



Newport Resilience Assessment Tour: Newport Waterfront Overview Summary

Coastal Resources Center/Rhode Island Sea Grant
Graduate School of Oceanography, University of Rhode Island
March 2015

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Citation: Rubinoff, P., & Rubin, C. (2015). *Newport Resilience Assessment Tour: Newport Waterfront Overview Summary*. Coastal Resource Center, University of Rhode Island, Narragansett, RI.
Available at www.beachsamp.org

*The Newport Resilience Assessment Tour was supported by:
11th Hour Racing, van Beuren Charitable Foundation, and Prince Charitable Trusts*



Project Description and Objectives

Newport, like other waterfronts in Rhode Island and globally, is experiencing increased risks from sea level rise, extreme tides, and storms. In order to assist Newport's waterfront businesses with making decisions and taking initial steps towards becoming more resilient, a team was assembled to participate in a rapid Newport Resilience Assessment Tour (NRAT) on July 29 – 31, 2014 and evaluate the vulnerabilities of waterfront businesses to sea level rise and extreme storms, and to identify opportunities to increase their resilience. The NRAT team consisted of members with a variety of engineering and design expertise - a structural engineering consultant, a stormwater specialist from University of New Hampshire Stormwater Center, an engineer from the Rhode Island Coastal Resources Management Council (CRMC), an engineer from the Insurance Institute for Business & Home Safety, a local historical preservation specialist, an architect - and specialists in coastal planning, policy, and regulations. The team was led by staff from the University of Rhode Island's Coastal Resources Center and Rhode Island Sea Grant at the Graduate School of Oceanography.



NRAT collaborators discuss issues and opportunities in Newport (Photo: P. Rubinoff)

The NRAT team toured Newport harbor by boat to observe the workings of the marine waterfront, the surrounding topography, and existing structures. Rapid risk assessments were also done at three key sites around the harbor: the Newport Shipyard, Sail Newport, and the Seamen's Church Institute. These individual site and building assessments were based primarily on visual inspection and concealed construction details were not known nor were mitigation measures assessed for these unknowns. The team also discussed the design, plans, and location of the new Sail Newport building that is scheduled to begin construction in September 2015.

The goal of this project was to begin to understand how storms and sea level rise impacts are affecting waterfront business, and to assess site-based issues and identify potential actions towards resilience for different types of marine related business. Scaling this up, the team identified practices and approaches that may be transferable to other businesses in Newport and other waterfront communities.

This document provides an overview of risks and vulnerabilities of the Newport waterfront and identifies a set of best risk management practices and actions that can reduce the vulnerability and increase resiliency of Newport's harbor and shoreline facilities.

Background and Context of the Project

The Newport Resilience Assessment Tour (NRAT) builds and expands on previous projects and studies in Newport and around the state of Rhode Island. Climate change impacts and effects on the state are a major focus of these projects and studies, including general impacts examined by the Rhode Island Executive Climate Change Coordinating Council in the [\(EC4\) Action Plan](#) (2014) and [Climate Change and Rhode Island's Coasts](#) (2012) produced by Rhode Island Sea Grant. The state of Rhode Island has revised and updated its [Hazard Mitigation Plan](#) (2014) to include actions cities and towns can take to reduce their risk of damage from major storms. Newport's updated [Hazard Mitigation Strategy](#) (2014) lays out the city's plans and strategies for minimizing its risk of impacts. Additionally, increasing focus is being placed on the economic impacts and opportunities presented by climate change in Rhode Island. The Rhode Island Commerce Corporation presented the report [Understanding the Economic Development Opportunity and Impact of Climate Change](#) (2014) to the Rhode Island Climate Change Commission, which includes discussion of the specific impacts and opportunities available for different economic sectors including marine trades and businesses. The RhodeMap RI [Economic Development Plan](#) includes some discussion of climate change economic impacts and addresses opportunities for improving the state's resilience. In 2010 the [Newport Waterfront Economic Study](#) clearly illustrated the high value of the city's waterfront businesses and properties, highlighting the importance of increasing the resilience of these vital waterfront businesses. The NRAT tour, findings, and recommendations tie together these reports and studies to examine the climate change vulnerabilities, potential impacts, and resiliency and adaptation opportunities available to Newport's waterfront businesses.



