoirs (which are recharged by groundwater as well as precipitation). After the 1993 drought, water-resource protection was identified as a primary goal in Jamestown's Comprehensive Community Plan.

In support of that goal, the town designated the Jamestown Brook Watershed (which encompasses the two reservoirs and the town's wellhead protection area) as a Watershed Conservation District. The town also purchased development rights to open space in the areas around the reservoirs (see Section 3.2, "Open Space Acquisition"); additionally, it acquired 100 tax-delinquent lots in the Shores area, thereby enhancing groundwater protection in the northwestern portion of the island. As a result of those purchases, 73 percent of the watershed acreage is now permanently protected. The town has also adopted an innovative ordinance which establishes performance standards for wastewater treatment, wetlands buffer protection and storm water management through limits on impervious cover and runoff standards for development in densely developed areas.

Wildfire Hazard Mitigation.

Jamestown has taken a variety of steps to ensure that wildfires are not sparked by human activity. Under ordinance revisions adopted by the town since its 1993 drought, every controlled bum (such as yard waste bums) must be permitted by the Fire Department. Camp fires less than two feet in diameter are exempted from the permitting requirement, but even those would be banned during prolonged droughts. Fire Department personnel listen every morning to reports from an association of other Rhode Island departments ("Northern Control") to decide if the day will be a "red flag" day - meaning no burning whatsoever. (The department may reach out to the Department of Environmental Management for additional input.) If a wildfire breaks out somewhere in the island's 916 acres of open or forested acreage, the James town Fire Department can respond with two fire trucks (one of which is a tanker). If the Department decides that assistance is necessary, it would request additional equipment and personnel from the Exeter Fire Department, with which the town has a cooperative agreement. Currently, the Fire Department is limited to one fire station; however, the Department- in consultation with the Town Council- plans to launch an engineering study to ascertain the costs and feasibility of building a second station on the north end of the island.

Lightning Hazard Mitigation

The best approach to mitigating the human safety hazards from lightning strikes is warning residents that severe thunderstorms are approaching. The Jamestown Police Department has implemented a state-of-the-art Emergency Notification System which alerts residents to imminent weather threats. The system sends automated alerts to the phone numbers and email addresses provided by residents to the Police Department, which transmits weather-related hazard warnings, such as flooding threats, to residents of the island. (Disabled residents requiring registration assistance are provided assistance by the Police Department.) Advising people that it would be dangerous to be

outdoors during an approaching thunderstorm will significantly reduce the risk that people will be, injured or killed by lightning strikes.

Earthquake Hazard Mitigation

To mitigate the earthquake hazards in Jamestown, the town has established stronger building codes for construction and re-construction permits. These codes ensure that structures other than single- or two-family dwellings built or modified since 1977 will withstand an earthquake that registers up to 3.0 on the Richter Scale.

Tornado Hazard Mitigation

The best approach to mitigating the human safety hazards from tornados is warning residents that severe storms with the potential to spawn tornados are approaching. The Jamestown Police Department has implemented a state-of-the-art Emergency Notification System which alerts residents to imminent weather threats. The system sends automated alerts to the phone numbers and email addresses provided by residents to the Police Department, which transmits weather-related hazard warnings, such as thunderstorm and tornado threats, to residents of the island. (Disabled residents requiring registration assistance are provided assistance by the Police Department) Advising people that it would be dangerous to be outdoors during an approaching storm with tornado potential will significantly reduce the risk that people will be injured or killed if a tornado should touch down in Jamestown.

Coastal Erosion Hazard Mitigation

To prevent further erosion of the barrier beach at Mackerel Cove, the town obtained a grant, post-Sandy, to re-vegetate the dunes with dune grass; however, a shortage of available seedlings has held up that project. Recently, residents have advised the Town Council to consider planting beach plum trees or beach pea plants. The need to mitigate the erosion hazards to Bayview Ave. is equally pressing. Currently, the town is seeking a grant to help pay for the installation of rip-rap along the shoreline. The rip-rap should significantly slow erosion along that shoreline. Erosion also poses a threat to other areas along the East Passage. Both of those areas (East Ferry and the Dumplings) are protected by seawalls, and both walls have recently been repaired.