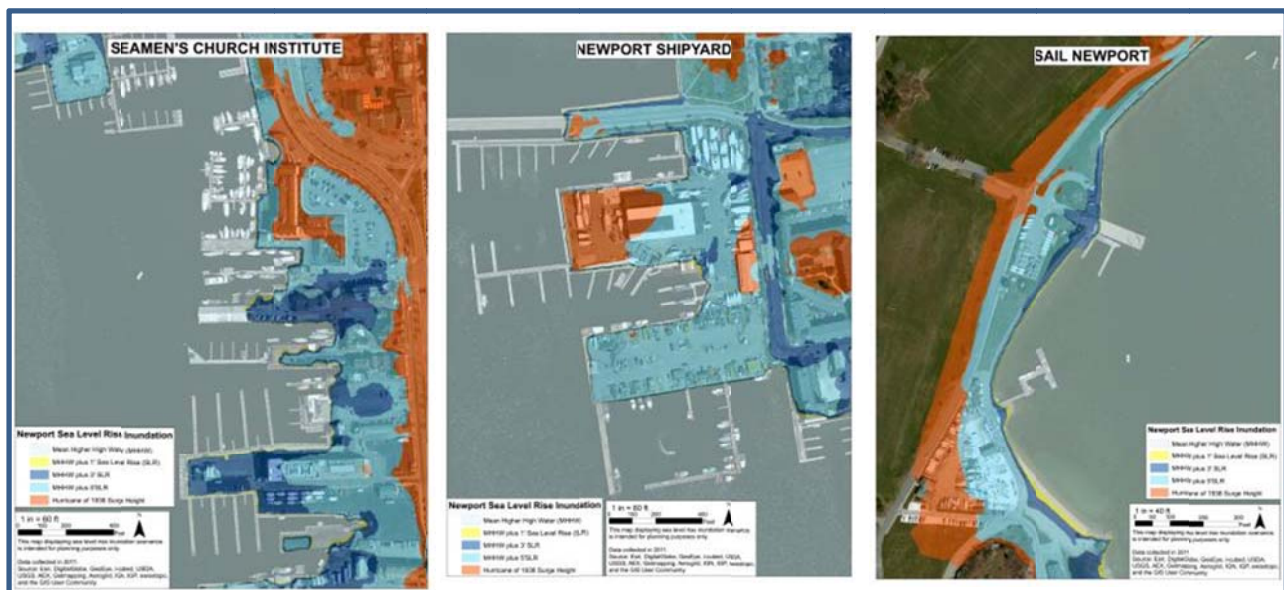
Newport's waterfront provides a mix of businesses and attractions (Photo: A. Desbonnet)

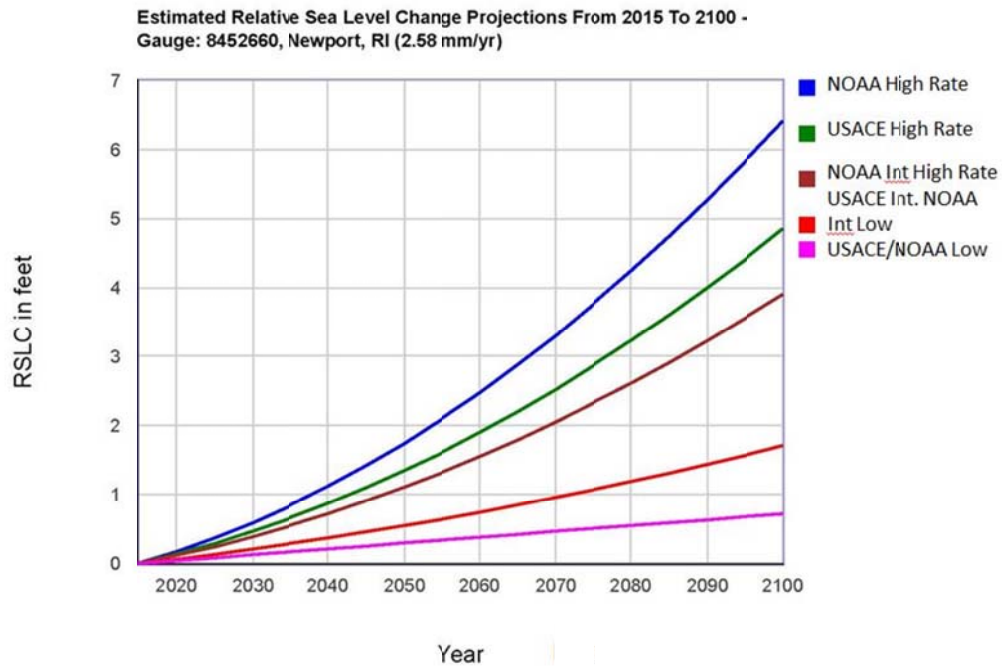
Climate Change in Rhode Island

Rhode Island's highly developed coastline is already seeing the impacts of rising sea levels as low lying areas are frequently inundated at high tide. The RI CRMC's current planning policy projects that the state will experience 3 to 5 feet of sea level rise by 2100. However, as the sea level rise curves in Figure 1 on page 4 illustrate, if the NOAA High Rate curve occurs, Rhode Island may see over 6 feet of sea level rise in less than 100 years. In addition to sea level rise, stronger storms with heavy precipitation and high winds may become

more frequent, resulting in storm surge flooding and damage. High precipitation events such as heavy rain storms may cause destructive inland flooding such as occurred during the March 2010 floods.