5.2.2 STAPLEE

The Jamestown Natural Hazard Mitigation Committee developed and refined hazard mitigation actions using careful evaluation criteria based on the

concept of STAPLEE. STAPLEE is an acronym for a general set of criterion common to public administration officials and planners. It stands for the Social, Technical, Administrative, Political, Legal, Economic, and Environmental criterion for making planning decisions. JNHMC ranked each of the mitigation strategies by utilizing the STAPLEE criterion. The Committee asked and then answered questions in order to determine the acceptability of the proposed mitigation action when being viewed in terms of six distinct criteria. See Table 5-1 for further explanation of the STAPLEE criterion.

Table 5-1. STAPLEE Criteria for Selecting Mitigation Actions

Criteria	Explanation
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 the 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? Will the Mayor, his Cabinet, County Council and other decision-making political bodies support the mitigation measure?
Legal	Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity? Is enabling legislation necessary? Are there any legal side effects (e.g. could the action be construed as taking)? Will the community be liable for action or lack of action? Will the activity be challenged?
Economic	What are the costs and benefits of this action? Does the cost seem reasonable for the size of the problem and the likely benefits? Are maintenance and administrative costs taken into account as well as initial costs? How will this action affect the fiscal capability of the community? What burden will this action place on the tax base or the local economy? What are the budget and revenue effects of this action? Does the action contribute to other community goals, such as capital improvements or economic development? What benefits will the action provide?

Environmental	Sustainable mitigation actions should not have an adverse effect on the environment, they should comply with federal, state, and local environmental regulations and should be consistent with the community's environmental goals.

The Committee responded to each of these above listed criteria, with a numeric score of "1" (indicating low impact), a "2" (indicating medium impact), and a "3" (indicating high impact). These numbers were then totaled and developed into an overall priority score detailed in Table XX. Also included in this table is the department responsible for implementing the action and the project and cost justifications.

A total of 13 actions were developed by the JNHMC along with input from stakeholders and the general public. See Table XX for a description of each Action Strategy and its respective priority scores.

5.2.3 Mitigation Actions, Priorities, and Timeframes

5.2.3.1 Planning and Regulation Actions

Action 1: Future Proposed Development- Medium Priority
Description: Map vulnerable areas and critical facilities for future proposed residential and commercial development.
Responsible Department: Planning Department with assistance of GIS
Time Frame: Near-term, Re-evaluate as development occurs
Resources Available: Town annual budget, staff time, Jamestown Natural Hazard Mitigation Plan

Action 2: Review Stormwater Mitigation Plan Requirements - Medium Priority
Description: Jamestown has a Stormwater Mitigation Plan as required by RIDEM and required Annual Reports are submitted. The town is consistently meeting the maintenance of town drainage systems as required by our general permit issued by RIDEM. This program needs annual review to insure we are meeting our general permit requirements.
Responsible Department: Public Works Department
Time Frame: Medium-term
Resources Available: Town annual budget- Capital budget

Action 3: Review the Harbor Management Plan and the Emergency Operations Plan for Town of Jamestown - Medium Priority
Description: It is important to review and revise these plans to ensure the adequacy of emergency operations. Revisions should be proposed as

necessary to meet adequacy. A schedule for review and revision should be devised. Also, training and education of key personnel needs conducted so all responsibilities are outlined and known.
Responsible Department: Harbor Management Commission and Jamestown Emergency Management Director
Time Frame: Near-term
Resources Available: Town annual budget, staff time

5.2.3.2 Property Protection, Structural Projects and Maintenance

Action 4: North Pond Dam- High Priority
Description: An in depth engineering evaluation is scheduled for 2013-14 to assess the dam structure. It is anticipated that structural repairs will be needed. Repairs are anticipated to be budgeted within the 5 year capital infrastructure replacement plan.
Responsible Department: Public Works
Time Frame: Medium-term
Resources Available: Town Annual Budget

Action 5: Regular Tree Trimming- High Priority
Description: Continue to implement the Tree Damage Mitigation Program to trim trees adjacent to utility lines to avoid power outages and therefore, maintain communication systems during and after hurricanes, thunderstorms, ice storms, and windstorms. National Grid complete "trimmed" the island in 2012 as part of their vegetation management planning. The town will continue to provide emergency tree and limb emergency removal and essential clean up after storm events per the Debris Management Plan as noted below.
Responsible Department: Department of Public Works will coordinate with National Grid to defray local costs
Time Frame: Near-term
Resources Available: Town annual budget

Action 6: Develop Debris Management Plan- High Priority
Description: Fallen debris and tree limb resulting from thunderstorms, hurricanes, ice storms, and windstorms collect under bridges, dams and block storm culverts. Prompt removal and proper siting of this material decreases potential of road and property flooding. A comprehensive tree-trimming plan will minimize potential impacts in addition to decreasing the costs of cleanup.
Responsible Department: Public Works Department

Time Frame: Near-term
Resources Available: Town annual budget

Action 7: Infrastructure Improvements - High Priority
Description: Evaluate existing condition of bridges concerning their foundation, structure, and drainage properties. Retrofit and repair as needed.
Responsible Department: RIDOT
Time Frame: Long-term
Resources Available: State funding, RI Transportation Improvement Program

Action 8: Road Hazard Assessment- High Priority
Description: Evaluate town and state roads that are at risk for impact due to storm events/sea level rise and determine capital budget implications or other funding sources. These include at a minimum North Road at the Creek, Beavertail Road at Mackerel Cove, East Shore Road at Potter Cove, and southern Bay View Drive near Bryer Beach.
Responsible Department: Public Works Department and Planning Department
Time Frame: Long-term
Resources Available: State funding, RI Transportation Improvement Program. Local funding

Public Information, Outreach and Incentive Programs

Action 9: Public Education and Outreach- High Priority

a.) **Description:** Develop and make preparedness and response material available concerning evacuation routes, emergency shelters, and maps of risks and critical facilities of Jamestown. Jamestown introduced the Code Red Calling System which notifies residents via phone of an impending emergency with 72 hour notice. Distribute material concerning proper building practices and how to retrofit structures against future damage.
Responsible Department: Jamestown Emergency Management Director, Police and Fire Departments and Building Inspector.
Time Frame: Near-term, Re-evaluate every 3 years
Resources Available: Jamestown Natural Hazard Mitigation Plan

b.) **Description:** Organize and conduct training program for town officials, employees, boards, and commissions regarding hazard mitigation, including flood mitigation, and actions/responsibilities during a natural disaster.
Responsible Department: Natural Hazard Mitigation Committee

Chair
Time Frame: Medium-term; Every 3 years
Resources Available: Town annual budget

Emergency Services (Protection of critical facilities)

Action 10: Inflow and Infiltration of Sewer System-Medium Priority
Description: One major problem with the existing sewer lines is the infiltration of groundwater into the lines. The infiltration reduces the amount of the system's treatment capacity. During heavy rainstorms, up to 1-million gallons per day infiltrates the sewer lines. Additionally, the connection of gutter drains and sump pumps to the sewer lines causes a further reduction in the treatment capacity of the system. The infiltration has been aggressively reduced by door to door searches during the upgrading of water meters and by smoke testing. The town should continue to mitigate this problem.
Responsible Department: Public Works Dept.
Time Frame: Medium-term
Resources Available: Town annual budget

Action 11: Water Treatment Facility- Low Priority
Description: The access to the Water Treatment Facility is within a flood zone. There are opportunities to access the plant other ways. This should be pursued as a short-term project. The current plant is out of harms way due to the raising of the new plant above the flood zone. The long term, low priority project involves planning for a new plant at a higher elevation. This will be necessary as sea level rises due to climate change. This may require acquiring another property for this purpose. The planning for this project should be considered in the next decade.
Responsible Department: Town Administration/Town Council/Public Works Dept.
Time Frame: Long-term
Resources Available: Town annual budget

5.2.3.4 Post-disaster Opportunities

Action 12: Replenish Beach with Sand Overwash - High Priority
Description: Sand overwash will be cleared off the streets and temporarily stored on the beach parking lots until the debris can be separated and the sand can be returned to the beaches.