In addition to sea level rise and intense storms, warmer average temperatures will contribute to declining air quality, which poses a risk to human health. Rhode Island's valuable tourism industry depends to a large extent on the state's natural beauty and beaches. As beach erosion is accelerated by sea level rise and severe storms, Rhode Island may experience lost revenue due to declining beach tourism. Overall, the state is likely to experience a range of impacts with varying severity, impacting businesses, homes, infrastructure, and ecosystems. More information on the impacts of climate change in Rhode Island may be found in [*Climate Change and Rhode Island's Coasts*](#) (2012) developed by Rhode Island Sea Grant





Sea level rise projection curves developed by U.S. Army Corps of Engineers and NOAA showing Relative Sea Level Change (RSLC) in feet. <http://www.corpsclimate.us/ccaceslcurves.cfm>



This snapshot of a map displays sea level rise and storm surge overlays available on the StormTools model (www.beachsamp.org).

Description of Waterfront and Harbor

Newport is one of Rhode Island's most popular tourist destinations and a world-renowned center for sailing and boating activities. The city's active harbor and waterfront area includes numerous marine businesses as well as restaurants, shops, and marinas. The waterfront, with its high value for tourism, historic value, and municipal revenues, estimated at approximately \$9.7 million in 2009, warrants a closer look as its businesses are increasingly vulnerable to damage from current major storm events as well as future climate change related impacts.



*Boating access in Newport is a valued amenity
(Photo: A. Desbonnet)*

It is evident that many Newport businesses, residents, and local and state leaders recognize the potential impact extreme storms and rising seas can have on this coastal community. Superstorm Sandy with its 4 feet of storm surge and high winds caused significant property damage, and stakeholders understand that risk assessment and adaptation measures are needed to ensure that Newport businesses remain operational and intact. Newport realizes that while there are various hurdles and economic impacts to natural hazards mitigation, there are greater consequences if nothing is done. The efforts undertaken by local and state leaders exemplify the community-based approach to increasing resiliency and should serve as a model to other coastal communities and states across the nation.

The team's rapid assessment focused on high wind, storm surge, flooding, storm water runoff, and coastal erosion hazards associated with severe storm events such as tropical storms, hurricanes, and nor'easters. Sea level rise also was considered as it is a significant concern for developed waterfronts like Newport. According to the sea level data collected from the Newport tide gauge, sea levels in Rhode Island have been increasing an average of one inch per decade since 1930. However, in recent decades the rate of rise has increased, resulting in a rise of six inches over the past 40 years.



Superstorm Sandy flooded Bowen's Wharf with a 4-foot storm surge (Photo: D. Hansen, Newport Daily News)

Accelerated sea level rise is projected to increase in the future and much more rapid increases in sea levels must be expected and planned for accordingly. Sea level rise is contributing to the exacerbation of Newport's exposure to the risks addressed above.

Newport's harbor has numerous water-dependent users including marine trades, tourists, and the cruise ship port. Surrounding the harbor are a variety of waterfront properties housing businesses, restaurants, retail shops, multi-story hotels and condominiums, marinas, piers, parks, a visitor center, yacht club, Sail Newport facilities, the Newport Shipyard, Fort Adams, and the International Yacht Restoration Society. These properties include multiple types of building construction with Historic Districts to the north and south of the downtown district. Some properties are recognized as historic buildings dating back to the early 1900s and earlier. Numerous roof types are also found, including steep slope with slate tiles or asphalt shingles, low sloped roofs with single-ply membranes, and pre-engineered all-metal buildings with metal panel roofs. Given the interest in potential wind damage, the team observed several steep sloped roofs during the tour that have gable end-type construction which is more vulnerable to high winds.

The variety of buildings and construction types and uses for the harbor and waterfront area necessitates a varied approach to increasing resiliency in Newport. There is not one solution or one set of actions that will work well for all buildings and all sites, thus each location must select the actions and strategies that will work best for its specific situation, together with its level of risk tolerance and requirements.

Vulnerability to Tides, Storm Inundation, Flooding, and Sea Level Rise

Newport's highly developed waterfront buildings, businesses, facilities and infrastructure are exposed to impacts from wave action, storm surge and tidal flooding, stormwater runoff, high winds, and long term sea level rise inundation. RI CRMC established policy projects 3 to 5 feet of sea level rise by 2100, which provides a guide for Newport with an estimate of how much sea level rise it needs to anticipate. Much of the infrastructure, both in the harbor and on land, was built when Newport was settled. Buried cast iron water and drainage pipes, granite block bulkheads, and historic buildings all pose challenges to adaptation actions. Large areas of impervious surfaces with inadequate drainage systems increase the risks of flooding and damage from stormwater runoff during intense rain periods which will only be exacerbated at extreme high tides when gravity-fed storm drains cannot discharge to the harbor. Storm surge inundation flooding have caused extensive damage to Newport's waterfront during previous storms, most recently Superstorm Sandy, which resulted in serious flooding and damage to many shoreline facilities and businesses. The built marine infrastructure, including seawalls, piers, floating docks, and marinas are vulnerable to wave damage from high-wind storms such as hurricanes and nor'easters. Climate change projections indicate that more intense storms are likely to cause more severe wind and flooding, increasing the vulnerability of the Newport waterfront to these impacts. Increasing the waterfront's resiliency and taking

adaptive actions will reduce the likelihood of future severe damage to the infrastructure, facilities, and businesses along the harbor.

As demonstrated during Superstorm Sandy, Newport's waterfront buildings and facilities are extremely vulnerable to storm surge flooding. In addition to damage to buildings and infrastructure, the public and private utilities and power systems in high-risk flood areas are not raised above flood levels resulting in more extensive damage and loss of critical utilities and equipment.

Tidal flooding and storm surge inundation as well as high winds and waves also pose a threat to the floating docks, piers, bulkheads, and marina infrastructure which may break loose or fail and cause damage to other boats, facilities, and waterfront buildings.

Vulnerability to Wind

Many buildings and facilities along Newport's waterfront are vulnerable to high winds and wind-borne debris as may occur during severe windstorms including hurricanes and nor'easters. Roofs, with shingles or slate tiles, can be damaged, allowing rain penetration of buildings. Rooftop equipment, much of which is not adequately secured, can become projectiles and wind-borne debris. Additionally, high winds pose a serious threat to boats at marinas and boat moorings that are not adequately secured and may break loose during high winds, becoming water-borne debris and causing additional damage. Each storm event with its unique wind and wave character poses a different risk to varied areas within the harbor. Each site and facility must evaluate its risks of wind damage and take the necessary steps as appropriate to its location to minimize its vulnerability. Overall, all buildings and facilities may be upgraded for natural hazard resiliency through several mitigation techniques such as installing impact resistant windows and siding and ensuring that roof system design and installation meet a "code-plus" standard for wind uplift through retrofit improvements or through replacement (see Building Protection: Code-Plus Design Standards below). In addition to reducing wind-related physical property damage, the loss of electric power from the utility company can also significantly increase loss of business operations and revenue. Depending on the storm strength and the local utility infrastructure, loss of power can range from hours to days to weeks.

Best Management Practices to Reduce Risk

The following list of best management practices, actions may be applied to buildings, facilities, and sites around the Newport waterfront to reduce risk. Not all recommendations will be practical or applicable to all locations, but they provide an outline of potential actions and opportunities that may be taken. These were compiled from NRAT members and site visits, building upon tools and techniques provided by FORTIFIED™, CRMC, National Flood Insurance Program, UNH Stormwater Center, among others.

General Considerations

- During the planning and construction of capital improvement projects and general facility maintenance, waterfront businesses should consider upgrading facilities and infrastructure to be more resilient to likely impacts by flood-proofing buildings, raising utilities, increasing the elevation of pilings and bulkheads, and upgrades to stormwater drainage infrastructure.
- All flood protection and mitigation measures should anticipate the depth of the water as well as the duration of the flood and the velocity of the floodwaters. When estimating flood depths, include a factor of safety over the base flood elevation, such as three feet or more for storm surge (1' freeboard required in Rhode Island Building Code). This will also assist in protecting against future surge levels associated with potential sea level rise. Flood insurance rates may be reduced for these types of mitigation measures. Businesses should consider future flooding events when developing long-term plans for the use of spaces and rooms in the basement and first floor.
- While planning capital improvement projects and new buildings, organizations and businesses should consider projected impacts from severe weather and climate change and increase the resiliency of their facilities and infrastructure.

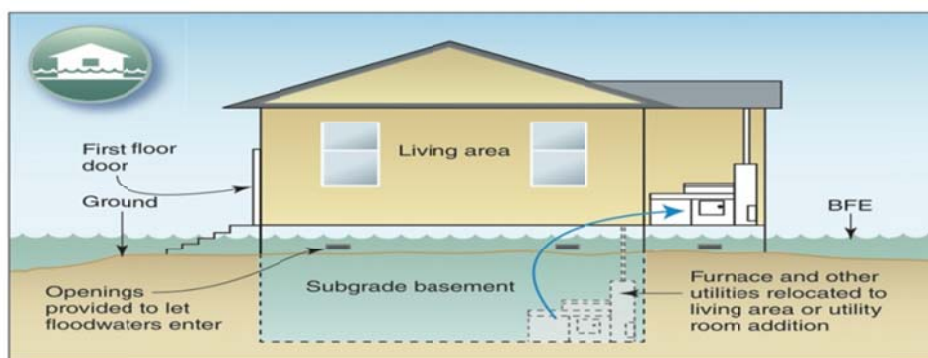


Illustration of elevation of utilities and use of openings that allow floodwaters to enter to reduce flooding damage to building structure (FEMA Homeowner's Guide to Retrofitting,

<http://cnycn.org/2014/10/coping-with-big-flood-insurance-changes-in-nyc-part-iv-mitigation/>).

Code-Plus Design Standards

State building codes provide the baseline level of safety for all of Rhode Island communities. Since building codes are the minimum acceptable standards for life safety and public welfare, they may not provide businesses with sufficient property protection. Given increased exposure to natural hazards, and demand for increased natural hazard resiliency, new and existing building construction should consider a “code-plus” systems approach. The Insurance Institute for Business & Home Safety (IBHS) has a suite of free “code-plus” standards for residential and commercial structures available to the public, including FORTIFIED for Safer Business™, FORTIFIED Home™, and FORTIFIED COMMERCIAL: Hurricane.

The FORTIFIED for Safer Business™ program is designed to help businesses and building owners reduce their potential for property damage from natural disasters and protect their physical assets including buildings, equipment, inventories, and business records. In addition, businesses that use FORTIFIED standards increase the likelihood of reopening immediately post-disaster, thus contributing to community recovery and minimizing loss of revenue. Even if a business is not ready to take all the steps to meet FORTIFIED standards, they may use the standards as a guide for increasing their resilience and preparedness one step at a time. As a business considers additions or renovations they may incorporate aspects and components of the FORTIFIED standards in a manner best suited to their vulnerabilities and needs. A full description of FORTIFIED programs may be found at www.disastersafety.org/fortified-main/.

STRUCTURAL PRACTICES

Tidal Flooding, Storm Surge Inundation, and Sea Level Rise

In order to reduce the waterfront’s vulnerability and risks of damage, several hazard mitigation and adaptation actions may be taken and adaptive planning may be implemented for the future.

Marine Infrastructure

- As pilings become damaged and worn and need maintenance consider replacing to higher elevation to account for increasing storminess, surge and rising sea levels.
- As bulkheads are replaced and/or maintained, review options to upgrade and elevate to account for increasing climate change impacts.
- When storing vessels on land, either for the off seasons or for evacuation purposes, they should be secured to the ground to prevent them from being swept upland due to flooding or storm surge.



Several marinas have increased pile heights around Newport (Photo: P. Rubinoff)

Building Retrofits

- Installing flood vents around office and buildings would allow flood water to exit the building, thereby reducing damages to facilities from tidal, storm surge, and stormwater runoff flooding.
- Raising the utilities, connections, and power systems (including back-up power) above estimated flood levels will minimize the cost of damages to utilities and greatly reduce the loss of business operations due to power loss and system repairs from future flooding events.
- For buildings located in a flood zone, wastewater systems must be elevated to ensure that sewage does not backup into a building's lower floors if electricity is lost. Placing a backflow prevention device on the main sewage lines can mitigate this issue.
- Buildings located in a FEMA-designated high-risk flood hazard zone should anticipate the depth of floodwaters as well as the duration of flooding and velocity of the floodwaters when designing their flood protection and mitigation measures.

Stormwater, Wastewater, and Potable Water Management

- Managing stormwater runoff will reduce the business' risks of flooding during extreme rainfall events. Managing stormwater runoff would also provide a public good by reducing potential runoff pollution to the harbor and flooding in other waterfront areas.
- Stormwater issues may be addressed using Low Impact Development (LID) strategies and solutions, which promote ways to increase stormwater storage capacity, use natural vegetation, and promote ways to filter runoff into the ground.
 - Redesigning impervious surface areas to use green infrastructure.
 - Promoting infiltration of stormwater into the ground.
 - Collecting rainwater using a roof collection system and reusing collected stormwater for non-potable water needs.
 - Considering use of permeable interlocking concrete pavers with stormwater storage reservoirs to better manage stormwater runoff, particularly in pedestrian areas.
- Having reliable access to uncontaminated potable water is a critical component for many commercial facilities. In anticipation of a possible operations problem from the local water department or line breakage from a natural disaster, alternative water supplies should be included in disaster preparations. Such as onsite water storage tanks, and stored bottled water.



Permeable pavers in a Charlestown, RI parking lot reduce stormwater runoff (Photo: P. Rubinoff). A median strip retrofit collects runoff for infiltration to the ground, Durham, NH (Photo: J. Houle).

- Reducing the impacts of high velocity stormwater runoff and flooding may be accomplished by:
 - Updating regulations requiring Low Impact Development (LID) and Green Infrastructure
 - Reducing the amount of impervious surfaces through redevelopment requirements that encourage improvements when repaving, adding impervious surface areas, or updating old infrastructure
 - Balancing the amount of impervious surface area through targeted municipal retrofit strategies at key locations such as pilot or demonstration project locations
- For wastewater systems, it is imperative to prevent sewage back-up into the basement and first floor. A mitigation option includes placing a backflow prevention device on the main sewage lines and checking the valves.
- Covers for wastewater storage systems also need to be well secured because major storms and flooding can lift covers off easily.

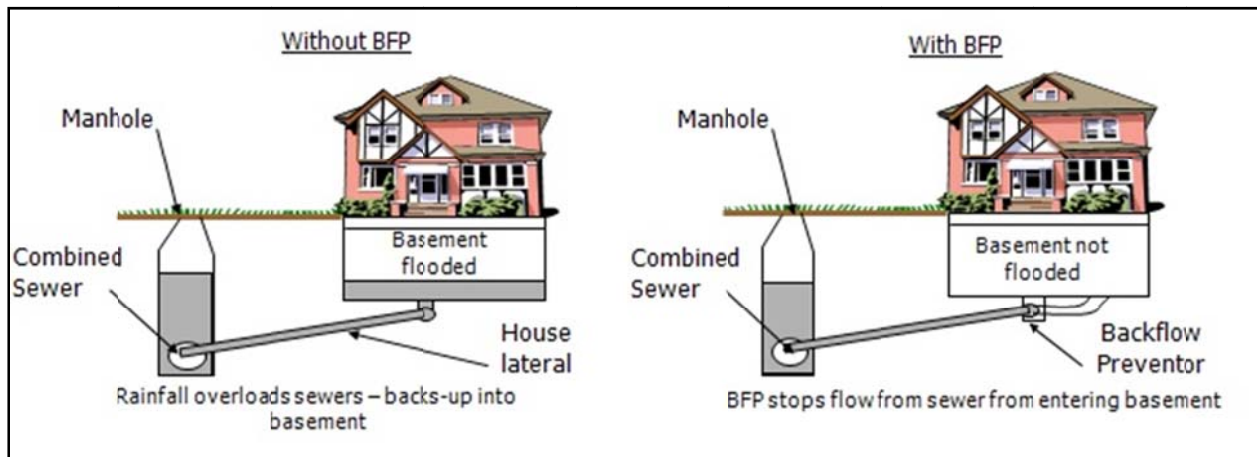


Illustration of use of backflow prevention device (<http://cnycn.org>).

Wind

High wind events such as hurricanes and nor'easters can cause serious damage to waterfront buildings and facilities. In addition, wind-borne debris may result in large amounts of property damage and lengthen post-disaster recovery times.

Roofing and Ventilation Units

- When buildings' roof cover and roof deck are replaced, owners should consider meeting "code-plus" disaster-resiliency standards that surpass the requirements of the existing state building code for relatively little extra cost.
- The perimeter roof edge flashing on existing buildings with low slopes or flat roofs should be checked for proper attachment periodically.
- Slate roofs should be inspected for loose and/or broken tiles, which may be lost in a high wind. Slate tiles may also become wind-borne projectiles and cause additional damage.
- Some buildings may want to explore using rubber roof alternatives, such as rubber slate-like roof tiles to reduce future maintenance.
- Steep slope wood roof decks should have secondary water protection by sealing roof deck from the topside when re-roofing or when installing a new roof. Another option to meet this intent is by using qualified closed-cell polyurethane foam, applied to all horizontal roof deck seams and along all roof-framing members at the underside of the deck.
- Ventilation units located on roofs are easily retrofit should be properly secured, so that the entire unit and/or its parts do not become dislodged, creating a large opening in the roof, as well as becoming windborne debris. When roofs are redone, ventilation units may be removed and replaced with more secure options.



Roof mounted equipment retrofits can help secure units to reduce potential impact (IBHS)

Openings: Doors and Windows

- Large commercial doors should include wind-rated design, they should be large missile impact-rated. Retrofit of existing doors is also an option.
- For buildings located in a wind-borne debris region, glazed openings should be protected or replaced with pressure- and impact-rated glazing systems.
- Installing new impact-resistant thermal insulated storm windows minimizes businesses' risk of damage to their windows during high winds and severe storms like nor'easters and hurricanes.

Building Improvements

- For new construction businesses should consider meeting "code-plus" building standards that ensure greater resilience to high winds (see Building Protection: Code-Plus Design Standards above).
- Businesses' roofs, siding, and windows may be inspected for wind resiliency and replaced with more wind-resistant materials, such as impact resistant windows.

Marine Infrastructure

- Floating docks should be inspected to ensure they are adequately secured to withstand high wind events or are removed as part of a preparedness plan.
- Boat storage facilities should be evaluated to determine whether stored boats are sufficiently secured to survive high wind events, including hurricanes and nor'easters.
- Boats stored in stands should be adequately tied down to minimize risk of falling over due to high wind events.

- If space permits, indoor storage facilities can house vessels and protect them from windborne debris and eliminate the need to tie down boats on stands.

Loss of Power

- In order to be sufficiently prepared for storms and power outages, businesses should consider investing in a reliable back-up power source and sufficient fuel to provide power during an emergency. During combined wind and flood events such as a hurricane reliable emergency power is vitally important for running sump pumps. During winter storms such as a nor'easter, keeping buildings adequately heated is also a concern.
- Back-up power for vital electrical systems should be considered. Businesses may install a transfer switch to connect to a portable generator during power outages. Generators can be purchased, rented, or borrowed with pre-storm contracts.

NON-STRUCTURAL PRACTICES

Business Continuity and Emergency Planning

Protection of the building continues after the construction phase. In addition to preventative maintenance and proper building up-keep, business continuity and severe weather emergency planning should be included in every business' overall plans to protect physical assets and quickly return to operations following a severe weather event. Creating a business continuity plan can assist with this goal. Several programs are available to assist with creating a plan, including IBHS' OFB-EZ™ (Open For Business-EZ) toolkit. OFB-EZ is a free streamlined business continuity tool designed to help small businesses focus on planning for any type of business interruption, so they can quickly re-open and resume operations following a disaster. The IBHS website includes a full description of the OFB-EZ™ toolkit (www.disastersafety.org/disastersafety/open-for-business-ez).

Emergency Preparedness

Due to the highly vulnerable nature of the shoreline area, Newport's waterfront businesses and organizations should have well-developed Emergency Plans, including actions to take prior to and during an emergency, organized and documented evacuation routes, and instructions for employees, clients, and visitors to follow in the event of a major storm or natural disaster.

Emergency Planning

- Waterfront businesses need to have a written emergency preparedness plan and an evacuation plan in the event that individuals need to be evacuated from the building.

- Taking the previously addressed actions to flood-proof and increase the wind-resistance of the structure and establishing an emergency power source are all factors contributing to emergency preparedness. These actions may be phased in over time, proactively increasing resilience and preparedness incrementally.
- The business or organization's evacuation plans should follow the fastest and easiest route to safe locations such as the city emergency shelters. Mobility considerations must also be taken into account in case individuals with special needs or disabilities need to be evacuated as well.
- Businesses should review their emergency preparedness plan and evacuation plan with the local Emergency Management Director and the Newport Fire Department if possible.

Written Emergency Plan Components

- Instructions for employees, visitors, and clients to follow during an emergency.
- Written procedures outlining the actions to take prior to a major storm or natural disaster to secure the facilities and minimize damages including which actions to take at which times.
- Clearly written evacuation procedures for employees, visitors, and clients including evacuation routes and safe shelter areas.
- Posted signs describing emergency preparedness requirements and procedures (for example, signs indicating evacuation routes).
- The organization's evacuation plans should follow the fastest and easiest route to safe locations such as the city emergency shelters. Mobility considerations must also be taken into account in case individuals with special needs or disabilities need to be evacuated as well.

Emergency Kit

- Consider having on hand sufficient food and water for employees and visitors for three days, a first aid kit, flashlights and extra batteries, and an emergency radio. Additional information about emergency preparedness kits may be found at www.ready.gov.

Emergency Planning Keys to Success

- Maintain a documented and up-to-date written plan with designated personnel responsibilities, with back-ups for all shifts.
- Include wind, flood, and severe winter weather preparations and recovery plans for building envelope, physical assets, business functions, and critical utilities.

- Include Alert Levels that trigger planning activities for impending storms (e.g. 72, 48, 24, 12 hours prior to arrival).
- For hurricanes and tropical storms, prepare for one storm category greater than the weather service forecast.
- Conduct periodic training and exercises.
- Include offseason activities (materials procurement, training, asset inspections/repairs).
- Develop material supply checklist.
- Feedback process after extreme weather events.

Outreach

- Businesses should ensure that all employees understand and are familiar with the Emergency Plan and procedures and are adequately trained to perform their responsibilities during an emergency.
- Review business emergency preparedness plan and evacuation plan with the local Emergency Management Director and the Newport Fire Department as well as other relevant state agencies if possible.

Special Considerations

- Consider how to deal with contaminated materials during a severe weather event. For example, if contaminated materials are stored in tanks consider adding additional tie downs to secure the storage vessels or removing tanks to higher ground prior to a storm event.

Outreach and Communication

Newport's historic and picturesque harbor and waterfront area is one of Rhode Island's top tourist destinations and hosts thousands of visitors every summer. Due to the city's large number of visitors from around Rhode Island, New England, and the world the waterfront area is highly visible and thus may serve as an example of proactive coastal resilience that may be followed by other places. Resiliency and adaptive actions that businesses and organizations are taking may be attractive to new business development. Additionally such examples can be incorporated into visitor information materials and tours of the harbor and waterfront, thus informing visitors of the steps Newport is taking to reduce its vulnerability and increase resilience. Educational plaques and displays may be placed in highly vulnerable popular destinations such as Bowen's Warf, Perrotti Park, Sail Newport, and the Newport Shipyard.

Engaging business in discussion on these issues is crucial. The Chamber of Commerce and the Newport Maritime Alliance can play an important role in facilitating discussion and motivating action. Sharing information and lessons learned is valuable for the waterfront business community. As the City of Newport continues its leadership in resiliency efforts, it can engage with waterfront businesses and organizations to disseminate information related to its vulnerabilities and opportunities to improve its resilience. Previous projects and studies have engaged other stakeholders within the City and this project provides an opportunity to build on previous work. By incorporating resiliency and adaptation into the City's overall approach to development and growth, Newport may become an example of a resilient waterfront city.

"They thought of this place as a big boat."

That's what Michelle Duga, superintendent of Seamen's Church Institute in Newport, says is behind the architectural choices that have helped protect the century-old brick building from the worst of flooding—first from storms, and now from rising sea level. "If you think about it, this place was built for and by mariners—they're always thinking first and foremost about how to stay above the water."

How to stay above water is increasingly on the minds of those who live or work along the Newport waterfront. The R.I. Coastal Resources Management Council, the URI Coastal Resources Center, and Rhode Island Sea Grant are providing technical assistance to Newport to prepare for climate change.

The Institute, which is participating in this project, exemplifies practical adaptations that could apply to other Newport businesses.

"When this place first started out, as a haven for mariners, it was built with the thinking that we're here for the long haul ... it's our mission. So yes, we're part of the business community, but we're the type of place that has, not a 50-year plan, but a 200-year plan. That's not a common model," Duga says.

The Institute, which can lodge, feed, and answer the needs of dozens or more sailors or community members at a time, has implemented a series of flood-smart tactics that include a water-shunting, sloped basement floor; simple, yet effective, drainage; and an effort to move equipment that heats the building and operates its water systems to an upper floor.

Pilot Projects

Pilot projects provide an excellent opportunity for learning and doing. Listed below are several activities that were identified by the NRAT team as potential candidates to jumpstart efforts to support a more resilient Newport Waterfront business community.

Business Preparedness

- Tabletop Exercise with members of the Newport Maritime Alliance, Chamber of Commerce and others.
- Debris reduction & management plan – define debris reduction and management – private property & public property.
- Emergency Preparedness Planning template prepared and shared in work sessions.

Waterfront and City Areas

- Utilize tree trenches for stormwater– replanting street trees, linking with the concept as Newport as a Tree City USA.
- Target shoreline access areas to convert to pervious pavement for stormwater storage.
- Install green infrastructure demonstration site at City Yard/Halsey Street Public Works complex .



Tree filters installed along the streets of Portsmouth New Hampshire help reduce stormwater impacts (Photo: J. Houle)

Coastal Resources Center/Rhode Island Sea Grant
Graduate School of Oceanography, University of Rhode Island
March 2015



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