Responsible Department:
Time Frame:
Resources Available:

Action 13: Continue Agreement with North Kingstown for purchase of Potable Water - High Priority
Description: The Town of Jamestown has had the need to purchase water from the Town of North Kingstown in the 1990's. The hose went across the old Jamestown Bridge. When that bridge was demolished, the town purchased a reel hose for this purpose. It has yet to be used for lack of need. The town should maintain and test regularly the emergency hose and reels so that they are ready if needed. In addition, the town should keep the agreement current with the Town of North Kingstown.
Responsible Department: Town Administrator/Public Works Dept.
Time Frame: Near-term
Resources Available: Town annual budget

5.3 NFIP

The National Flood Insurance Program (NFIP) was created in 1968 to help cut taxpayer costs for federal disaster relief. In order for the residents of a community to be eligible for federal flood insurance, the community must agree to abide by the NFIP's minimum requirements for floodplain management. These requirements include the adoption of a floodplain management ordinance or bylaws. In 2010, Jamestown adopted a "Community flood plain ordinance for special flood hazard areas" as part of its Zoning Ordinance. This ordinance will be amended in 2013 to comply with the new FEMA flood hazard determinations (FHDs) affecting the Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS) report for the Town of Jamestown.

Jamestown participates in the NFIP through an agreement with the Federal government. Through the NFIP, the FEMA provides maps of hazardous areas and provides federally backed flood insurance. In return, communities agree to enact and enforce floodplain regulations intended to minimize the threats to life and property. The NFIP for Jamestown currently insures a total of 214 policies. 46 have made claims concerning flood damage since 1978.

All 39 municipalities in Rhode Island participate in the NFIP, and they are cooperating with FEMA, the Rhode Island Emergency Management Agency, and the U.S. Army Corps of Engineers to modernize their flood maps. New and revised flood maps are designed to view on a computer, to use in Geographic Information System (GIS), or to print as paper maps. Flood maps are composites of a photographic base map, topographic data, and flood layers. Flood layers can be used with parcel information or other data to

more easily determine if a specific building or site is in a Special Flood Hazard Area or Floodway.

The town's Building Code regulations allow construction in flood hazard areas (where permitted by zoning), provided that the building is structurally flood-proofed and the first floor elevation is above the base flood elevation. Special flood hazard insurance is available through the Federal Government to property owners who build in flood hazard areas if the builder takes these structural measures.

Table 5-2 represents National Flood Insurance information for the town of Jamestown. It can be seen from this table that although Jamestown has 212 policies there has only been $40,901.00 in payments since 1978. This indicates that although several residents have purchased flood insurance, few claims are made and they are for minor damages and no repetitive losses have been filed.

Table 5-2. National Flood Insurance Information for Jamestown, RI

Total Flood Insurance Policies	Value of Property Covered	Number of Claims since 1978	Payments since 1978	Number of Repetitive Loss
214	$59,667,600.00	46	$179,0	1

5.4 Financing Options

In Jamestown's budget process, all line items are discussed and debated during workshops, public hearings, and Town Council meetings. If is only after these rounds of public input that the budget recommended by the Town Administrator goes to the Council for final deliberations and a vote. (In some cases, votes are held on individual line items). Once the Council adopts a budget, it proceeds to the annual Financial Town Meeting- where it is presented to residents for approval. During the Financial Town Meeting, additional budget adjustments (also known as warrants) may also be offered by the public for a vote.

Because the public is thoroughly engaged in every stage of this process, any line item related to natural hazard mitigation is "on the table" for debate. Examples of natural hazard-mitigation proposals which have sparked public debate in recent years include the replacement of the East Ferry and Dumplings seawalls, and the merger of the Fire Department with the Emergency Management Service.

Over the last 23 years, Jamestown voters have consistently supported Council recommendations to increase spending for public safety enhancements. In Jamestown's current fiscal year, 36.5% of the general government budget is allocated to public safety, versus 31% in 2000 and 22% in 1990. (Public safety expenditures include those for the Police and Fire Departments, Emergency Medical Services, and Office of Building Official.)

Although the budget appropriation to the Department of Public Works has decreased to 24% of the town budget this fiscal year, its share had been 26% in fiscal year 2000. This decline - notwithstanding greater DPW spending during this period- is largely attributable to decreases in the town's share of insurance payments on behalf of DPW employees. The decline in DPR's share of the public safety budget has not affected DPW's hazard-mitigation responsibilities in anyway.

5.5 Table/Matrix

ACTION #	PRIORITY	POTENTIAL PROGRAM	DESCRIPTION OF STRATEGY	AFFECTED LOCATION	TYPE OF ACTIVITY	RELATED GOAL(S) / Objectives	FUNDING SOURCES	TIMEFRAME	RESPONSIBLE DEPARTMENT	STATUS
1	Medium	Future Proposed Development	Map vulnerable areas and critical facilities for future proposed residential and commercial development	Town-wide	Planning and Regulations	1,4 1,3,5	Town Annual Budget, Staff Time	Near-term	Planning Department	
2	Medium	Review Stormwater Mitigation Plan Requirements	Annual review of stormwater mitigation plan	Town-wide	Planning and Regulations	1,2,3,4 14,5	Town Annual Budget	Medium-term	Public Works Department	Ongoing
3	Medium	Review the Harbor Management Plan and the Emergency Operations Plan after every storm or every three years	It is important to review and revise these plans to ensure the adequacy of emergency operations. Revisions should be proposed as necessary to meet adequacy	Town-wide	Planning and Regulations	1,2,3,4	Town Annual Budget, Staff Time	Medium-term	Harbor Management Commission and Emergency Management Director	
4	High	North Pond Dam	Repairs are anticipated to be budgeted within the 5 year capital infrastructure replacement plan	Downstream (North Road)	Property Protection, Structural Projects and Maintenance	1,2	Water Annual Budget	Medium-term	Public Works Department	
5	High	Regular Tree Trimming	Tree Damage Mitigation Program to trim trees adjacent to utility lines to avoid power outages and therefore, maintain communication systems during and after hurricanes, thunderstorms, ice storms, and windstorms.	Town-wide	Property Protection, Structural Projects and Maintenance	2,4	Town Annual Budget	Near-term	Public Works Department National Grid	Ongoing
6	High	Develop Debris Management Plan	Develop plan for prompt removal and proper siting of fallen debris and tree limbs which decreases potential of road and property blockage.	Town-wide	Property Protection, Structural Projects and Maintenance	1,2,3,4	Town Annual Budget	Near-term	Public Works Department	
7	High	Electric Supply Redundancy Plan	Work with National Grid to develop an electrical supply redundancy plan	Town-wide	Planning and Regulation	2,4	National Grid	Medium-term	Administration	

ACTION #	PRIORITY	POTENTIAL PROGRAM	DESCRIPTION OF STRATEGY	AFFECTED LOCATION	TYPE OF ACTIVITY	RELATED GOAL(S) Objectives	FUNDING SOURCES	TIMEFRAME	RESPONSIBLE DEPARTMENT	STATUS
8	High	Infrastructure Improvements	Evaluate existing condition of bridges concerning their foundation, structure, and drainage properties. Retrofit and repair as needed	Town-wide	Property Protection, Structural Projects and Maintenance	2,4	Local Funding	Medium-term	RIDOT	
9	High	Local Road Hazard Assessment	Evaluate town roads that are at risk for impact due to storm events/sea level rise and determine capital budget implications or other funding sources	Town-wide	Property Protection, Structural Projects and Maintenance	1,2,4	Local Funding	Medium-term	Public Works Department Planning Department	
10a	High	Public Education and Outreach	Develop and make preparedness and response material available concerning evacuation routes, emergency shelters, and maps of risks and critical facilities of Jamestown	Town-wide	Public Information, Outreach and Incentive Programs	1,2,3,4	Town Annual Budget	Near-term	Emergency Management Director, Police and Fire Departments and Building Inspector	
10b	High	Public Education and Outreach	Organize and conduct training program for town officials, employees, boards, and commissions regarding hazard mitigation, including flood mitigation, and actions/responsibilities during a natural disaster	Town-wide	Public Information, Outreach and Incentive Programs	1,2,3,4	Town Annual Budget	Medium-term	Natural Hazard Mitigation Committee Chair	
11	Medium	Inflow and Infiltration of Sewer System	Program to mitigate the infiltration of groundwater into the sewer lines	Town-wide	Emergency Services (Protection of critical facilities)	1,2,4	Sewer Annual Budget	Medium-term	Public Works Department	Ongoing
12	Low	Water Treatment Facility	The long term, low priority project involves planning for a new access and infrastructure to service the existing Water Treatment Facility	Town-wide	Emergency Services (Protection of critical facilities)	1,2,4	Water Annual Budget	Long-term	Town Administration Town Council Public Works Department	
13		Shoreline Protection and Retrofit of ???	Develop shoreline sea level rise resilience plan which involves shoreline protection strategies	Town-wide	Planning and Regulation	1,4	Town Annual Budget	Medium-term	Planning, Pubic Works, Police, and Fire	
14	High	Continue Agreement for purchase of Potable Water	The Town should maintain and test regularly the emergency hose and reels so that they are ready if needed. The Town should keep the agreement current with the Town of North Kingstown.	Town-wide	Public Information, Outreach and Incentive Programs	2,4	Water Annual Budget	Near-term	Town Administrator Public Works Department	Ongoing

6.0 Moving Towards a Safe, Resilient, and Sustainable Rhode Island Community

6.1 Evaluation: Progress & Challenges

XXXXXXXX

References

Appendix A: Assessing Risk – Maps

Map 1 – Critical Facilities in Jamestown

This map depicts the critical facilities in the Town of Jamestown

Map 2 – Surge Risks in Jamestown

This map depicts the inundation areas within the Town of Jamestown

Map 3 – Flood Risks in Jamestown

This map depicts the 100 year floodplain within the Town of Jamestown

Map 4 – Urban Fire Risks in Jamestown

This map depicts the areas in the Town of Jamestown that are at risk of an urban fire conflagration.

Map 5 – Past Hurricane Strikes in and around Jamestown

This map depicts past hurricane strikes in and around the Town of Jamestown

Map 6 – Evacuation Routes in Jamestown

This map depicts the evacuation routes in the Town of Jamestown

Appendix B: Building Support: Planning Process Additional Documentation

Outreach Strategy & Materials

Meeting Summaries, Notes, Sign-In Sheets

Invites, Public Mtg Announcements, Web/Ad postings

Surveys, Questionnaires, Evaluations, etc.

Appendix C: Capability Assessment [Additional documentation, if needed]

Appendix D: Determining Technical and Financial Assistance for Mitigation and Climate Change Adaptation

Appendix E: Emergency/Preparedness Strategy Actions

Appendix F: Final Local Mitigation Plan Review Tool from Approved Plan

Appendix G: Glossary

Accretion – the deposition of sediment, sometimes indicated by the seaward advance of a shoreline indicator such as the water line, the berm crest, or the vegetation line.

Active beach – the portion of the littoral system that is frequently (daily or at least seasonally) subject to transport by wind, waves, and currents.

Algal bloom – a sudden increase in the amount of marine algae (seaweed) often caused by high levels of phosphates, nitrates, and other nutrients in the nearshore area.

Armoring - the placement of fixed engineering structures, typically rock or concrete, on or along the shoreline to reduce coastal erosion. Armoring structures include seawalls, revetments, bulkheads, and rip rap (loose boulders).

Backshore – the generally dry portion of the beach between the berm crest and the vegetation line that is submerged only during very high sea levels and eroded only during moderate to strong wave events.

Beach – an accumulation of loose sediment (usually sand or gravel) along the coast.

Beach loss – a volumetric loss of sand from the active beach.

Beach management district – a special designation for a group of neighboring coastal properties that is established to facilitate cost sharing and streamline the permitting requirements for beach restoration projects.

Beach narrowing – a decrease in the useable beach width caused by erosion.

Beach nourishment – the technique of placing sand fill along the shoreline to widen the beach.

Beach profile – a cross-sectional plot of a shore-normal topographic and geomorphic beach survey, usually in comparison to other survey dates to illustrate seasonal and longer-term changes in beach volume.

Berm – a geomorphologic feature usually located at mid-beach and characterized by a sharp break in slope, separating the flatter backshore from the seaward-sloping foreshore.

Building setback – the country-required seaward limit of major construction for a coastal property. Building setbacks on Maui vary from 25 feet to 150 feet landward of the certified shoreline.

Coastal dunes – dunes within the coastal upland, immediately landward of the active beach.

Coastal erosion – the wearing away of coastal lands, usually by wave attack, tidal or littoral currents, or wind. Coastal erosion is synonymous with shoreline (vegetation line) retreat.

Coastal plain – the low-lying, gently-sloping area landward of the beach often containing fossil sands deposited during previously higher sea levels.

Coastal upland – the low-lying area landward of the beach often containing unconsolidated sediments. The coastal upland is bounded by the hinterland (the higher-elevation areas dominated by bedrock and steeper slopes).

Day-use mooring – a buoy or other device to which boats can be secured without anchoring.

Deflation – a lowering of the beach profile.

Downdrift – in the direction of net longshore sediment transport.

Dune – a landform characterized by an accumulation of wind-blown sand, often vegetated.

Dune restoration – the technique of rebuilding an eroded or degraded dune through one or more various methods (sand fill, drift fencing, re-vegetation, etc.).

Dune walkover – light construction that provides pedestrian access without trampling dune vegetation.

Dynamic equilibrium – a system in flux, but with influxes equal to outfluxes.

Erosion – the loss of sediment, sometimes indicated by the landward retreat of a shoreline indicator such as the waterline, the berm crest, or the vegetation line.

Erosion hotspots – areas where coastal erosion has threatened shoreline development or infrastructure. Typically, the shoreline has been armored and the beach has narrowed considerably or been lost.

Erosion watchspots – areas where the coastal environment will soon be threatened if shoreline erosion trends continue.

Foreshore – the seaward sloping portion of the beach within the normal range of tides.

Hardening – see Armoring.

Inundation – the horizontal distance traveled inland by a tsunami.

Improvement districts – a component of a beach management district established to help facilitate neighborhood-scale improvement projects (e.g., beach nourishment).

Land banking – the purchase of shoreline properties by a government, presumably to reduce development pressure or to preserve the parcel as a park or as open space.

Littoral budget – the sediment budget of the beach consisting of sources and sinks.

Littoral system – the geographical system subject to frequent or infrequent beach processes. The littoral system is the area from the landward edge of the coastal upland to the seaward edge of the near-shore zone.

Longshore transport – sediment transport down the beach (parallel to the shoreline) caused by longshore currents and/or waves approaching obliquely to the shoreline.

Lost beaches – a subset of erosion hotspots. Lost beaches lack a recreational beach, and lateral shoreline access is very difficult if not impossible.

Monitoring – periodic collection of data to study changes in an environment over time.

Nutrient loading – the input of fertilizing chemicals to the nearshore marine environment, usually via non-point source runoff and sewage effluent. Nutrient loading often leads to algal blooms.

Offshore – the portion of the littoral system that is always submerged.

Overwash – transport of sediment landward of the active beach by coastal flooding during a tsunami, hurricane, or other event with extreme waves.

Revetment – a sloping type of shoreline armoring often constructed from large, interlocking boulders. Revetments tend to have a rougher (less reflective) surface than seawalls.

Risk – refers to the predicted impact that a hazard would have on people, services, specific facilities and structures in the community.

Risk management – the process by which the results of an assessment are integrated with political, economic, and engineering information to establish programs, projects and policies for reducing future losses and dealing with the damage after it occurs.

Scarp – a steep slope usually along the foreshore and/or at the vegetation line, formed by wave attack.

Scarping – the erosion of a dune or berm by wave-attack during a storm or a large swell.

Sea bags – large sand-filled geotextile tubes used in coastal protection projects.

Seawall – a vertical or near-vertical type of shoreline armoring characterized by a smooth surface.

Shoreline setback – see Building setback.

Siltation – the input of non-calcareous fine-grained sediments to the nearshore marine environment, or the settling out of fine-grained sediments on the seafloor.

Storm surge – a temporary rise in sea level associated with a storm's low barometric pressure and onshore winds.

Urban runoff – the input of hydrocarbons, heavy metals, pesticides and other chemical to the near shore marine environment from densely populated areas.

Vulnerability – the characteristics of the society or environment affected by the event that resulted in the costs from damages.

Vulnerability assessment – the qualitative or quantitative examination of the exposure of some component of society, economy or the environment to natural hazards.

Acronyms

FEMA	Federal Emergency Management Agency
HUD	Housing and Urban Development
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey