Town of Salisbury

Community Resilience Building Workshop

Summary of Findings

February 2019

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Ocean Front at Salisbury Beach. Source: The Daily News of Newburyport

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Salisbury Beach Post-Winter Storm. Source: The Eagle-Tribune

1.0 OVERVIEW

Figure 1. Beach Road in Salisbury, MA
Source: The Daily News of Newburyport

The Northeastern U.S. has already experienced the effects of climate change. Since 1970, annual temperatures in this region have increased by two degrees Fahrenheit. Average temperatures in Salisbury, Massachusetts could increase further, possibly by almost 11 degrees by the end of the century (NECASC 2018). With these temperature changes, winter snowpack has decreased and the number of extremely hot summer days has increased. But extreme temperatures are not the only risks faced by Salisbury and the surrounding area. Riverine and stormwater flooding due to heavy rains have become Merrimack Valley region's most frequent and costly natural disasters.

1.1 Environmental Risk in Salisbury

The Town of Salisbury has already experienced extreme weather. In 2018 alone, a February storm led to substantial rebuilding and a summer drought led to town-wide water restrictions. In the aftermath of past storms, main roads have been inundated and residents have been left without power for up to four days. A 2017 analysis of Salisbury's assets found that there were critical facilities, public-utility stations, underground storage tanks, and a transportation hub located in both the 2013 and the 2070 Hazard Zone (National Wildlife Federation (NWF) and Ipswich River Watershed Association (IRWA), 2017). Please refer to the list of Works Cited and Additional Resources in Sections 7.5-7.6 for more information on climate change projections and adaptation plans in Massachusetts, Merrimack Valley, and Salisbury.

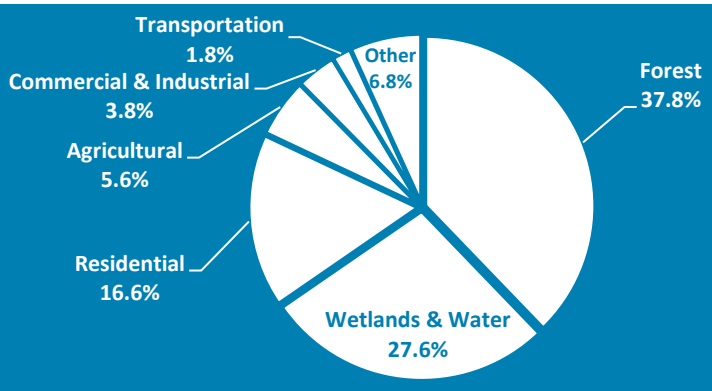
1.2 Land Use in Salisbury

Salisbury is facing a range of environmental risks, and adaptation strategies will need to consider Salisbury's varying landscape conditions. The town's beach, forest, and farmlands will be impacted differently by flooding, extreme temperatures, and drought, and will require localized solutions. Considering the full scope of Salisbury's environmental risks can lead to a comprehensive set of strategies to prepare for extreme events and mitigate their impact.

SALISBURY FLOODPLAIN

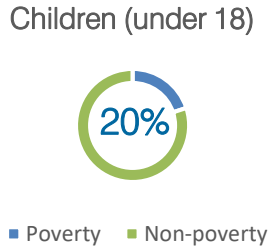
43% OF TOWN IS INCLUDED IN THE 100-YEAR FLOODPLAIN (MVPC, 2015)

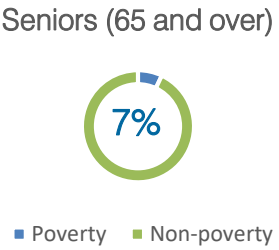
The Town of Salisbury is primarily made up of forest, salt marsh and wetlands, and residential development. The Town is also home to a 3.8-mile-long barrier beach owned by the Massachusetts Department of Conservation and Recreation. Additional land uses are shown below (Merrimack Valley Planning Commission (MVPC), 2015).



1.3 Demographics in Salisbury

The needs of vulnerable populations should be carefully considered when planning for environmental risk. Vulnerable populations can include the elderly, the infirm, residents with language barriers, residents with special needs, and residents with low or moderate income. Census data for the Town of Salisbury shows that approximately 20% of children and 7% of seniors live in poverty (American Community Survey (ACS), 2016).





Other demographic information for the Town of Salisbury is summarized below:

Population

- 8,283 residents were recorded by the 2010 Census (MVPC, 2015)
- 10,100 residents are projected by 2035 (MVPC, 2015)
- Summer population can increase to an estimated 24,000 residents (NWF and IRWA, 2017)

Age

- 16.0% of residents are under age 18 (ACS, 2016)
- 18.4% of residents are 65 or older (ACS, 2016)

Education

- 91.6% of residents have a high school diploma (U.S. Census, 2012-2016)
- 28.3% of residents have a bachelor's degree (U.S. Census, 2012-2016)

Income

- Median household income is $65,347 (U.S. Census, 2012-2016)
- 10.3% of residents are below the poverty level (ACS, 2016)

Employment

- There are 4,650 employed civilians 16 years old and over (MVPC, 2015)
- 1,596 are employed in Management & Professional fields (MVPC, 2015)
- 889 are employed in Service fields (MVPC, 2015)
- 1,299 are employed in Sales and Office fields (MVPC, 2015)
- 382 are employed in Natural Resources, Construction, and Maintenance fields (MVPC, 2015)
- 484 are employed in Production, Transportation, and Material Moving fields (MVPC, 2015)

Residential Property Values

- There are 4,563 housing units (MVPC, 2015)
- The average property value is $326,800 (MVPC, 2015)

2.0 COMMUNITY RESILIENCE BUILDING WORKSHOP: SUMMARY OF FINDINGS

The timeline of climate adaptation and mitigation efforts in Salisbury extends for more than a decade. Salisbury introduced a Multi-Hazard Mitigation Plan in 2008, which was later updated in 2015 (MVPC, 2015). The Federal Emergency Management Agency (FEMA) updated the area's Flood Insurance Rate Maps (FIRM) in 2009 and 2012, which included most of Salisbury's beach in the floodplain. The Town has been proactive in planning for increased environmental risks, from requiring new development to be elevated or sited outside of the floodplain, to joining the National Flood Insurance Program's (NFIP) Community Rating System (CRS). Communities participating in the CRS can earn community-wide discounts on flood insurance in exchange for floodplain management exceeding FEMA's minimum requirements. In addition, Salisbury has used grants to fund flood mitigation work at Town Creek and to relocate the Police Station to a site with a lower level of flood risk (MVPC, 2015).

Additional examples of climate mitigation work range from the Great Marsh Restoration Project, to the Dune Nourishment work in 2010 and 2014. The Great Marsh Restoration Project was a joint effort between seven coastal communities to improve flood mitigation by protecting the Marsh's ability to buffer storm surge, mitigate erosion, and absorb flooding (MVPC, 2015). The Dune Nourishment work brought together the Massachusetts Department of Conservation and Recreation (DCR), University of New Hampshire, Conservation Commission, and local stakeholders to restore more than 20-acres of dunes across three towns. This project involved the addition of thousands of cubic yards of sand, planting vegetation, installing fencing for stabilization, and creating a "living classroom" to educate students and other stakeholders about restoration efforts (NWF and IRWA, 2017). These climate adaptation projects were made more urgent by the winter storms that Salisbury experienced between January and March 2015, and the severe coastal flooding during January 2018 (Chiaramida, 2016; CBS News, 2018)

Salisbury's application to the Municipal Vulnerability Preparedness (MVP) Planning Grant continues the Town's history of climate change planning. The MVP program helps support Massachusetts communities in preparing for extreme weather and implementing priority resilience projects. Eligible communities complete the MVP program, become certified, and apply for MVP Action grant funding. As a participating community, Salisbury can use this funding to improve resilience and preparedness for natural and climate-driven hazards; collaborate with stakeholders regarding climate change, natural hazards and impacts; and increase education, planning, and implementation of priority actions.

Salisbury's MVP application outlined the impact of extreme weather events and pledged to incorporate findings from the MVP Project into future updates of the Town's Hazard Mitigation Plan, and into considerations by the Planning Board, Zoning Board of Appeals, Board of Health, and Conservation Commission.

On October 10, 2018, the Town of Salisbury worked with Weston & Sampson to host a Community Resilience Buildings (CRB) workshop as part of the MVP Program. The Workshop's central objectives were to:

- Define top local, natural, and climate-related hazards of concern
- Identify existing and future strengths and vulnerabilities
- Develop prioritized actions for the Community
- Identify immediate opportunities to collaboratively advance actions to increase resilience

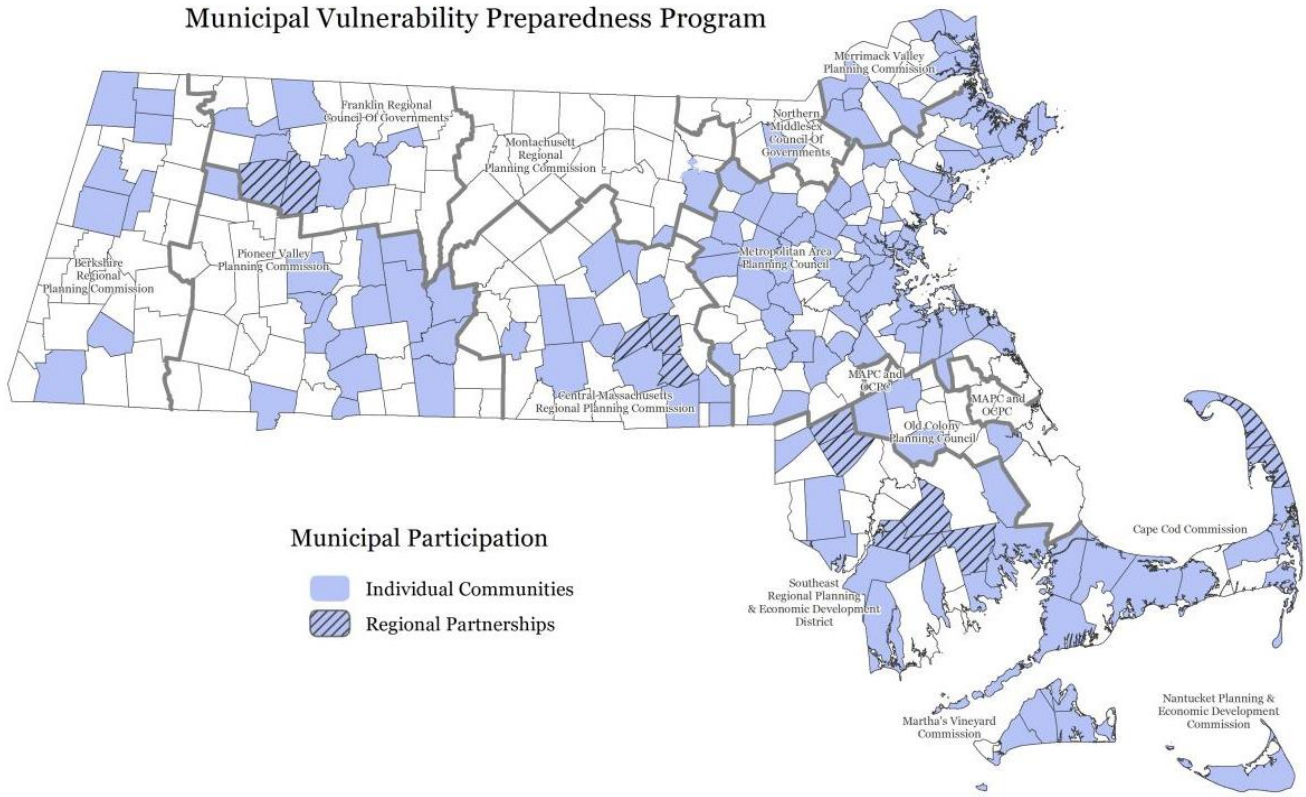


Figure 2. A map of communities participating in the MVP Program

The Municipal leadership involved in this workshop included the Town Manager, Planning Director, Building Inspector, Water Superintendent, and representatives from the Fire Department, Emergency Management, Public Works, the Police Department, and Conservation. More than twenty stakeholders participated in the event, working alternatively in large and small groups to identify hazards, at-risk areas, and recommendations related to environmental risk and climate adaptation. This report summarizes the CRB workshop process and findings.

Figure 3. Discussions during the community workshop

3.0 TOP HAZARDS AND VULNERABLE AREAS

Natural hazards in Salisbury include extreme heat, sea level rise and storm surge, heavy precipitation, wind, drought, snow and ice, and erosion. A 2015 Risk Assessment ranked the following natural hazards from high to low risk:

Table 1: Salisbury Natural Hazards Risk Assessment	
Natural Hazard	Community Risk Rating
Floods	High
Winter Storms (blizzard/snow/ice)	High
Northeasters	High
Power Outages	High
Hurricanes	Moderate
Drought	Moderate
Wildfire/Brush Fires	Moderate
Tornadoes	Low
Earthquakes	Low
Landslides	Low
Dam Failures	Low

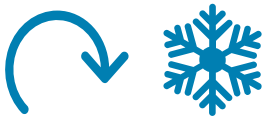
Table reproduced from the Merrimack Valley Region Multi-Hazard Mitigation Plan (MVPC, 2015)

3.1 Top Hazards

All climate risks were presented and discussed during the CRB workshop. The top hazards identified by participants during the workshop include:


Sea level rise, coastal storm surge, and erosion


Extreme precipitation: both heavy rain and drought


Extreme storms; including wind, ice, and Nor'easters


Extreme temperatures

3.1.1 Sea Level Rise, Coastal Storm Surge, and Erosion

While sea level rise projections vary depending on emission scenarios and time horizons (NECASC 2018), the region has identified 40" of sea level rise by 2070 as a planning benchmark. Increased coastal flooding will lead to increased shoreline erosion, which is also a serious concern in Salisbury. The beach has experienced erosion during extreme weather and the State replenished sand on Salisbury Beach in July of 2018.

3.1.2 Extreme Precipitation

This category includes both heavy rain and drought. Between 1961 and 2015, the 24-hour, 100-year rain event increased from 6.5 inches to 8.4 inches (NOAA, 2015; U.S. Department of Commerce, 1961). Drought will impact water supply; local rivers, streams, and wetlands; and the crops on local farmlands.

3.1.3 Extreme Storms

This category includes strong winds, ice, and Nor'easters. High winds will impact infrastructure, trees, and properties.

3.1.4 Extreme Temperatures

This category includes both very low and very high temperatures. Average temperatures in the Merrimack Basin, including Salisbury, could increase by 3.0°F to 6.4°F by mid-century, and by 3.9°F to 10.9°F by the end of the century. There could also be an increase in days with temperatures above 100°F. The number of these extremely hot days could increase to between 1 and 5 days by 2050, and between 1 and 22 days by 2100 (NECASC 2018).

3.2 Vulnerable Areas

Vulnerable areas identified as part of the 2017 NWF and IRWA *Great Marsh Coastal Adaptation Plan* are shown below:

Table 2: Vulnerable Areas in Salisbury	
High Hazard Concerns	Type of Hazard
Salisbury Beach	Erosion
Salisbury Beach at Broadway	Storm over-wash during storms
Neighborhoods along Blackwater River	Flooding during extreme high tides and storms
US Route 1 North at Town Creek	Tidally influenced flooding
US Route 1 South; March Road and 1st St.	Tidally influenced flooding
US Route 1A (Beach Road)	Tidally influenced flooding
Jak-Len Drive	Freshwater flooding from storms
Smallpox Brook	Freshwater flooding from storms
North End Boulevard (Old Town Way to 18th St.)	Storm-related flooding

Participants discussed vulnerable areas during the CRB workshop. The impact of extreme events on Salisbury Beach was cited as a concern. Route 1A experiences frequent flooding. Ring Island and Ferry Road were identified as vulnerable to severe weather. Participants also discussed the impact of environmental risk on vulnerable populations, which can include children, the elderly, the infirm, those with language barriers, low-income populations, and the homeless. Due to its tourism economy, Salisbury also has a large transient population. These vulnerable communities will need support and access to shelters, information, cooling centers, and evacuation plans in the event of an emergency.

Figure 4. Salisbury Beach Center after a storm. Source: The Daily News, February 10, 2016

Figure 5. Weather causes serious erosion at Salisbury Beach, January 2016

Figure 6. State replenishes sand on Salisbury Beach, July 2018

4.0 CURRENT CONCERNS AND CHALLENGES PRESENTED BY HAZARDS AND CLIMATE CHANGE

1,710 BUILDINGS IN THE 100-YEAR FLOODPLAIN

$418M PROPERTY VALUE

$258M CONTENT VALUE (MVPC, 2015)

Floods have had a significant impact on the Town of Salisbury. The Town's 100-year floodplain is home to 1,710 buildings with a property value of $418 million and a content value estimated at $258 million. Since 1978, 37 sites in Salisbury have already had 114 payouts from the NFIP totaling $2.9 million (MVPC, 2015).

Flooding is not Salisbury's only concern. During the CRB workshop, long-term residents remarked on erosion along Salisbury Beach, which they had observed during frequent walks and from photos taken over the course of decades. The State also declared a drought in the summer of 2016, which led to town-wide water restrictions. Workshop participants expect that these hazards will worsen in the future and may even lead to new risks. For example, worsening drought conditions could lead to forest fires or to a decrease in the drinking water supply. Participants expressed the need to plan for multiple hazards and to prepare for the impact of these hazards on vulnerable populations, including the elderly and the homeless.

4.1 Specific Categories of Concerns and Challenges

The main areas of concern were grouped within the following three categories or "features:" infrastructural, societal, and environmental.

4.1.1 Infrastructural

Concerns within the infrastructural category include:

- Roads: this was the most commonly cited infrastructural area of concern. Participants discussed the need to protect transportation and evacuation routes, including Route 1A (Beach Road), March Road, and Ferry Road.
- Reliable power supply
- The Salisbury Beach Reservation, owned by the Massachusetts DCR
- Buildings: buildings were another frequently cited area of concern. Participants discussed the need to protect shelters and municipal buildings like the police station and the fire station.
- Wells
- Communication
- Utilities, including gas and sewer systems
- Bridges, tide gates, and culverts

Figure 7. Areas of concern include the Fire Department, transportation, assisted living facilities, and the Police Department

4.1.2 Societal

Concerns related to the societal category include:

- Municipal services and facilities, including emergency management at Town Hall, the Fire Department, and the Police Department
- Businesses, including the need to protect the Salisbury Beach Center
- Commercial and economic vulnerability, due to the impact of environmental risks on tourism
- Children, including special needs youth
- Shelter availability and accessibility
- Elderly populations, senior centers, and assisted living facilities
- Low income communities
- Transient populations, including seasonal populations, renters, the homeless, and those living in a campground, motel, or mobile home park

4.1.3 Environmental

Concerns related to the environmental category include:

- Beachfront
- Marsh
- Aquifers
- Merrimack River

5.0 CURRENT STRENGTHS AND ASSETS

Despite the range of risks that Salisbury faces, participants in the workshop were able to identify several existing strengths and assets within the town. Those examples include:

- Buildings that are currently used as shelters during emergencies
- Existing cooling centers
- Areas that encourage tourism and contribute to the town's economy, like the beach
- Public open space, like trails and parks
- Landscape features that help manage stormwater and mitigate extreme temperatures, like trees and the 37.8% of forested land in Salisbury (MVPC, 2015)
- Programs fostering community resilience, like the Boys and Girls Club
- Children
- Elderly residents and their local knowledge
- Aquifers and wells
- The Merrimack River and the Black Water Creek
- The Great Marsh and other wetlands
- The Power Grid
- Communication systems
- Sewage Treatment
- Municipal services, including the Police and the Fire Station
- Local farmland
- Infrastructure, including bridges and tide gates
- The State Reservation

Figure 8. Erosion at Salisbury Beach after a pair of Nor'easters in March 2018

6.0 TOP RECOMMENDATIONS TO IMPROVE RESILIENCE

After listing vulnerabilities, hazards, and possible actions, participants ranked their recommendations from high to low priority. A summary of findings from the final group matrix is included below.

Figure 9. Participants created matrices of risks and vulnerabilities at each table, before consolidating their findings into one matrix and ranking priority actions

6.1 Highest Priorities

- Protect roads as municipal investments and as access/evacuation routes for residents, tourists, and workers. Strategies could include designing alternative modes of transportation; raising roads; improving drainage and flushing at road-water crossings; and protecting areas along, or in the vicinities of, Beach Road, March Road, Ferry Road, and Route 1A. There should also be regular maintenance programs and work to improve drainage and reduce surface flooding.
- Protect the beachfront including residents, existing buildings, environmental resources, and businesses, such as those at the Salisbury Beach Center. Strategies could include maintaining dunes, maintaining seawalls, maintaining and creating dunes through regular beach nourishment, diversifying plant species, retreat, elevation of structures and infrastructure, reduction of impervious surfaces, and education and advocacy.
- Evaluate and study the addition of tide gates or other flood protection measures, as appropriate, on flood-prone streets/areas.
- Provide and prepare existing shelters. This will require emergency transportation options, communication, planning, reliable power, backup power, adequate staffing and equipment, evacuation routes, and the materials and facilities needed to sustain evacuated residents.
- Disaster prevention and management, including a tailored evacuation and notification plan; training and emergency management planning; being prepared with evacuation equipment including rafts; and protecting related infrastructure, that serves residents, businesses, tourists, and others.
- Protect the marsh by implementing strategies that eliminate restrictions, studying options for buffer protection and resilience, increasing biodiversity, and planting drought-resistant species.
- Protect critical municipal facilities and services by implementing strategies that provide backup power to Town Hall and Library and other critical municipal facilities; provide equitable access to facilities with power. Protect municipal buildings and services against flooding and provide adequate staffing and training.
- Protect the State Reservation through beach nourishment, the beach nourishment plan, tide gates under the reservation road, and other related efforts.
- Protect aquifers and current water sources.

6.2 Additional Priorities

- Protect public health by conducting water quality monitoring, and by providing shade trees and structures, at the State Reservation, and other public spaces.
- Improve communication before, during, and after extreme events.
- Educate children to prepare the next generation to tackle climate change.
- Protect underground utilities like gas, water, and sewers through redundancy and back-up power.
- Protect wells by seeking new water sources.
- Expand sanitary sewers in critical areas.
- Prevent exposed utilities.

7.0 REFERENCES

7.1 CRB Workshop Participants:

Salisbury Assistant Planner / Bart McDonough
* Salisbury Board of Selectmen / Freeman Condon / Table 3
* Salisbury Planning Board / Gina Park / Table 3
Salisbury Planning Board / Lou Masiello
Salisbury PTA President / Jennifer Roketenetz
Salisbury Conservation Commission / Jessica Stucker
* Salisbury Citizens for Change / Jim Baskin / Table 3
Salisbury Zoning Board of Appeals / Joe Stucker
Salisbury Zoning Board of Appeals / Kevin Henderson
* Salisbury Conservation Agent / Michelle Rowden / Table 3
Salisbury Town Manager / Neil Harrington
* Salisbury Emergency Management Director / Robert Cook / Table 1
Salisbury Board of Health / Ron Lafferly
* Salisbury Beach Betterment Association / Ray Champagne / Table 5
* Salisbury Fire Chief / Scott Carrigan / Table 3
* Salisbury Police Department / Sargent Robert Roy / Table 4
* Salisbury Chamber of Commerce / Tracy Brown / Table 1
* Director of Public Works / Lisa DeMeo / Table 5
* Director of Planning and Development / Lisa Pearson / Table 2
* Director of Council of Aging / Liz Pettis / Table 5
* Director of Health / Jack Morris / Table 1
* Merrimack Valley Planning Commission / Joe Cosgrove / Table 4
Merrimack Valley Planning Commission / Peter Phippen
* MA DCR / Darryl Forgione / Table 2
MA State Representative / James Kelcourse
* North Shore Regional Coordinator CZM / Kathryn Glenn / Table 4
* Seabrook Water Superintendent / Curtis Slayton / Table 1
* Building Inspector, Zoning Officer / Scott Vandewalle / Table 2
Environmental Protection Agency / Ed Reiner
UNH Department of Biological Sciences / Gregg Moore
W.C. Cammett Engineering Inc. / Woodbury Cammett
Engineer / Joe Serwatka
Laffely Real Estate Associates / Sally Laffely
* Tom Saab Real Estate / Tom Saab / Table 2
SPL Development Group LLC / Steve Paquette
* Rings Island Tax Payer, Coastal Trails Coalition / Jerry Klima / Table 2
* Rick Rigoli / Table 4
* Wilma McDonald
* Weston & Sampson / Chris Perkins
* Weston & Sampson / Kathleen Baskin
* Weston & Sampson / Jim Riordan / Table 3
* Weston & Sampson / Adria Boynton / Table 2
* Weston & Sampson / Rob Almy / Table 4

* Weston & Sampson / Sarah Miller / Table 5
* Weston & Sampson / Steve Roy / Table 1

Notes:
Asterisks (*) are placed next to attendees
While the listed table numbers reflect table assignments, some invitees may have moved

7.2 Citation

Town of Salisbury. 2018. *Community Resilience Building Workshop Summary of Findings*. Prepared by Weston & Sampson. Salisbury, Massachusetts.

7.3 Workshop Project Team:

Town of Salisbury, Municipal Leadership:
Neil Harrington, Town Manager
Lisa Pearson, Planning Director

Town of Salisbury, Core Team Members:
Scott Carrigan, Fire Chief
Robert Cook, Emergency Management
Lisa DeMeo, Public Works
Tom Fowler, Police Chief
Michelle Rowden, Conservation
Scott Vandewalle, Building

Note: for contact information for the Core Team Members, please refer to the meeting minutes included in Appendix E.

Weston & Sampson, Team Assisting with the Workshop:
Chris Perkins, Principal-in-Charge
Kathy Baskin, Project Manager/Facilitator
Rob Almy, Table Facilitator
Adria Boynton, Table Facilitator
Sarah Miller, Table Facilitator
Jim Riordan, Table Facilitator
Steve Roy, Table Facilitator

7.4 Acknowledgements

A special thanks to the Massachusetts Executive Office of Energy and Environmental Affairs for providing the grant that funded the Community Resilience Building Workshop. Additional thanks to all the participants and to the Workshop Project Team for a successful event.

7.5 Works Cited

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7.6 Additional Resources

Underwater: Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate (Union of Concerned Scientists, 2018)

Community Exposure to Potential Climate-Driven Changes to Coastal-Inundation Hazards for Six Communities in Essex County, Massachusetts (U.S. Department of the Interior, U.S. Geological Survey, 2016)

Massachusetts Climate Change Adaptation Report (Massachusetts Executive Office of Energy and Environmental Affairs, Adaptation Advisory Committee, 2011)

APPENDIX A

Workshop Handouts

Workshop Agenda
Handout, *Modeling Future Effects of Coastal Storms and Sea Level Rise*
Base Maps used for participatory mapping exercise

Town of Salisbury
Municipal Vulnerability Preparedness Planning Project
Community Resilience Building Workshop
Colchester Room, Town Hall, 5 Beach Road, Salisbury, MA 01952
Wednesday, October 10, 2018
8:30 am – 4:30 pm

8:30 am – 9:00 am	Registration and Refreshments
9:00 am – 9:20 am	Welcome and Introductions • Neil Harrington, Town Manager • Lisa Pearson, Planning Director • Core Team Members • Weston & Sampson Team • Participant Introductions
9:20 am – 9:30 am	MVP Workshop Purpose and Overview • MVP Program Background • Purpose, Desired Outcomes, Objectives, Expectations • Review Agenda • Logistics
9:30 am – 10:00 am	Data Resources and Overview of Science • Hazards • Existing Climate Change • Projected Climate Change • Recent Planning Efforts • Overview of Data and Maps Being Used During Workshop
10:00 am – 10:30 am	Large Group Exercise #1 • Identify Major Hazards in Community • Prioritize Top Four Hazards
10:30 am – 10:45 am	BREAK

10:45 am – 11:00 am	Risk Matrix
	• Hazards
	• Features
	  • Infrastructure, Societal, Environmental
	  • Vulnerability or Strength
	  • Location
	  • Ownership
	• Actions

Town of Salisbury
Municipal Vulnerability Preparedness Planning Project
Community Resilience Building Workshop
Colchester Room, Town Hall, 5 Beach Road, Salisbury, MA 01952
Wednesday, October 10, 2018
8:30 am – 4:30 pm

11:00 am – 11:25 am	Small Group Exercise #1 • Infrastructure Features • Vulnerability or Strength, Location, Ownership
11:25 am – 11:50 pm	Small Group Exercise #2 • Societal Features • Vulnerability or Strength, Location, Ownership
11:50 pm – 12:15 pm	Small Group Exercise #3 • Environmental Features • Vulnerability or Strength, Location, Ownership
12:15 pm – 1:15 pm	LUNCH
1:15 pm – 1:45 pm	Community Actions • Infrastructure • Nature-Based Solutions
1:45 pm – 2:00 pm	BREAK
2:00 pm – 2:50 pm	Small Group Exercise #4 • Define Community Actions
2:50 pm – 3:50 pm	Large Group Exercise #2 • Identify Priority Actions
3:50 pm – 4:00 pm	Wrap-up and Closing Remarks

Town of Salisbury, Massachusetts

Modeling Future Effects of Coastal Storms and Sea Level Rise

Introduction

Like many communities along the North Shore of Massachusetts, the Town of Salisbury is vulnerable to climate-driven hazards, including sea level rise and storm surge. Predicted sea level rise and increased storm surge have the potential to significantly impact the town's coastal economy and the natural systems that the community depends upon. Understanding where and how these hazards are likely to impact the community is a necessary first step in addressing vulnerability.

Given its exposure to climate-driven hazards, the Town of Salisbury took part in a mapping effort to identify areas that are particularly vulnerable to coastal inundation. This poster highlights the results of this effort and is intended to help support the Town of Salisbury as it works to identify adaptation strategies that reduce its vulnerability to sea level rise and storm surge.

Mapping Coastal Flooding

These maps illustrate current (2013) and future (2070) probability of coastal inundation in Salisbury, Massachusetts. Results are based on a hydrodynamic model developed for the Massachusetts Department of Transportation (Famely et al. 2016). Note: This data does not take into account inland freshwater flooding.

This advanced hydrodynamic model incorporates:

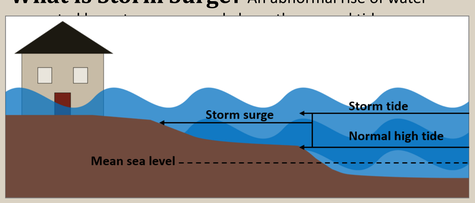
Modeled Storm Events
Including hurricanes and nor'easters, as well as climatology projections

Sea Level Rise Projections
Consistent with both the US National Climate Assessment and projections specific to Massachusetts

Dynamic Coastal Processes
Driven by wave effects, wind, tides, and storm surge

Hydrodynamic Model

What is Storm Surge? An abnormal rise of water



Adapted from NOAA

Coastal Inundation Probability

Probability of inundation is defined as the likelihood that at least 2 inches of flood water will encroach on the land at a particular location at least once in a calendar year. Note that the 1% probability of inundation shown on the present day maps (2013) roughly corresponds to the Federal Emergency Management Agency's (FEMA) 100-year storm.

How much sea level rise?

- Present day (considered 2013) results incorporate existing sea level conditions
- 2070 results incorporate 3.4 feet of sea level rise, which is also approximately the "Intermediate-High" scenario for 2090 (Figure 1)

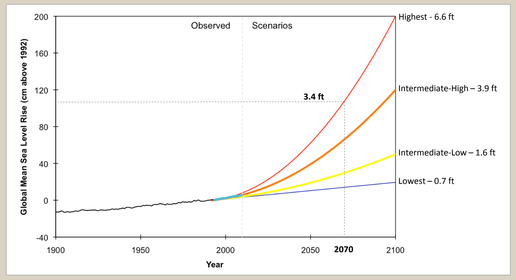
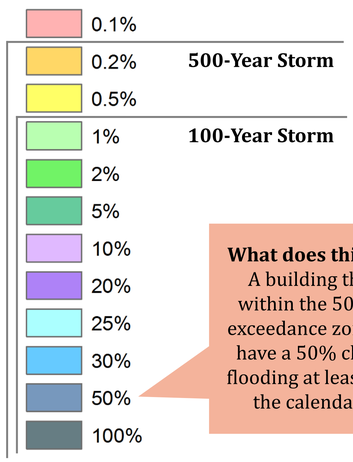
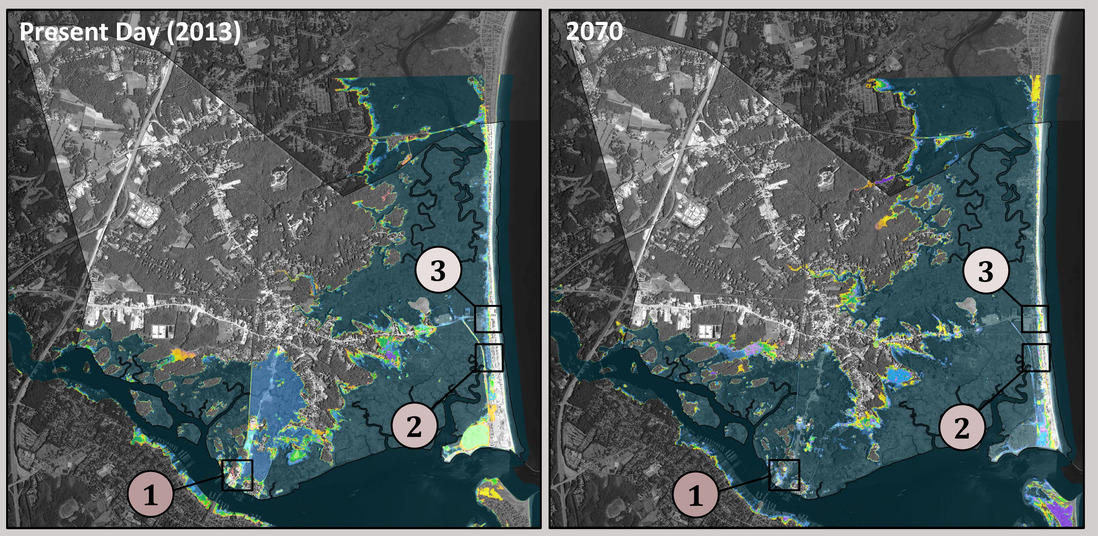


Figure 1. Global Mean Sea Level Rise Scenarios. The highest, or worst case, scenario is based on estimated rise in ocean temperatures leading to thermal expansion combined with maximum melting of the glaciers and ice sheets. The lowest scenario assumes a historical rate of sea level rise with no increase due to climate change. Adapted from the US National Climate Assessment (Melillo et al. 2014) and NOAA (Parris et al. 2012).

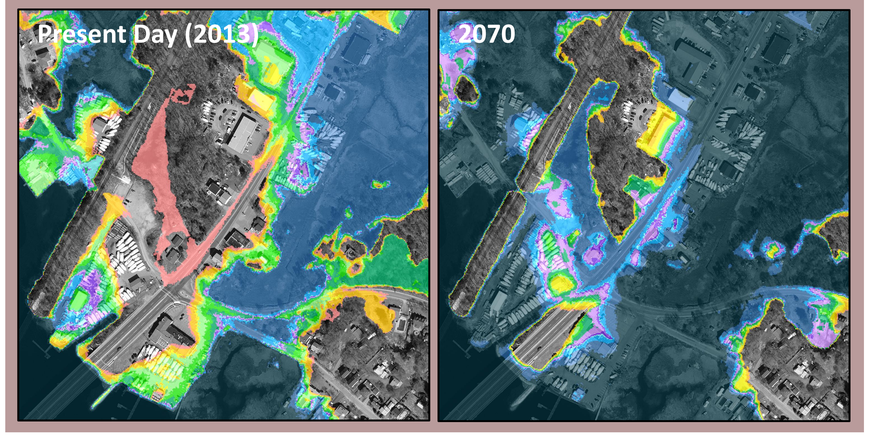
Percent Risk of Coastal Flooding



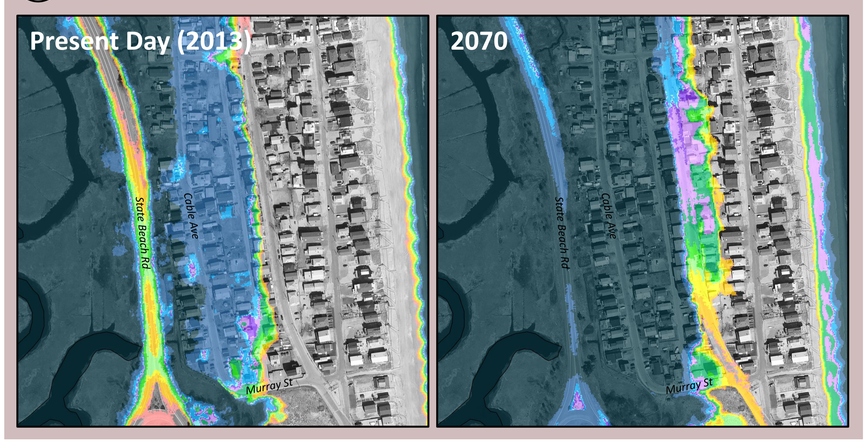
What does this mean? A building that lies within the 50% flood exceedance zone would have a 50% chance of flooding at least once in the calendar year.



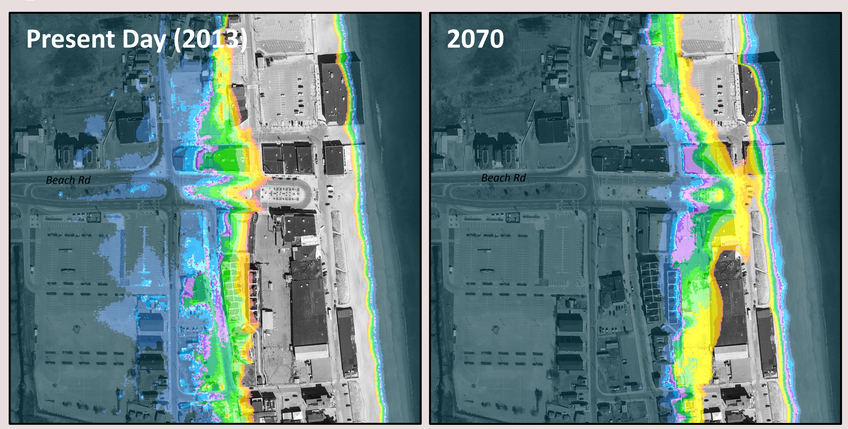
1 Route 1 at Merrimack Bridge



2 Southern end of Cable Avenue



3 Salisbury Beach Center



Created by the National Wildlife Federation with funding provided by the Massachusetts Office of Coastal Zone Management through their Coastal Community Resilience Grant Program.

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Famely, J., K. Bosma and B. Hoffnagle. 2016. *Sea Level Rise and Storm Surge Inundation Mapping – Great Marsh Communities (Essex County, MA)*. Prepared by Woods Hole Group for National Wildlife Federation and U.S. Geological Survey.

Melillo, J.M., T.C. Richmond, and G.W. Yohe, Eds. 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. Washington, DC: U.S. Global Change Research Program, 841.

Parris, A., P. Bromirski, V. Burkett, D. Cayan, M. Culver, J. Hall, R. Horton, K. Knuuti, R. Moss, J. Obeysekera, A. Sallenger, and J. Weiss. 2012. *Global Sea Level Rise Scenarios for the United States National Climate Assessment*. NOAA Tech Memo OAR CPO-1. Silver Spring, MD: National Oceanic and Atmospheric Administration, 37.

Data Source: Bosma, K., E. Douglas, P. Kirshen, K. McArthur, S. Miller and C. Watson. 2016. MassDOT-FHWA Pilot Project Report: Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the Central Artery. Photo Science, Inc. (2012). State of Massachusetts (Raster DEM): LIDAR for the North East – ARRA and LiDAR for the North East Part II. (USGS Contract: G10PC00026, ARRA LIDAR Task Order Numbers) USGS Contract: G10PC00026 Task Order Number: G10PD02143 Task Order Numbers: G10PD01027 (ARRA) and G10PD02143 (non-ARRA). Aerial Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Coordinate System: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001. Maps created by the National Wildlife Federation using: ArcGIS 10.3 for Desktop (v10.30.1332)

Seabrook Nuclear Power Plant approximately 1 mile north

N

South Hampton, NH

Seabrook, NH

AMESBURY

NEWBURYPORT

SALISBURY FIRE DEPARTMENT Headquarters

SALISBURY POLICE DEPARTMENT

Amesbury Elementary School

Salisbury Elementary School

Sparhawk School (Lower School)

Sparhawk School (Middle & High School)

Coastal Connections Academy

Francis T Bresnahan Elementary School

Heritage Park Mobile Homes

Kendall Lane Mobile Homes

Salisbury Inn Mobile Homes

Salisbury Inn

Hilton Center

East Parish United Methodist Church

Star of the Sea Church

Boys and Girls Club

Express Food Mart

Substation

CVS

Rings Island

Back River

Lucy Brook

Meader Brook

Clarks Pond

Millyard Dam 2

Millyard Dam

Mill Street Dam

Patten Pond Outlet Dam

Patters Pond

Pow Wow River

Smallpox Brook

Little River

Little River Dam

Dead Creek

Town Creek

Vincent Creek

Black River

Allen Creek

Shad Creek

Morrill Creek

Middle Creek

Black Rock Creek

Blackwater River

Route 286

Route 1A

Route 1

Route 95

Route 110

Route 107

Route 150

Route 49

INTERSTATE 95

INTERSTATE 95 CONNECTOR

BEACH ROAD

FERRY ROAD

MARCH ROAD

ELM STREET

MAIN STREET

HIGH STREET

FOREST STREET

CONGRESS STREET

LOCUST STREET

BLACK RIVER ROAD

FOLLY MILL ROAD

COLLINS ROAD

OLDELM STREET

MERRILL STREET

BRIDGE ROAD

MUDNOCK ROAD

PLEASANT STREET

DOCK LANE

SEABROOK ROAD

CORPORAL PATTEN WAY

BAKER ROAD

GERRISH ROAD

FOREST ROAD

COUNTY ROAD

ATLANTIC AVENUE

ELEVENTH STREET

TWELFTH STREET

LIBERTY STREET

NORTH PROMENADE

CENTRAL AVENUE

OCEAN ROAD

PARKER AVENUE

STATE BEACH ROAD

ACCESS ROAD

1,150 0 1,150

Scale In Feet

Legend

- Town Hall
- Fire Stations
- Local Police
- Underground Storage Tanks
- Boys and Girls Club, Daycare
- Emergency Shelter
- Gas Station
- Groceries
- Hotel
- Mobile Home Park
- Public Parking
- Public telephone
- Substation
- Lighthouses
- Drinking Water Booster Station
- Public Water Supply
- Water Tank
- Wastewater Treatment Facility
- Sewer Pump Station
- Powerline
- Railroad

Schools (Pre-K Through HS)

- Public
- Private
- Special Education

Libraries

- Public
- School

- Evacuation Routes

Long Term Care Residences

- Assisted Living Facility
- Nursing Home
- Rest Home

Dams

- Significant Hazard
- Low Hazard
- N/A

DEP Wetlands

- Marsh/Bog
- Wooded marsh
- Salt Marsh
- Open Water
- Tidal Flats
- Beach/Dune

FEMA National Flood Hazard Layer

- 1% Annual Chance of Flooding (Zones A, AE, AH, AO)
- AE: Regulatory Floodway
- VE: High Risk Coastal Area
- X: 0.2% Annual Chance of Flooding

FIGURE 1

TOWN OF SALISBURY

HAZARDS AND RESOURCES

OCTOBER 2018 SCALE: NOTED

Weston & Sampson℠

Seabrook Nuclear Power Plant approximately 1 mile north

N

South Hampton, NH

Seabrook, NH

AMESBURY

NEWBURYPORT

Back River

Lucy Brook

Meader Brook

Clarks Pond

Millyard Dam 2

Millyard Dam

Mill Street Dam

Smallpox Brook

Blackwater River

Little River

Little River Dam

Dead Creek

Town Creek

Vincent Creek

Allen Creek

Shad Creek

Morrill Creek

Middle Creek

Elliot Rock Creek

Heritage Park Mobile Homes

Kendall Lane Mobile Homes

Salisbury Inn Mobile Homes

Salisbury Elementary School

Amesbury Elementary School

Coastal Connections Academy

Sparhawk School (Lower School)

Francis T Bresnahan Elementary School

SALISBURY FIRE DEPARTMENT Headquarters

SALISBURY POLICE DEPARTMENT

Hilton Center

East Parish United Methodist Church

Boys and Girls Club

Star of the Sea Church

Salisbury Inn

Express Food Mart

CVS

Substation

Rings Island

INTERSTATE 95 CONNECTOR

INTERSTATE 95

1A

1

110

113

286

150

495

Legend

- Town Hall
- Fire Stations
- Local Police
- Underground Storage Tanks
- Boys and Girls Club, Daycare
- Emergency Shelter
- Gas Station
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- N/A

DEP Wetlands

- Marsh/Bog
- Wooded marsh
- Salt Marsh
- Open Water
- Tidal Flats
- Beach/Dune

2070 1% Inundation Depth

- 0.5 ft
- 1.0 ft
- 1.5 ft
- 2.0 ft
- 2.5 ft
- 3.0 ft
- 3.5 ft
- 4.0 ft
- 4.5 ft
- 5.0 ft
- 10 ft
- >10 ft

Data Sources:
- Basemap data and points of interest from MassGIS.
- Water & Wastewater Infrastructure data from Town of Salisbury , MA.
- 2070 Inundation Probability & Depth data (National Wildlife Federation) was created by Bosma et al. 2016.

1,150 0 1,150
Scale In Feet

FIGURE 1

TOWN OF SALISBURY

2070 1% INUNDATION DEPTH

OCTOBERER 2018 SCALE: NOTED

Weston & Sampson

Seabrook Nuclear Power Plant approximately 1 mile north

South Hampton, NH

Seabrook, NH

AMESBURY

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Interstate 95

Interstate 95 Connector

Route 286

Route 1

Route 1A

Route 110

Route 495

Route 150

Route 113

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Dams

- Significant Hazard
- Low Hazard
- N/A

DEP Wetlands

- Marsh/Bog
- Wooded marsh
- Salt Marsh
- Open Water
- Tidal Flats
- Beach/Dune

2070 Inundation Probability

- Dry
- 0.1%
- 0.2%
- 0.5%
- 1%
- 2%
- 5%
- 10%
- 20%
- 25%
- 30%
- 50%
- 100%

Data Sources:
- Basemap data and points of interest from MassGIS.
- Water & Wastewater Infrastructure data from Town of Salisbury , MA.
- 2070 Inundation Probability & Depth data (National Wildlife Federation) was created by Bosma et al. 2016.
Vizualization from Famiey et al. 2016.

N

1,150 0 1,150
Scale In Feet

FIGURE 1

TOWN OF SALISBURY

2070 INUNDATION PROBABLILITY

OCTOBERER 2018 SCALE: NOTED

Weston & Sampson℠

APPENDIX B

Workshop Presentation

welcome

Community Resilience Building Workshop

Salisbury, Massachusetts

Welcome & Introductions

Salisbury Introductions

Municipal Leadership

- Neil Harrington, Town Manager
- Lisa Pearson, Planning Director
- Core Team Members
  - Scott Carrigan, Fire Chief
  - Robert Cook, Emergency Management
  - Lisa DeMeo, Public Works
  - Tom Fowler, Police Chief
  - Michelle Rowden, Conservation
  - Scott Vandewalle, Building

Weston & Sampson Introductions

<u>Assisting with the Workshop</u>

- Chris Perkins, Principal-in-Charge
- Kathy Baskin, Project Manager/Facilitator
- Table Facilitators
  - Rob Almy
  - Adria Boynton
  - Sarah Miller
  - Jim Riordan
  - Steve Roy

Participant Introductions

- Your name
- Relationship to Salisbury
- Why you are here today

Workshop Outline

Workshop-Wide

- Overview of Science & Data Resources
- Characterize Hazards

BREAK

Individual Tables

- Identify Community Features
  - Infrastructure
  - Societal
  - Environmental

Post-Workshop

- Combine Ideas
- Prepare Report

LUNCH

Individual Tables

- Identify and Prioritize Actions

BREAK

Workshop-Wide

- Determine Overall Priority Actions

What is the Municipal Vulnerability Preparedness (MVP) Program?

Massachusetts program:

- Assist municipalities plan for climate change resiliency and implement priority projects

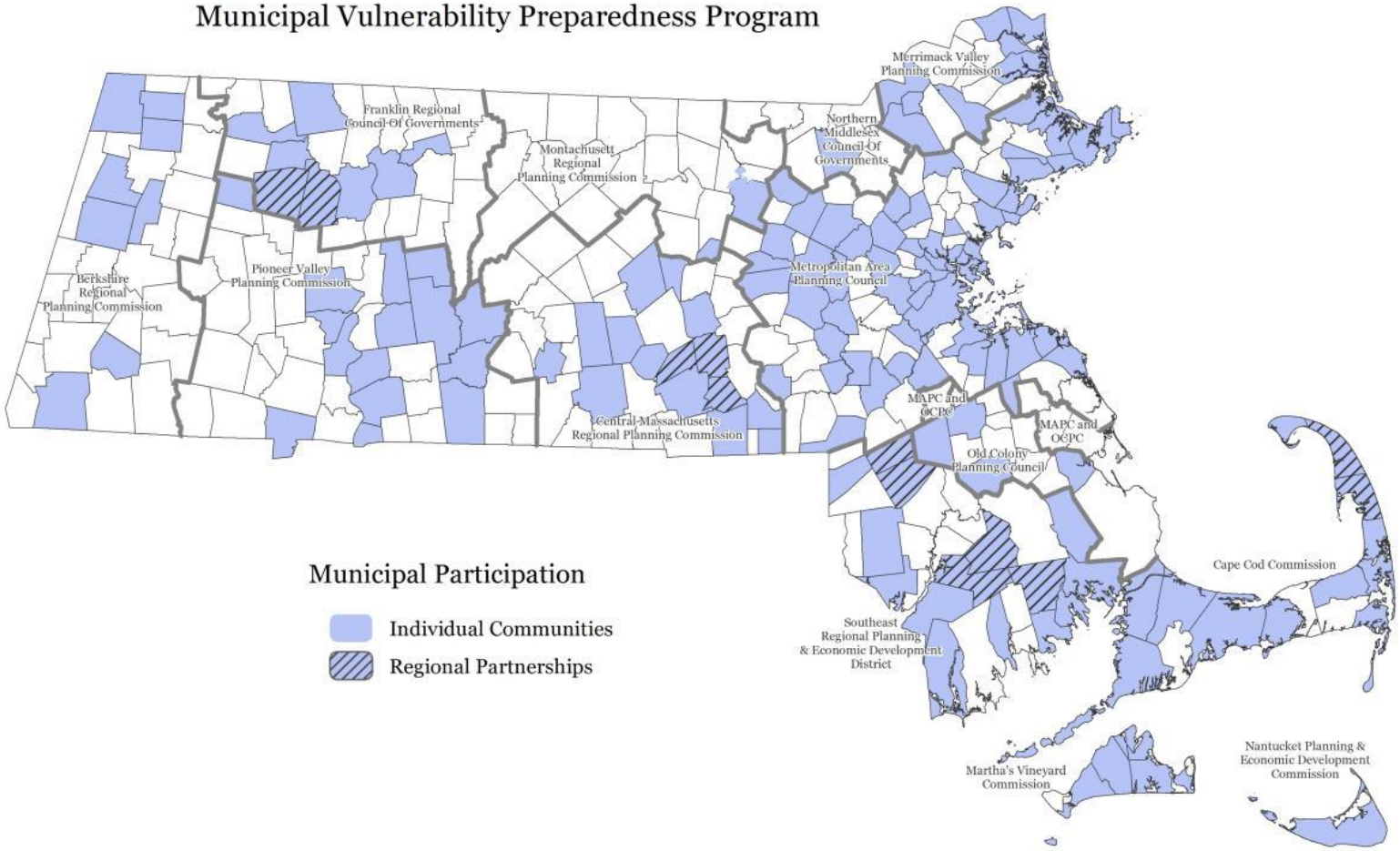
Helps communities:

- Define extreme weather hazards and climate change impacts
- Identify key features
- Determine vulnerabilities and strengths
- Develop and prioritize actions
- Complete vulnerability assessments
- Implement key actions

Source: MA Coastal Zone Management

Eligible Communities

Complete MVP program; become certified; apply for MVP Action grant funding



What the MVP Program offers Salisbury

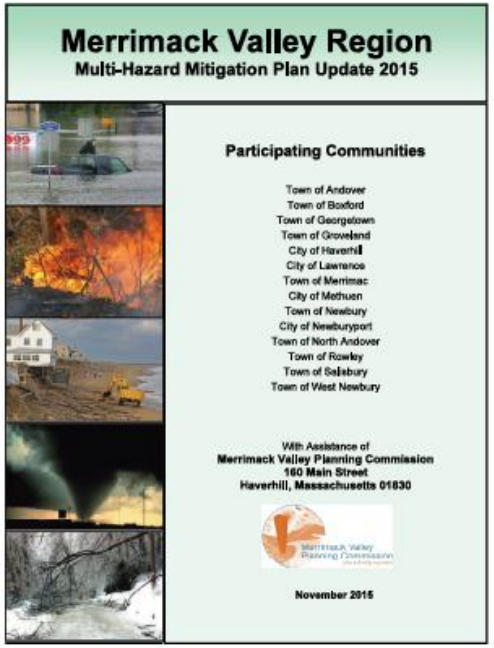
- Improved **resilience and preparedness** of natural and climate-driven hazards
- **Collaboration with stakeholders** about climate change, natural hazards and impact
- **Increased education, planning, and implementation** of priority actions

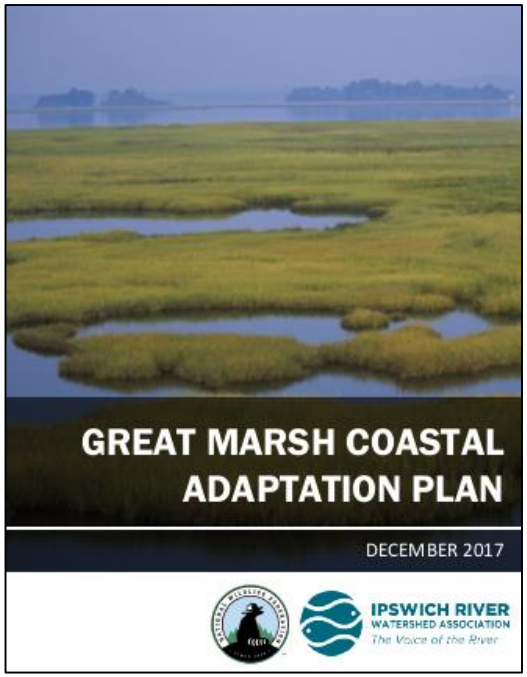
Data Resources
&
Overview of Science

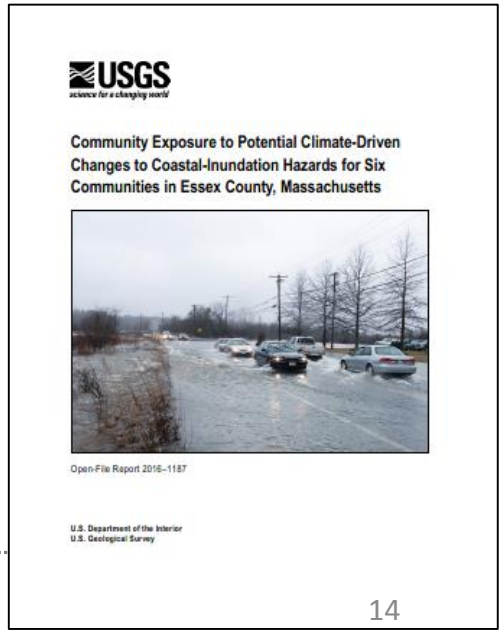
Data Resources

Lots of great work has already taken place recently!

- Salisbury Aquatic Barrier Assessment Report (IRWA, 2018)
- Underwater: Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate (UCS, 2018)
- Massachusetts Climate Change Projections (NECSC, 2018)
- Great Marsh Coastal Adaptation Plan (NWF, IRWA 2017)
- Merrimack Valley Region Multi-Hazard Mitigation Plan Update (MVRPC, 2016)
- Community Exposure to Potential Climate-Driven Changes to Coastal-Inundation Hazards for Six Communities in Essex County, Massachusetts (USGS, 2016)
- Massachusetts Climate Change Adaptation Report (MA EEA, 2011)







Salisbury's Land Use

- Salisbury Beach: 3.8 mile long barrier beach
- Infrastructure: mostly in Salisbury Beach & Salisbury Square

- Forest (37.8%)
- Salt marsh/wetlands (27.6%)
- Residential (16.6%)
- Commercial & Industrial (3.8%)
- Agricultural (5.6%)
- Transportation (1.8%)
- Other (6.8%)

Erosion at Salisbury Beach following a pair of nor'easters in March 2018

Natural Hazards in Salisbury

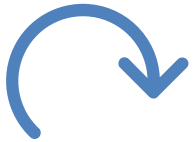
Current and future under climate change

Extreme Heat

Sea Level Rise/ Storm Surge

Heavy Precipitation

Wind



Drought

Snow/Ice

Erosion

Hazards in Salisbury

(Source: Merrimack Valley Region Multi-Hazard Mitigation Plan, 2015)

Table 5.13-4. Salisbury Natural Hazards Risk Assessment

Natural Hazard		Community Risk Rating
Floods		HIGH
Winter Storms (blizzard/snow/ice)		HIGH
Northeasters		HIGH
Power Outages		HIGH
Hurricanes		Moderate
Drought		Moderate
Wildfire/Brush Fires		Moderate
Tornadoes		Low
Earthquakes		Low
Landslides		Low
Dam Failures		Low

Floodplain & Repetitive Loss

Floodplain

- 11,007 acres (15.5 square miles)
- 4,779 acres in 100-year floodplain (43.4%)
- 1,710 buildings in 100-year floodplain
  - Property value assessed at $418M
  - Content value estimated at $258M

National Flood Insurance Program

- 37 sites have had 114 payouts totaling $2.9 million since 1978

Salisbury Beach Center
(source: The Daily News, February 10, 2016)

Hazards in Salisbury

(Source: NWF Great Marsh Coastal Adaptation Plan, 2017)

High Hazard Concerns	Type of Hazard
Salisbury Beach	Erosion
Salisbury Beach at Broadway	Storm over-wash during storms
Neighborhoods along Blackwater River	Flooding during extreme high tides and storms
US Route 1 North at Town Creek	Tidally influenced flooding
US Route 1 South; March Road and 1st St.	Tidally influenced flooding
US Route 1A (Beach Road)	Tidally influenced flooding
Jak-Len Drive	Freshwater flooding from storms
Smallpox Brook	Freshwater flooding from storms
North End Boulevard (Old Town Way to 18th St.	Storm-related flooding

Existing Climate Change

Increased Temperatures in Northeast

- Warmer annual temperatures - up 2°F since 1970
- Warmer winters - up 1.3°F per decade since 1970
- Decreasing winter snowpack
- Earlier flowering plants
- More frequent extreme summer heat

(Source: MA Coastal Zone Management)

Heavy Precipitation

Riverine and Stormwater Flooding

- Merrimack Valley region's most frequent and costly natural disaster

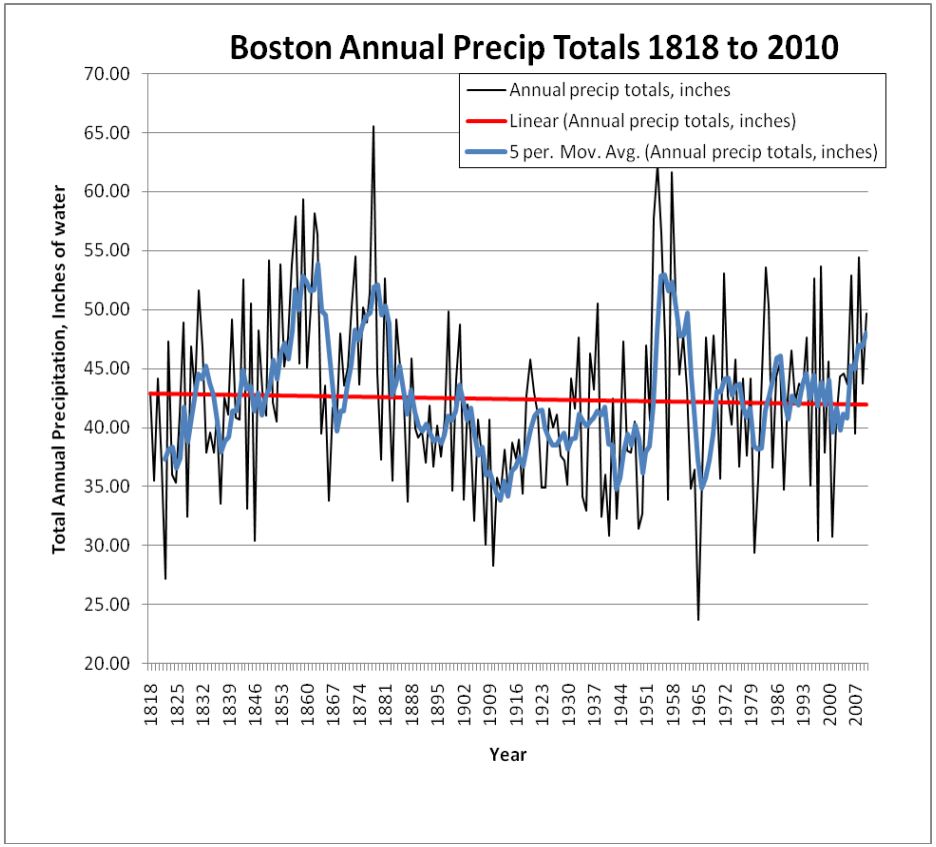
- Affects infrastructure, property damage, natural resources

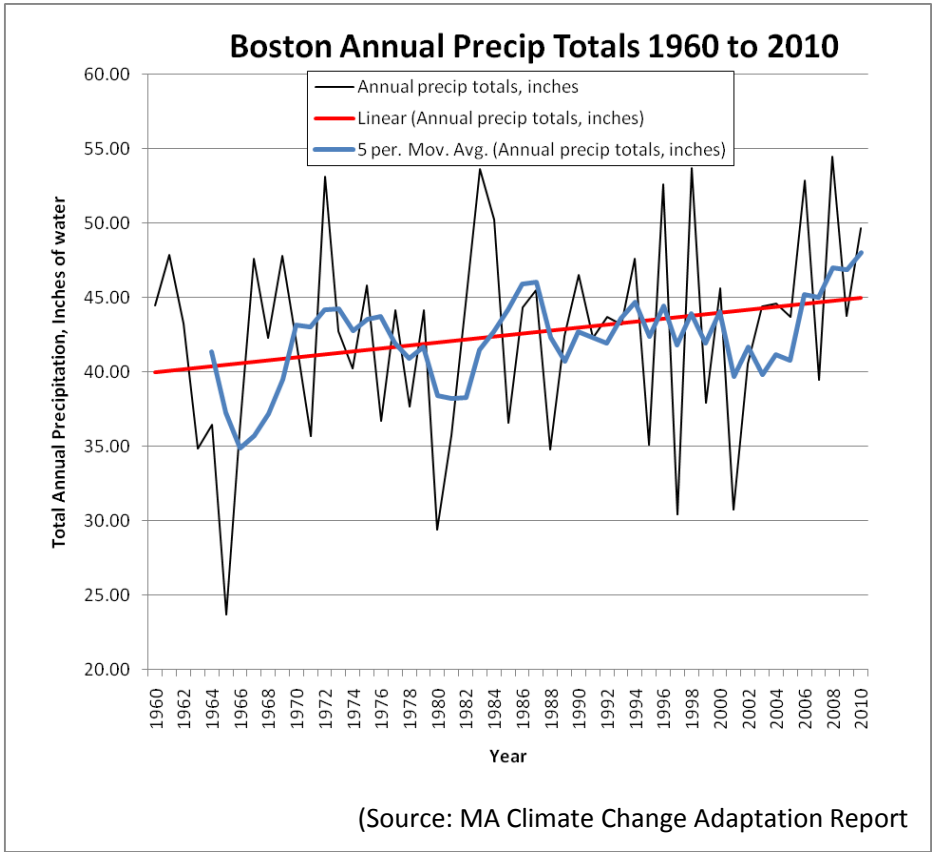
Beach Road in Salisbury, MA

(Source: The Daily News of Newburyport)

Annual Precipitation in Boston

January 1818 to December 2010





(Source: MA Climate Change Adaptation Report

The blue line represents a five-year moving average and the red line a least squares regression.

Change in Precipitation

6-hour, 10-year event

- 1961 = 3.2 inches
- 2015 = 3.35 inches

24-hour, 100-year event

- 1961 = 6.5 inches
- 2015 = 8.40 inches

(Sources: NOAA TP-40 (1961) and NOAA Atlas Volume 10 (2015)

Sea Level Rise

Relative annual mean sea level

Source: Northeast Climate Adaption Science Center

(Source: The Daily News of Newburyport)

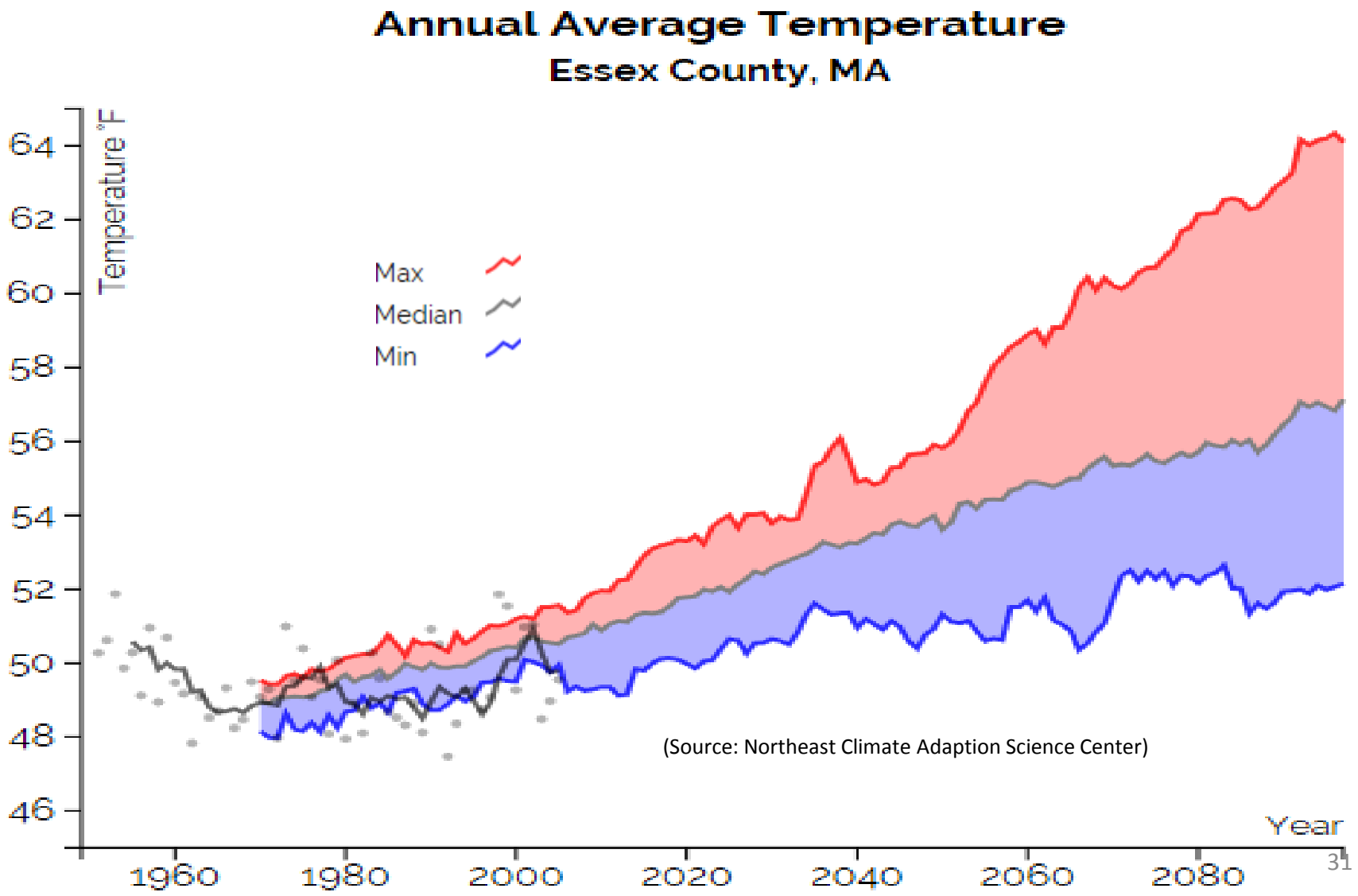
Predicted Climate Change

Increased Temperatures/Extreme Heat

	Observed Baseline	Projected Change 2050's	Projected Change End of Century
MA Average Temp (°F)	47.6	+2.8 to +6.2	+3.8 to +10.8
Salisbury Average Temp (°F)	48.1 to 49.7	+2.7 to +6.4	+3.5 to +10.9
Days with Temperatures Above 90°F	7 to 8	+7 to +33	+10 to +74
Days with Temperatures Above 100°F	<1 to 1	2 to 16	4 to 47
Days with Temperatures Below 32°F	121 to 148	-18 to -44	-23 to -66

(Source: NECSC, 2018)

Projected: Annual Average Temperature in Essex County



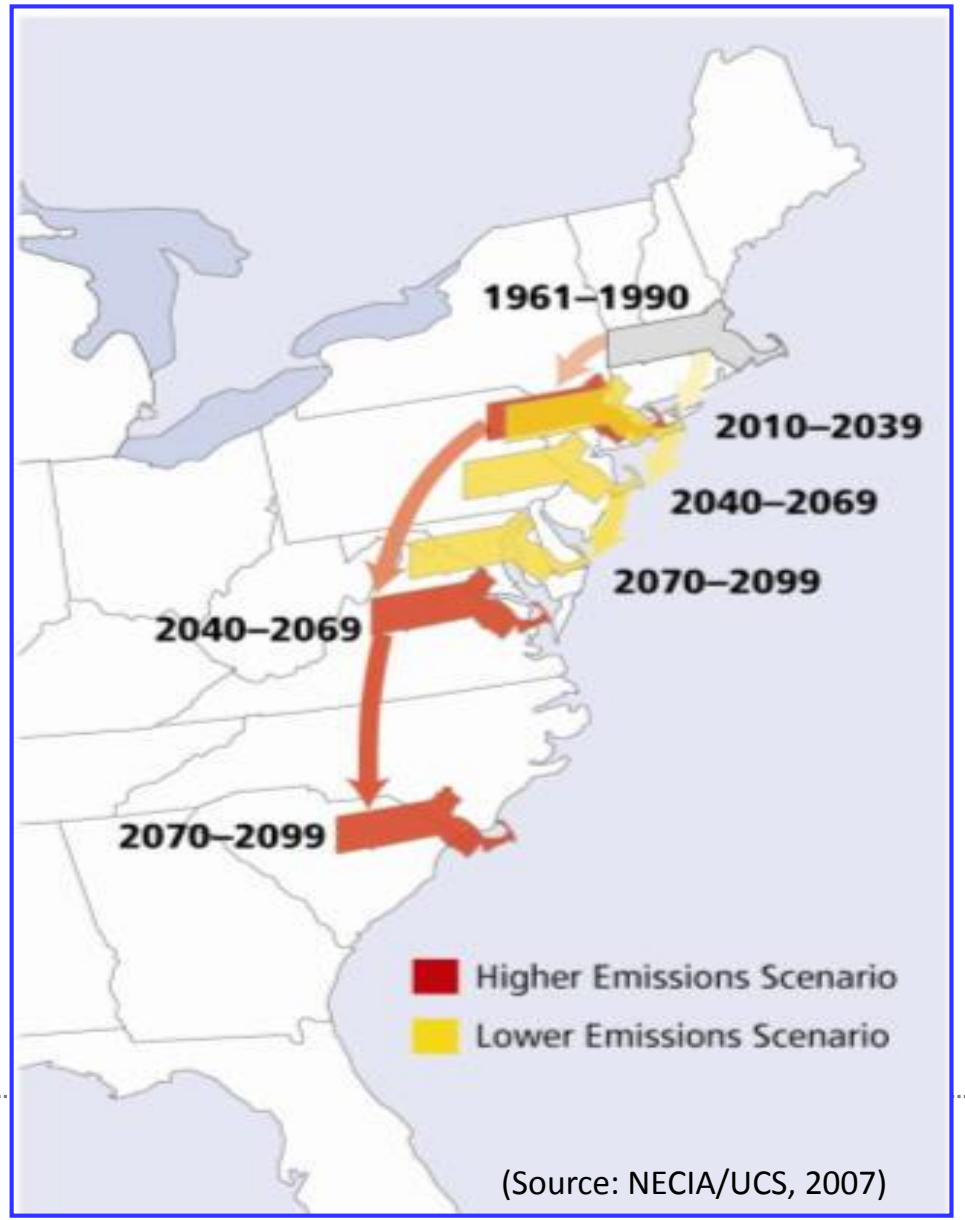
(Source: Northeast Climate Adaption Science Center)

Extreme Heat

Temperatures Predicted to Increase

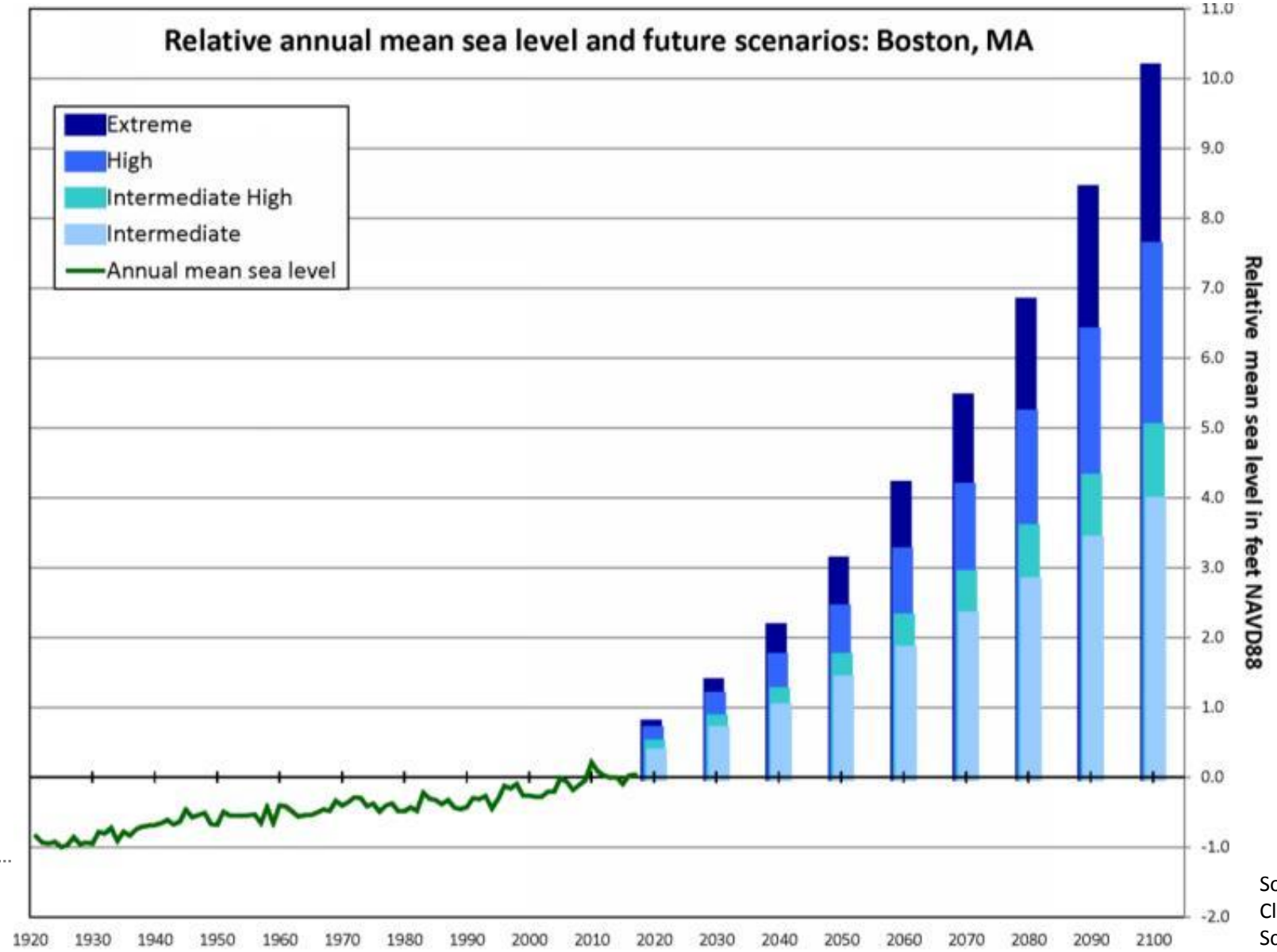
Winter: 15 to 40% ↑

Summer: 6 to 18% ↑



(Source: NECIA/UCS, 2007)

Sea Level Rise and Storm Surge



Source: Northeast Climate Adaption Science Center

Boston Sea Level Rise Projections

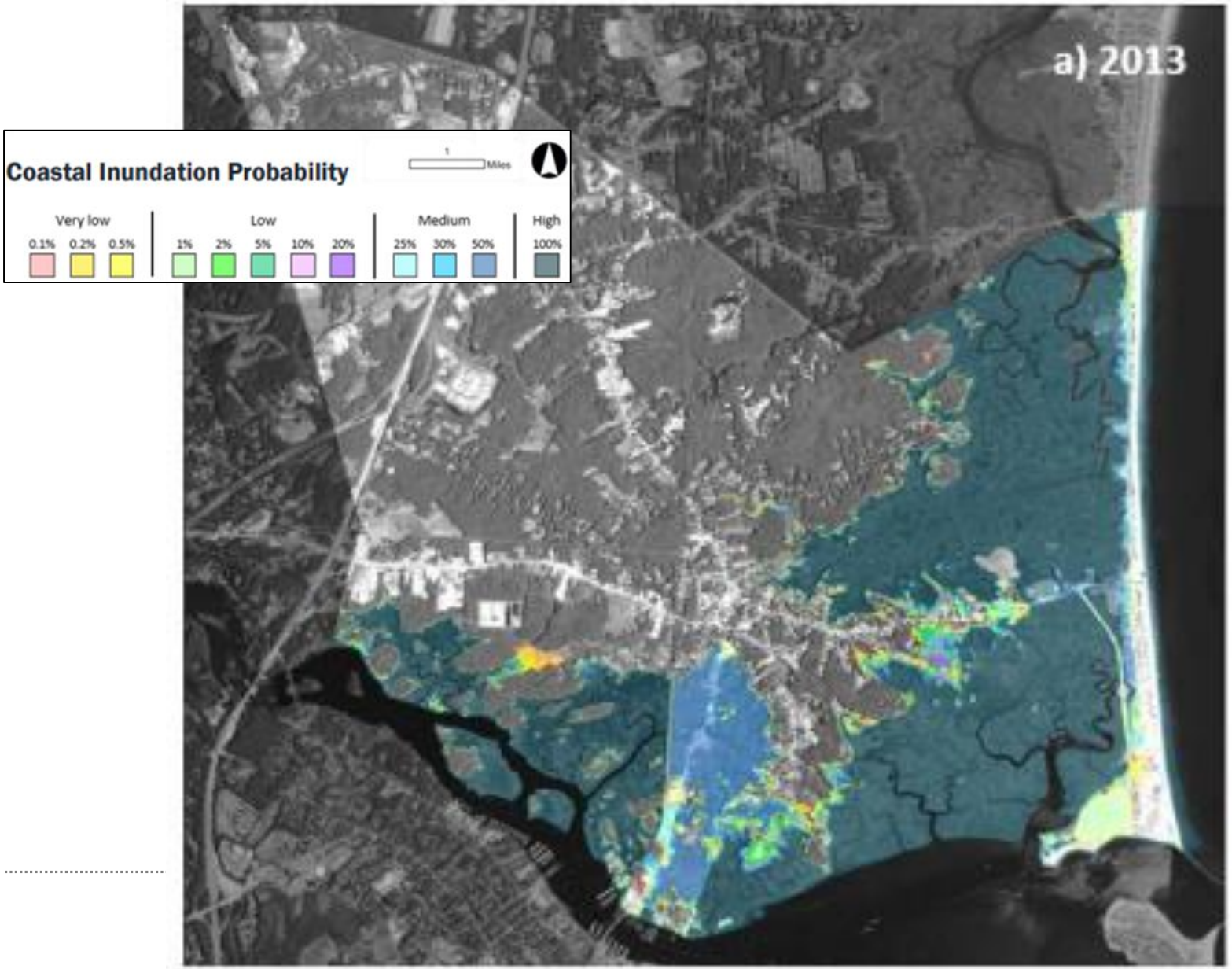
Threatens barrier buildings, infrastructure, beach and dune systems, and people

Emission Scenario	2030 (ft)	2050 (ft)	2070 (ft)	2100 (ft)
Intermediate	0.7	1.4	2.3	4.0
Intermediate-High	0.8	1.7	2.9	5.0
High	1.2	2.4	4.2	7.6
Extreme	1.4	3.1	5.4	10.2

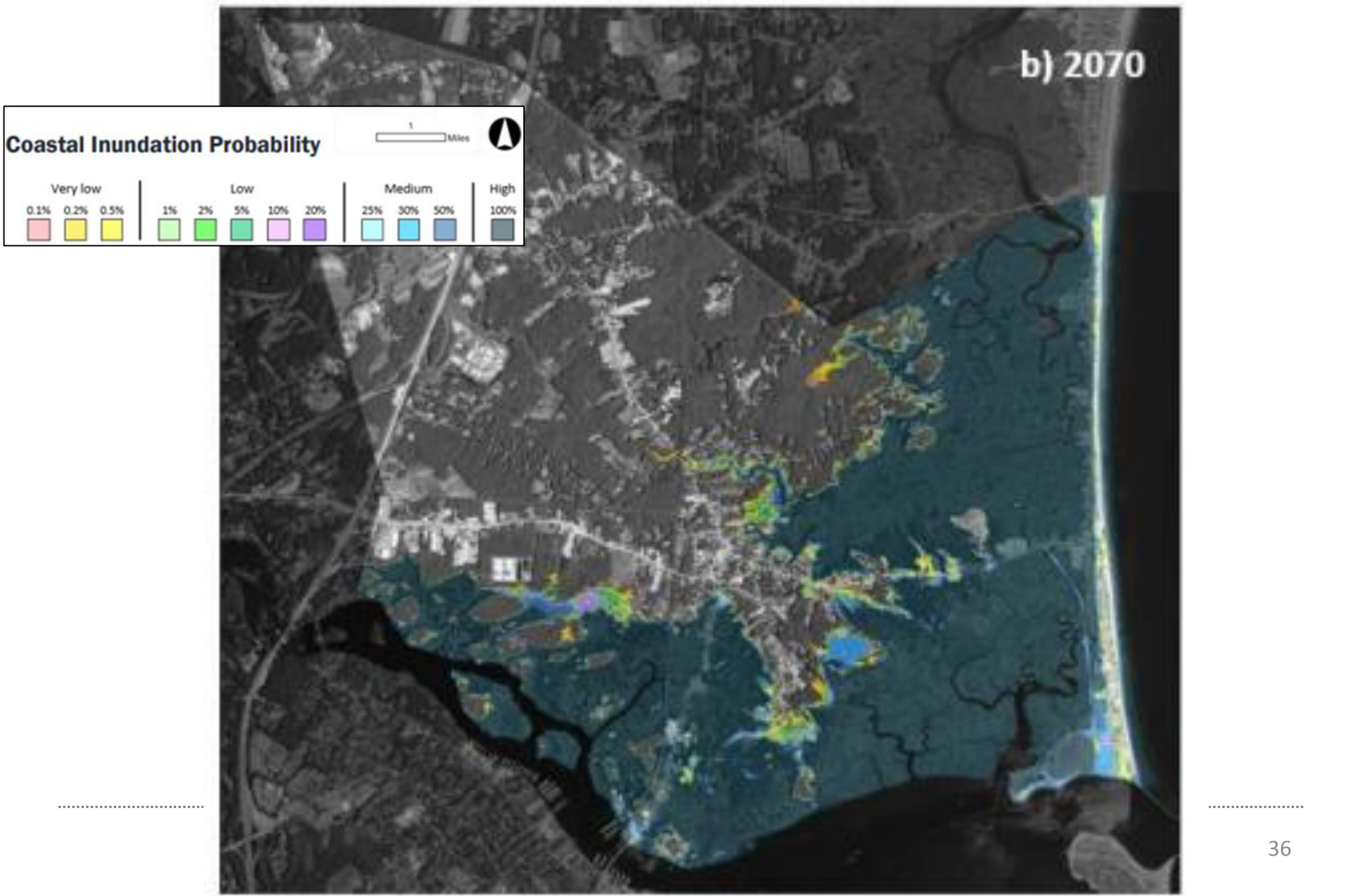
- Increased coastal flooding
- Permanently inundated low-lying coastal areas
- Increased shoreline erosion

(Source: Northeast Climate Adaption Science Center)

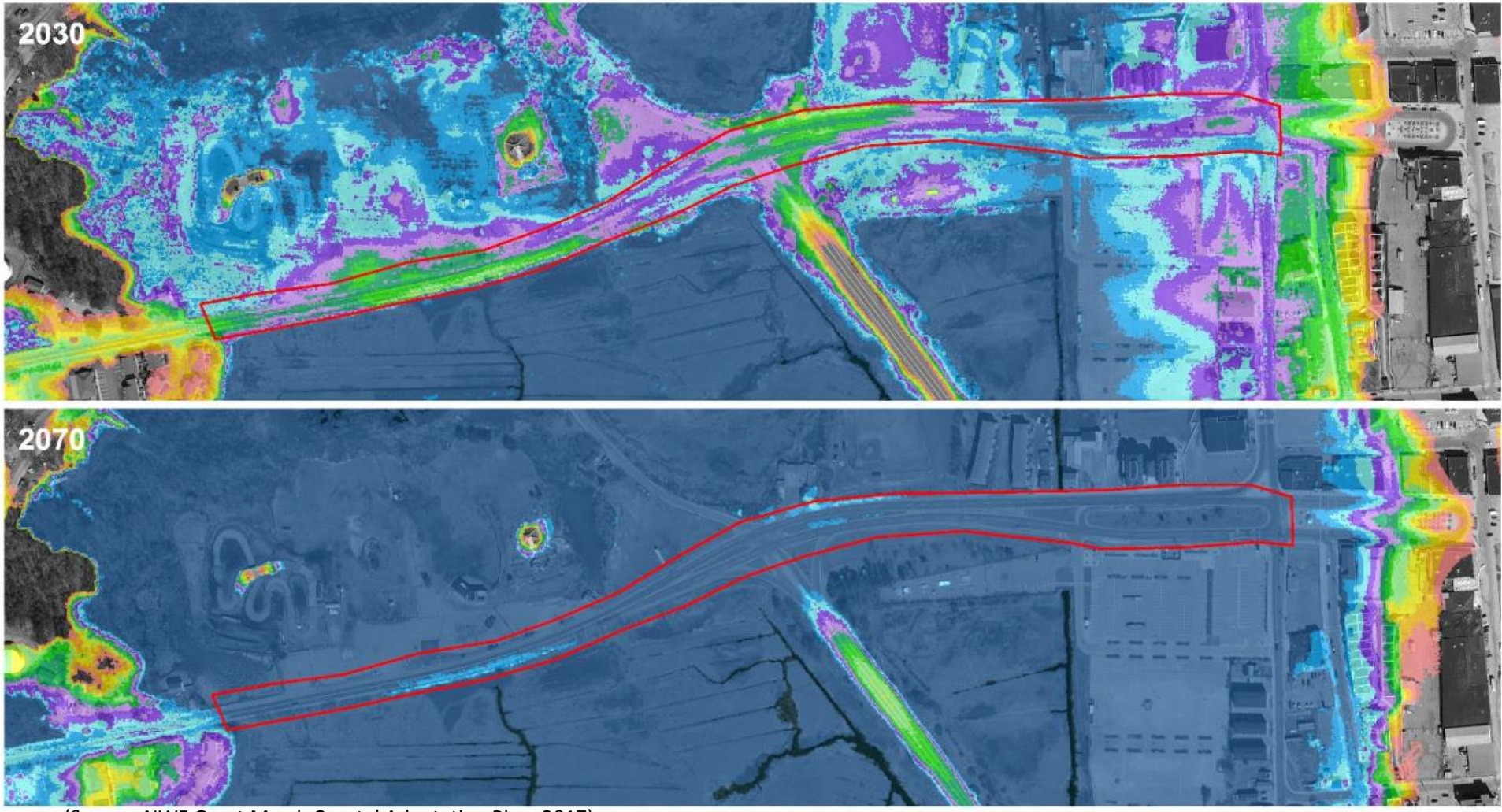
Current Coastal Inundation



Projected 2070 Coastal Inundation



Projected 2030 & 2070 Coastal Inundation



(Source: NWF Great Marsh Coastal Adaptation Plan, 2017)

1% (100-Year Storm) Inundation Depth

0.5 ft | 1.0 ft | 1.5 ft | 2.0 ft | 2.5 ft | 3.0 ft | 3.5 ft | 4.0 ft | 4.5 ft | 5.0 ft | 10 ft | >10 ft

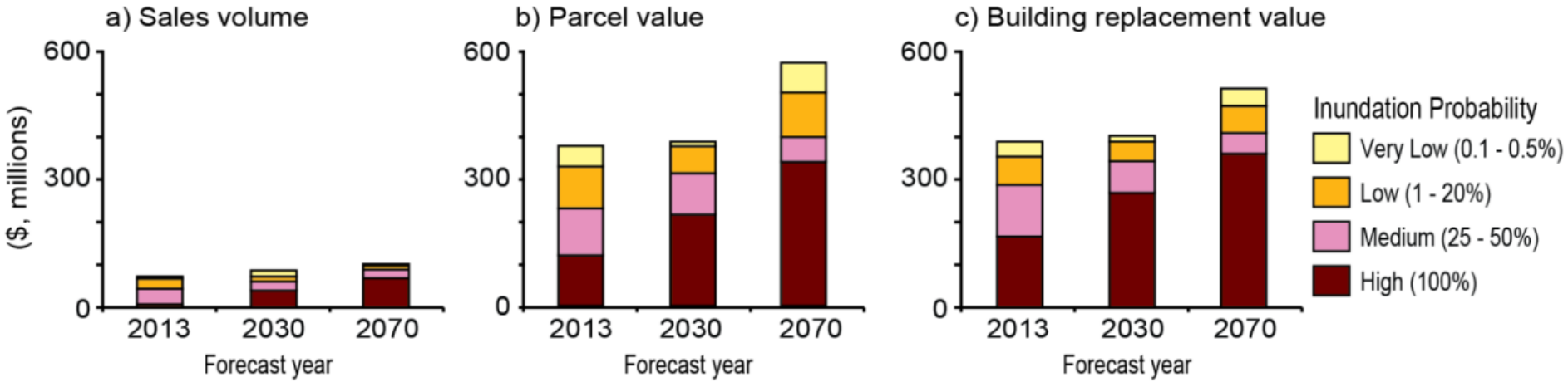
Route 1A (Beach Road)

500 Feet

Underwater Report (UCS, 2018)

Year	Emissions Scenario	Homes at Risk	Value at Risk	Population currently housed in at risk homes	% Population currently housed in at risk homes
2030	High	457	$150,005,600	827	9.98
	Intermediate	427	$141,273,900	773	9.33
2100	High	1,209	$398,120,000	2,188	26.42
	Intermediate	950	$305,105,200	1720	20.77
	Low	610	$193,553,000	1104	13.33

Replacement Costs in Coastal Hazard Zones



(Source: NWF Great Marsh Coastal Adaptation Plan, 2017)

Erosion

Weather causes serious erosion at Salisbury Beach (January 2016)

State replenishes sand on Salisbury Beach (July 2018)

http://www.newburyportnews.com/news/local_news/state-replenishes-sand-on-salisbury-beach/article_d746032-79de-5ea6-9137-921206bae645.html

Heavy Precipitation

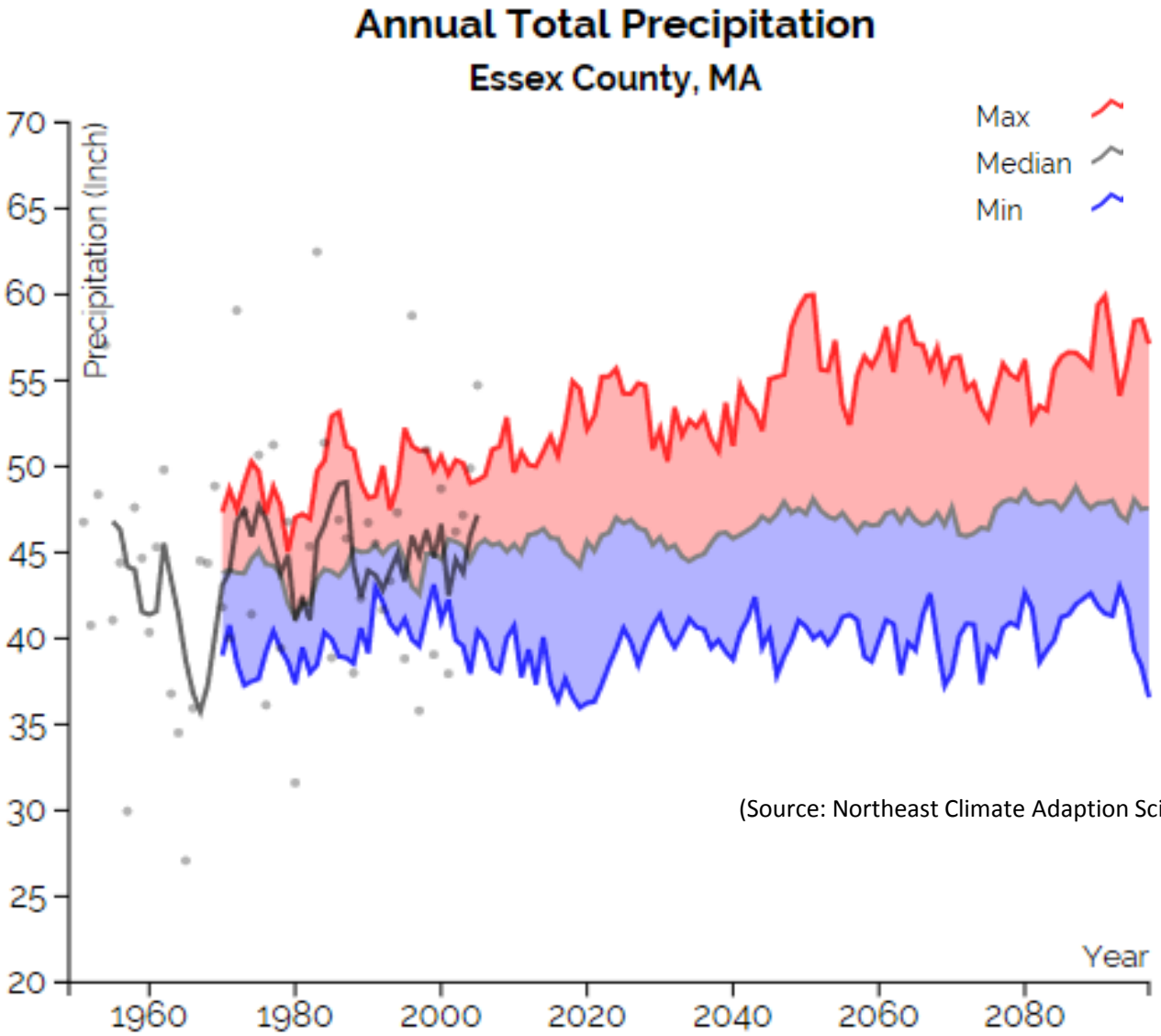
Predicted:

- Higher winter flows and flooding
- Earlier peak flows in spring
- Extended summer low flows

(Source: MA Coastal Zone Management)

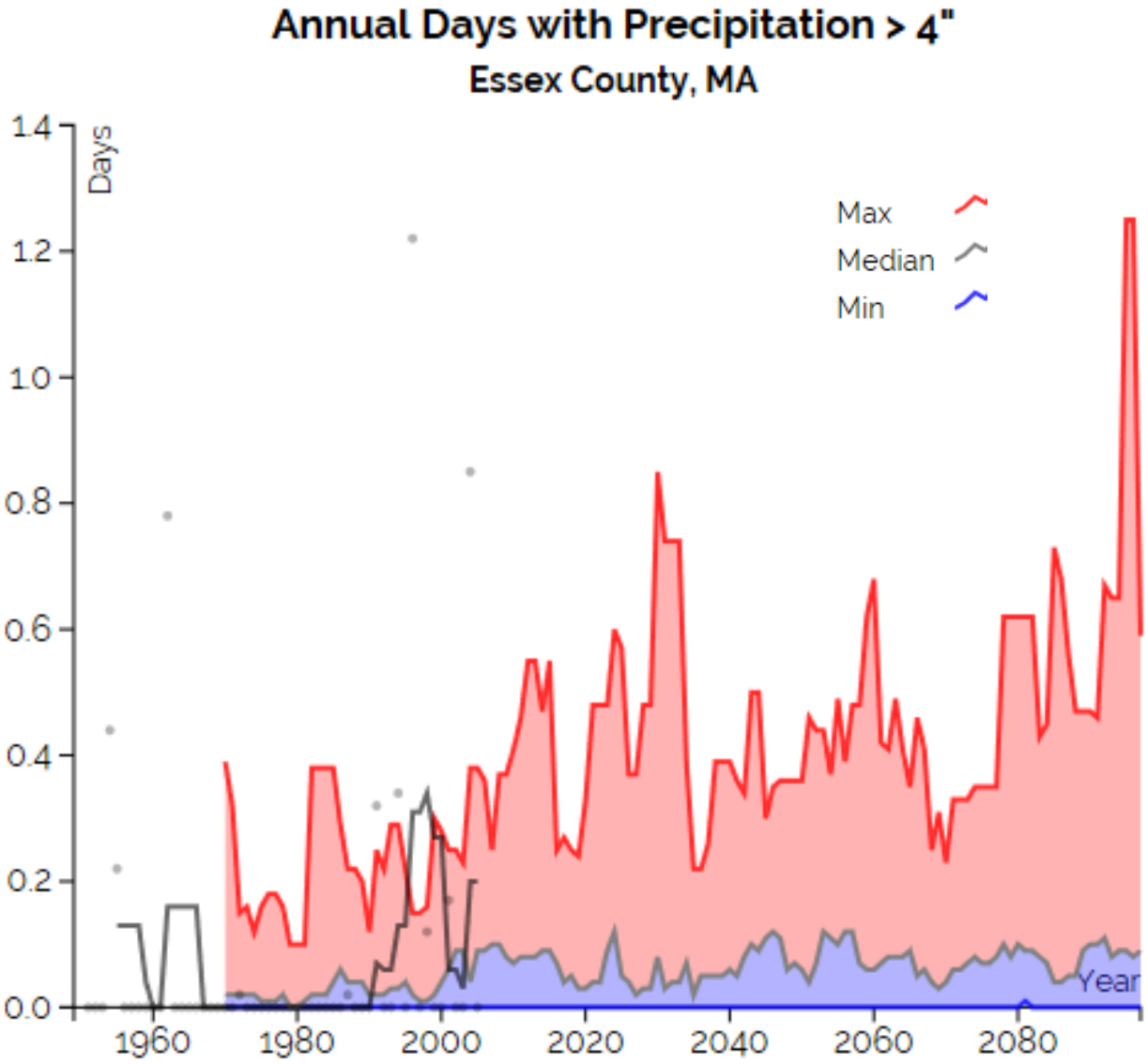
Increased flooding, polluted stormwater and wastewater discharges

Heavy Precipitation



(Source: Northeast Climate Adaption Science Center)

Heavy Precipitation



(Source: Northeast Climate Adaption Science Center)

Drought

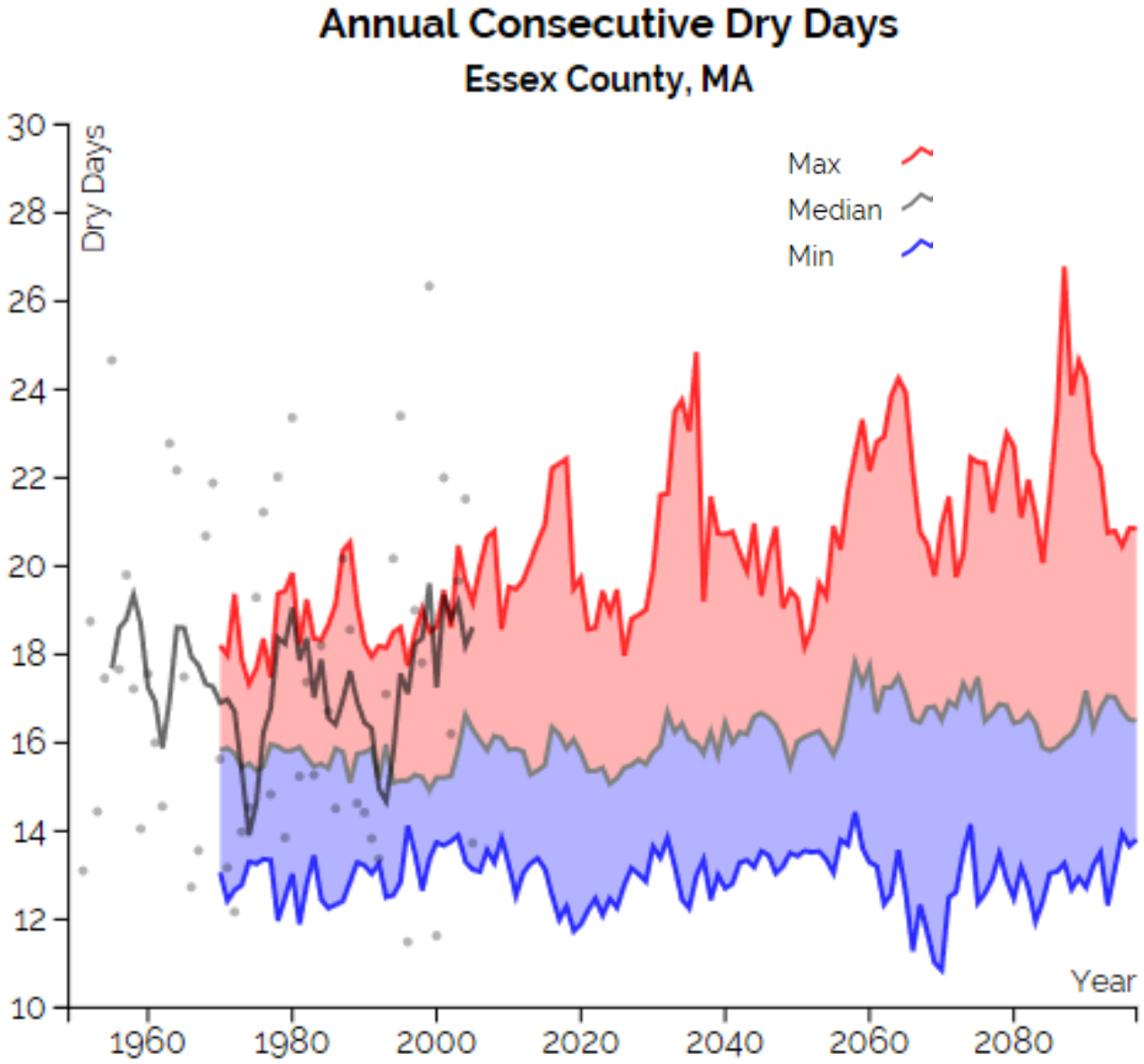
- Higher risk of drought in summer and fall

- Projected impacts to:
  - Water supply
  - Rivers, streams, wetlands
  - Vegetation and crops

Bartlett Farm in Salisbury

https://essexheritage.org/attractions/bartlett-farm

Drought



(Source: Northeast Climate Adaption Science Center)

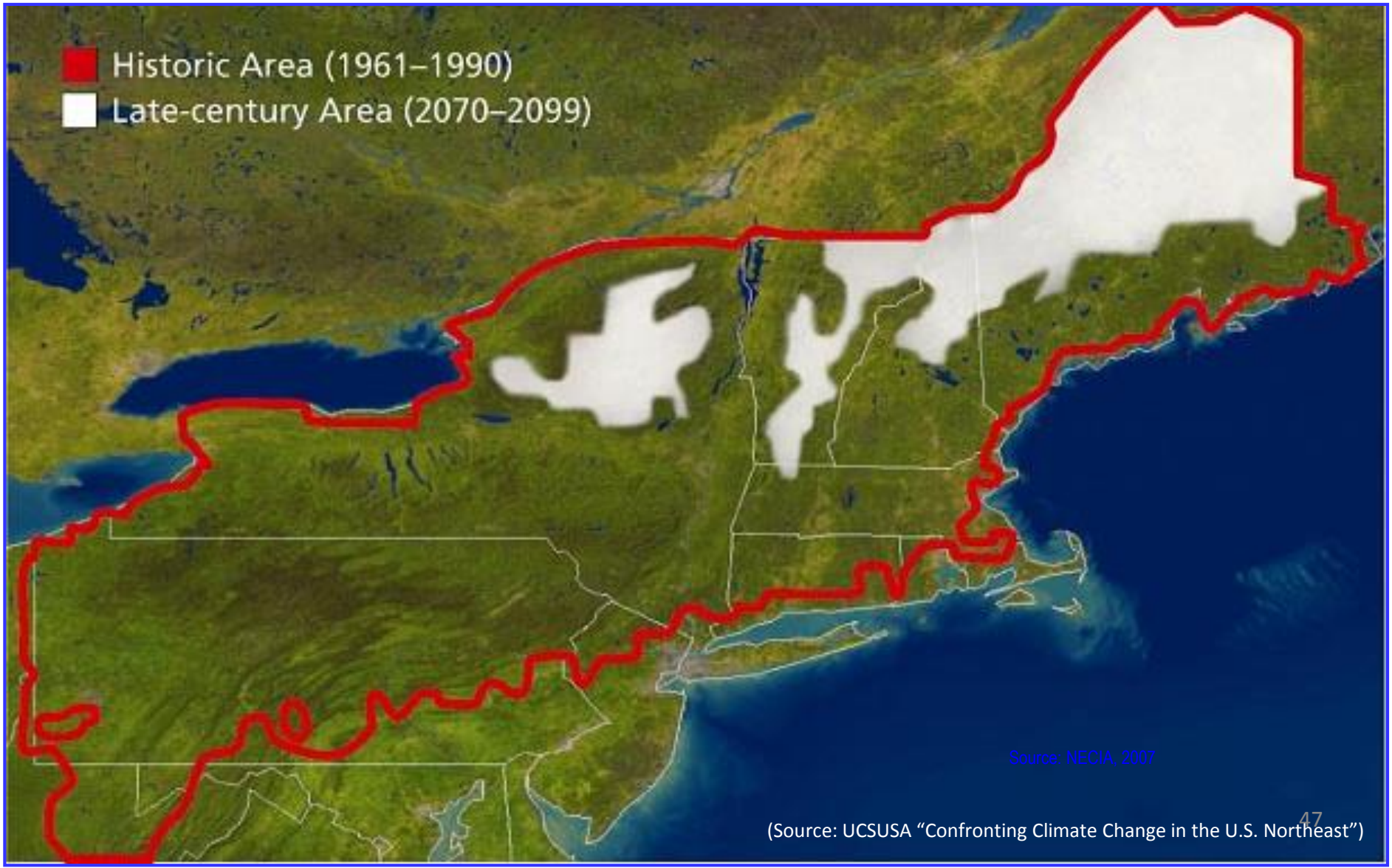
Ice/Snow Storms

- Past few decades, more rain in winter
- Projected, more rainy and icy winters

(Example: serious damage caused by Dec 2008 ice storm)

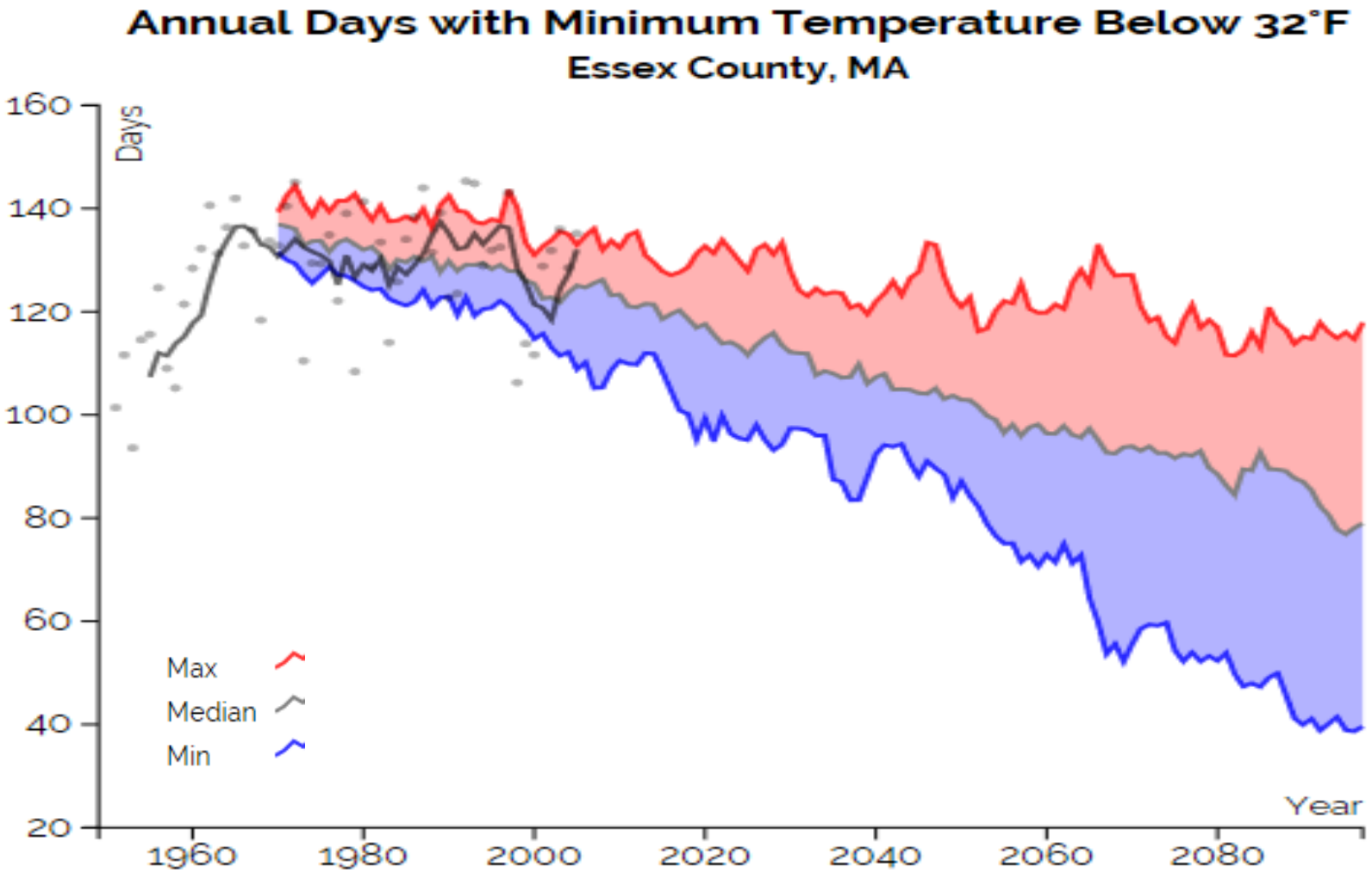
(Source: The Eagle-Tribune)

Predicted Snow Cover



(Source: UCSUSA "Confronting Climate Change in the U.S. Northeast")

Projection: Annual Days in Essex County with Minimum Temperature Below 32°



(Source: Northeast Climate Adaption Science Center)

(Source: WGNS Radio)

Wind

- NWS Wind Advisory:
  - 31 to 39 mph for at least one hour
  - Any wind speed between 46 to 57 mph

- NWS High Wind Warning:
  - 58 mph or higher

Impacts: town resources, infrastructure, trees, private and public property

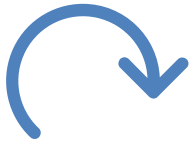
Choose Four Hazards

Extreme Heat

Sea Level Rise/ Storm Surge

Heavy Precipitation

Wind



Drought

Snow/Ice

Erosion


15-Minute Break!

Risk Matrix

Risk Matrix

Community Resilience Building Risk Matrix www.CommunityResilienceBuilding.com

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S					Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Societal									
Environmental									

Risk Matrix - Hazards

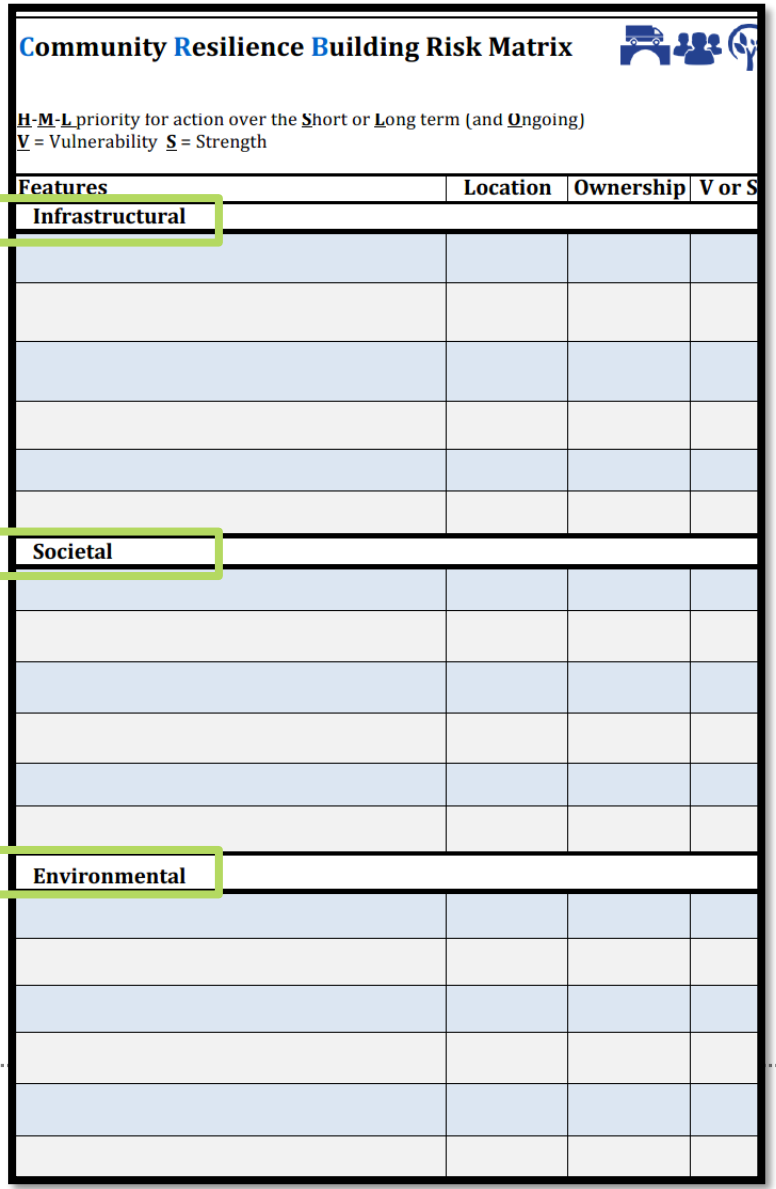
Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)					
				Priority	**Time**
				H - M - L	**Short Long Ongoing**

Risk Matrix- Features

Infrastructural

Societal

Environmental



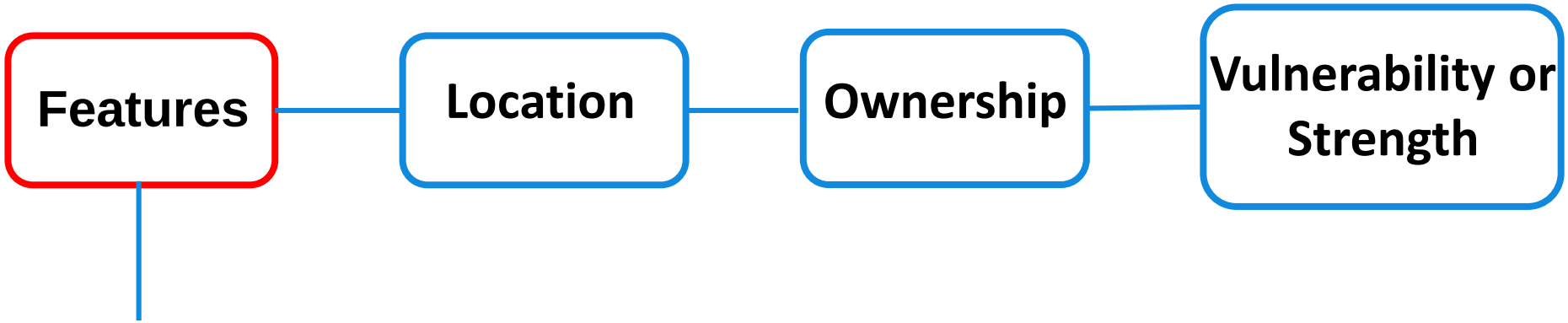
Community Resilience Building Risk Matrix

H-M-L priority for action over the Short or Long term (and Ongoing)
V = Vulnerability S = Strength

Features	Location	Ownership	V or S
Infrastructural			
Societal			
Environmental			

Features in Salisbury

Infrastructural, societal, and environmental features



Infrastructural

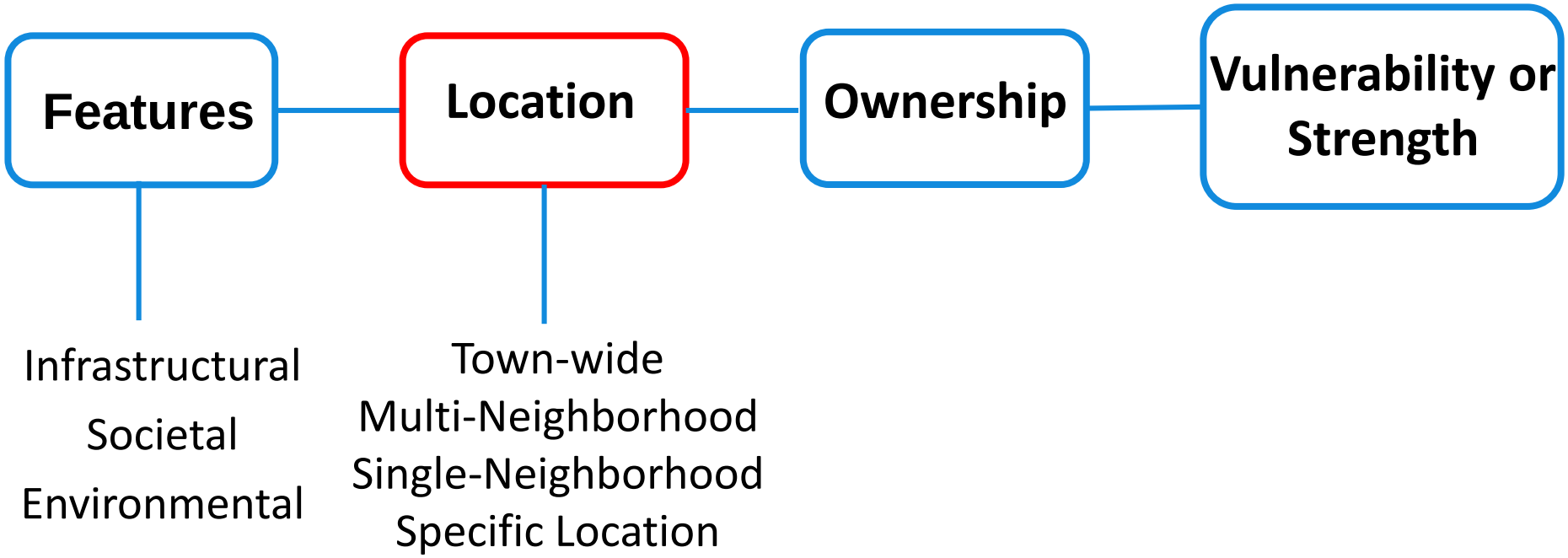
Societal

Environmental

Features in Salisbury

Location

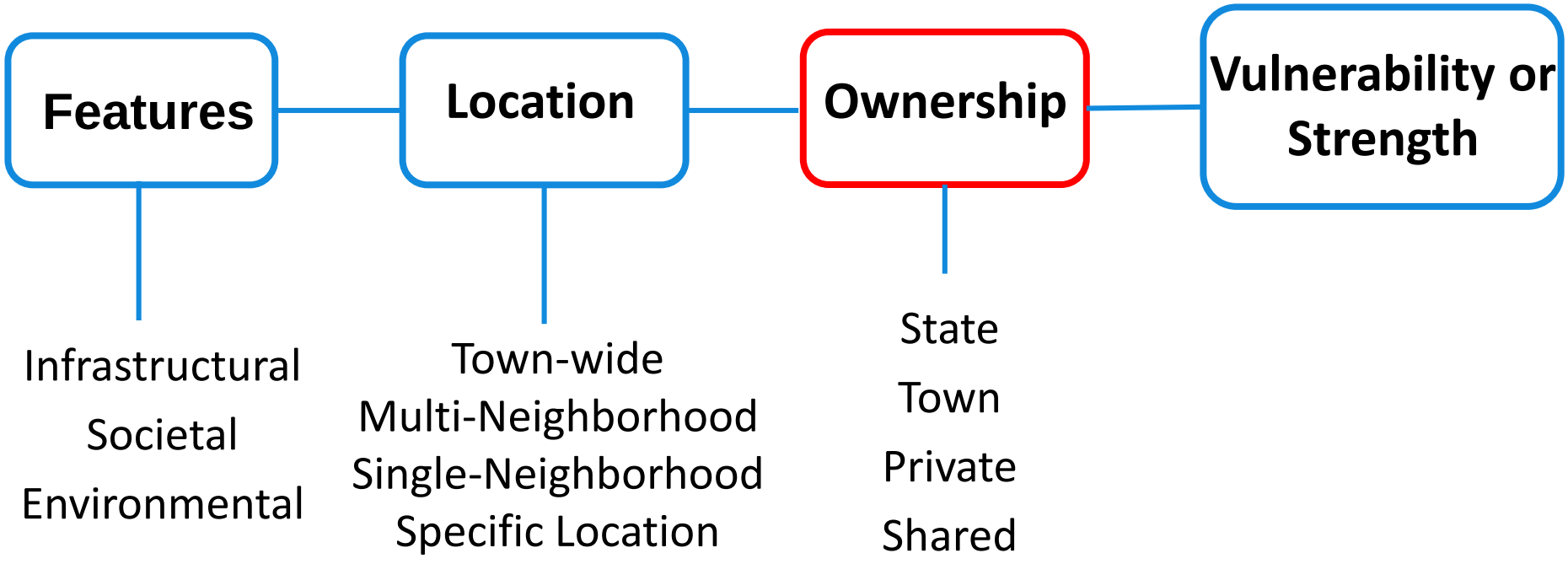
Infrastructural, societal, and environmental features



Features in Salisbury

Ownership

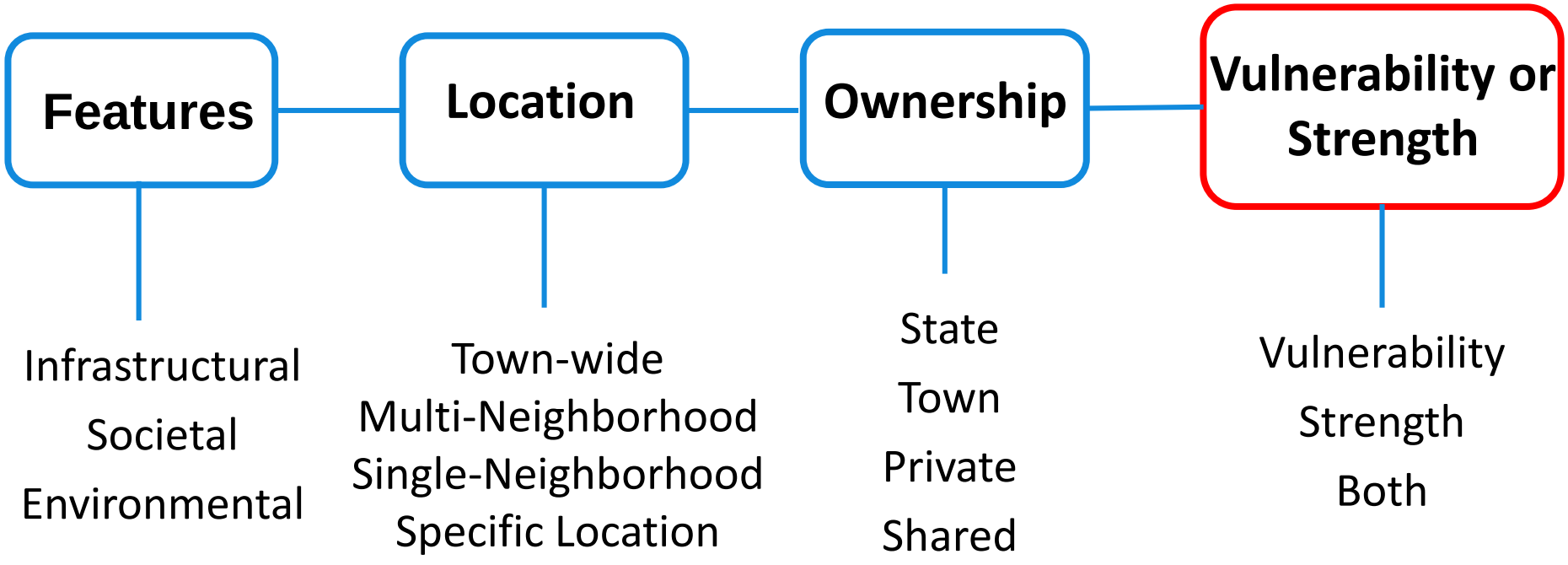
Infrastructural, societal, and environmental features



Features in Salisbury

Vulnerability or Strength

Infrastructural, societal, and environmental features



Infrastructure Features

Infrastructure

- Utilities such as electric power, gas, water, hydraulics, compressed air, municipal
- Water supply and treatment plants
- Wastewater treatment plants, sanitary & stormwater sewer systems
- Energy
- Manufacturing equipment and pollution control equipment
- Communication, data and voice computer networks
- Transportation

Energy Generation

(Seabrook Station Nuclear Power Plant)

Infrastructure: Police

http://www.salisburypolice.com/

Infrastructure: Fire Department

http://www.salisburyfirefighters4694.org/?zone=/unionactive/view_page.cfm&page=Station

Infrastructure: Wastewater Treatment and Collection

Infrastructure: Roadways

https://mycoast.org/reports/38427

Infrastructure: Water Supply

Infrastructure: Bridges

(I-95 Whittier Bridge)

Critical Facilities and Infrastructure in Salisbury, MA

Asset Description	Located in 2013 Hazard Zones	Located in 2070 Hazard Zones
Critical facilities	3	3
Transportation hub	1	1
Public-utility stations	3	3
Underground storage tanks	2	2
Declared activity and use limitation site	1	1
Total roads (miles)	18	19

(Source: NWF Great Marsh Coastal Adaptation Plan, 2017)

Societal Features

Societal: Salisbury's People

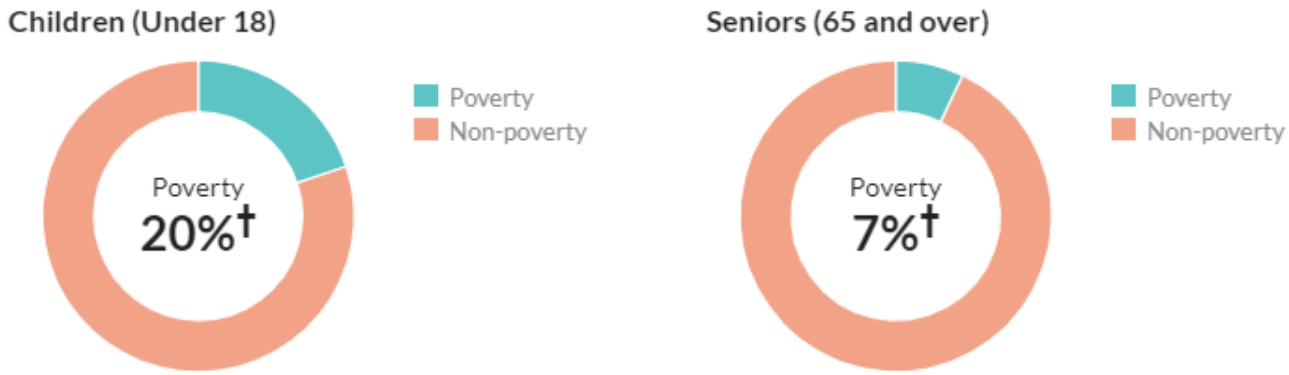
- Population
  - 2010 Census: 8,283
  - 2035 Projection: 10,100
- Age
  - Under age 20 = 15.2%
  - Age 65 or older = 12.5%
- Education
  - 91.6% high school
  - 28.3% Bachelors degree
- Income
  - Median household = $65,347
  - 36.5% low to moderate income
  - 10.3% below poverty level

Societal: Salisbury's Jobs

- Number of Jobs
  - 2010 Census: 2,795
  - 2035 Projection: 4,037
- 876 Companies
  - Retail
  - Manufacturing
  - Accommodation & food
  - Transportation & warehousing

Societal: Vulnerable Populations

Elderly, low/moderate income, special income, language barriers, infirmed

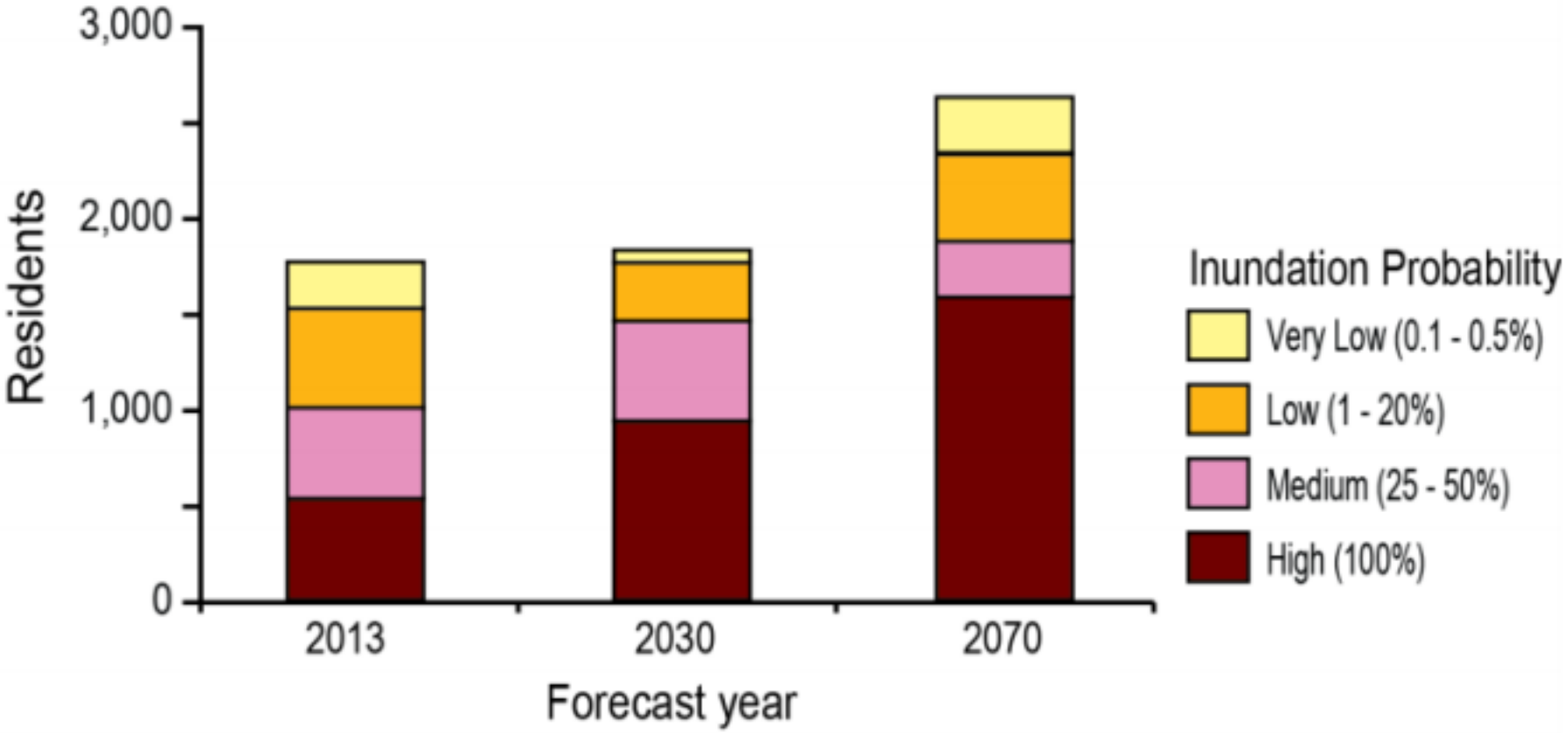


(Source: Censusreporter.com)

Census data: ACS 2016 5-year

Societal: Assisted Living and Senior Centers

Societal: Salisbury Resident Exposure to Coastal Inundation



(Source: NWF Great Marsh Coastal Adaptation Plan, 2017)

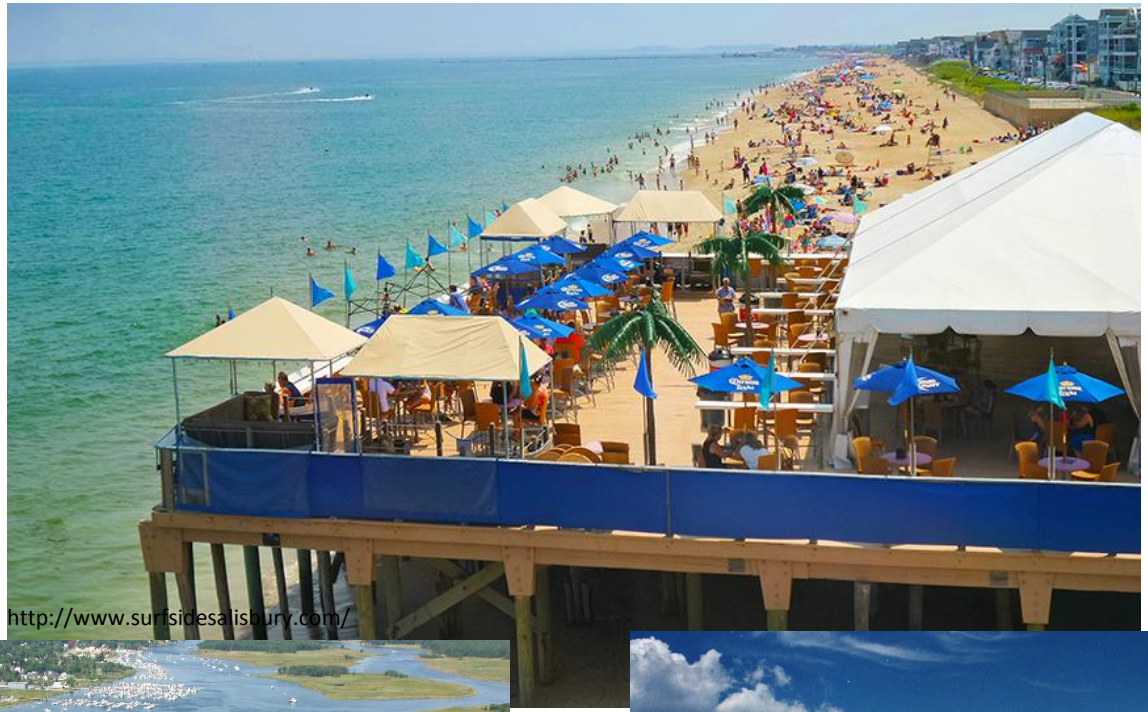
Environmental Features

Environmental: Natural Resources

- Merrimack River
- Salisbury Beach
- Coldwater Streams
- Forests
- The Great Marsh
- Other Marshes & Wetlands
- Aquifers

Salisbury 2015 (Source: MA Coastal Zone Management)

Environmental: An Economic Driver



http://www.surfsidesalisbury.com/

https://marinas.com/view/marina/jncpej_Bridge_Marina_Salisbury_MA_United_States

https://www.massvacation.com/blog/2015/08/a-day-trip-to-salisbury/

Environmental: Climate Stressors

- Flooding
- Erosion
- Water quality/quantity impacts
- Invasive fauna and flora
- Wetland soil Impacts
- Increase in stormwater runoff
- Less groundwater recharge
- Disruption of salt marsh

Salisbury Beach Center Post Super Storm Sandy

(Source: MA Coastal Zone Management)

Environmental: Salisbury Beach

- 3.8 mile barrier beach
- Densely developed
- High exposure to erosion
- Defense against storm surge and sea level rise

Salisbury Beach after two nor'easters in March 2018

(Source: Newburyport News, 2018)

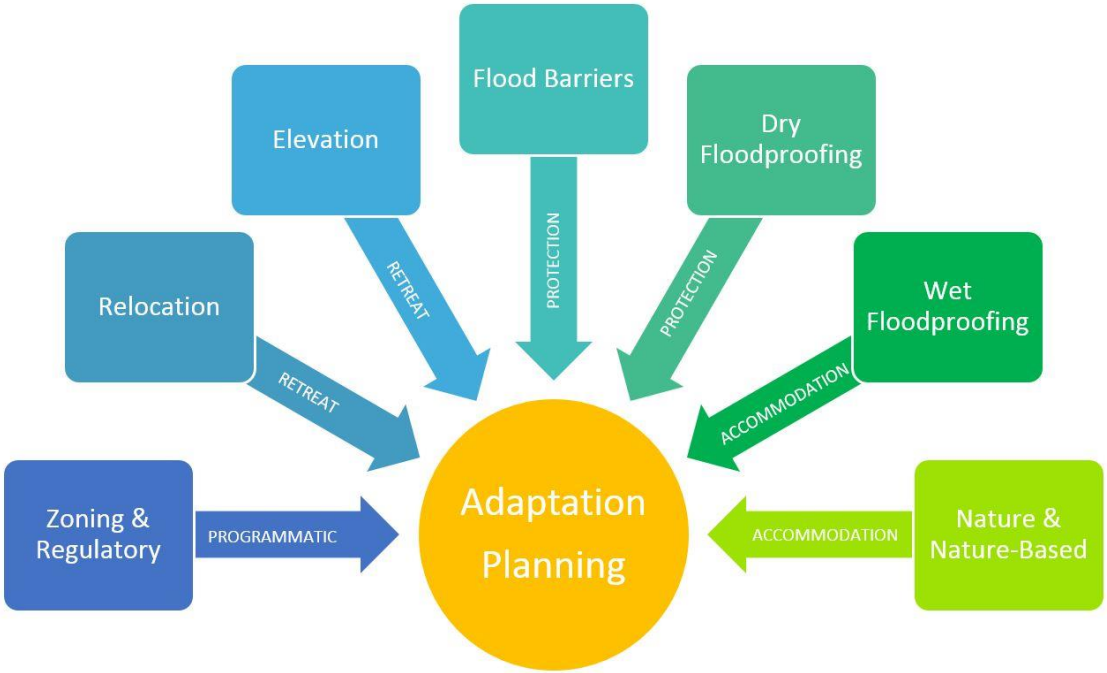
Environmental: Marshes

- Great Marsh = 27% of Salisbury
- Marsh attenuates reduces wave height
- Marshes and dune can migrate inland as a response to sea level rise
- Residential and commercial development has intensified effects of storm surge and erosion by damaging marshes and vegetated dunes

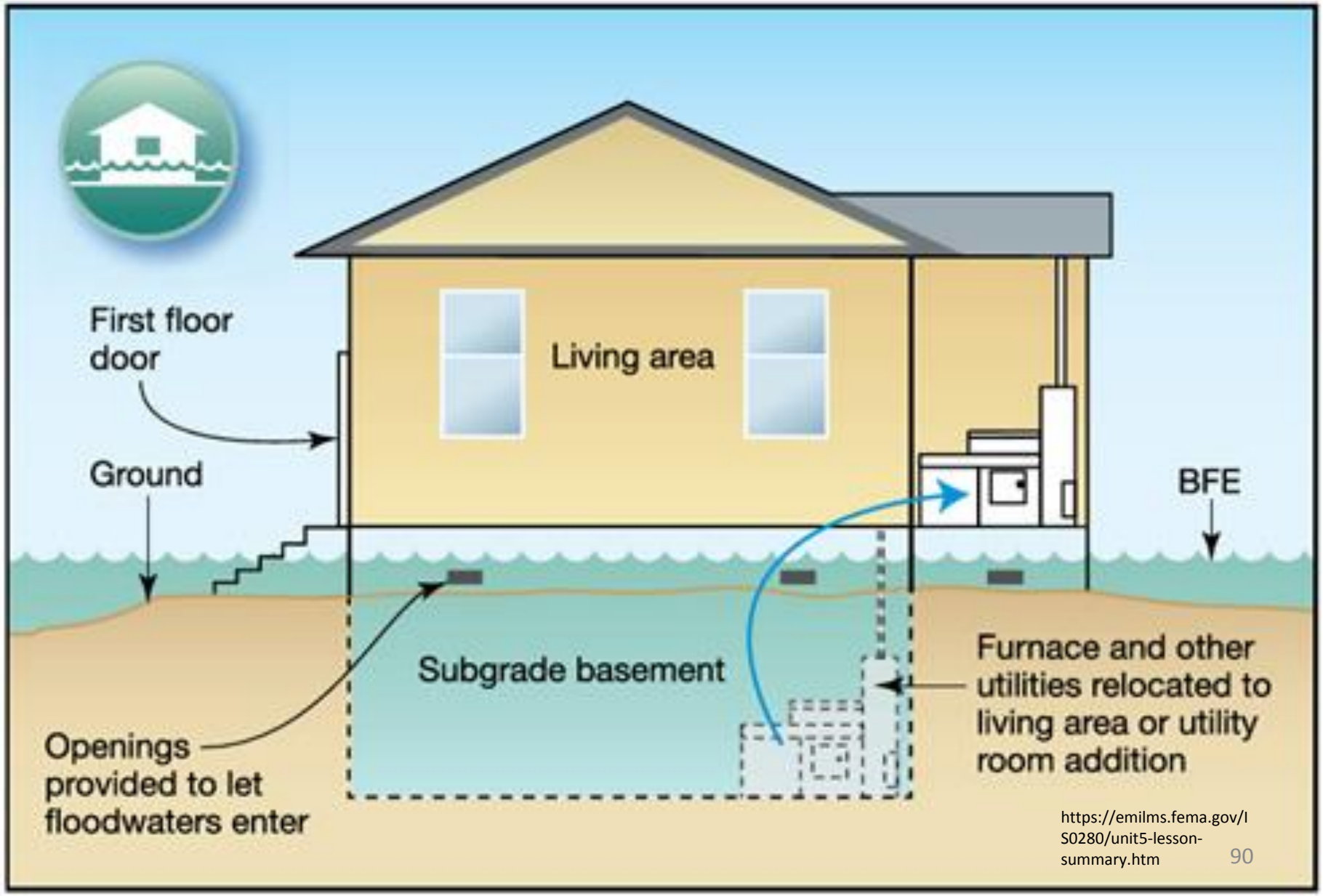
(Source: NWF Great Marsh Coastal Adaptation Plan, 2017)

1-Hour Lunch

Community Actions



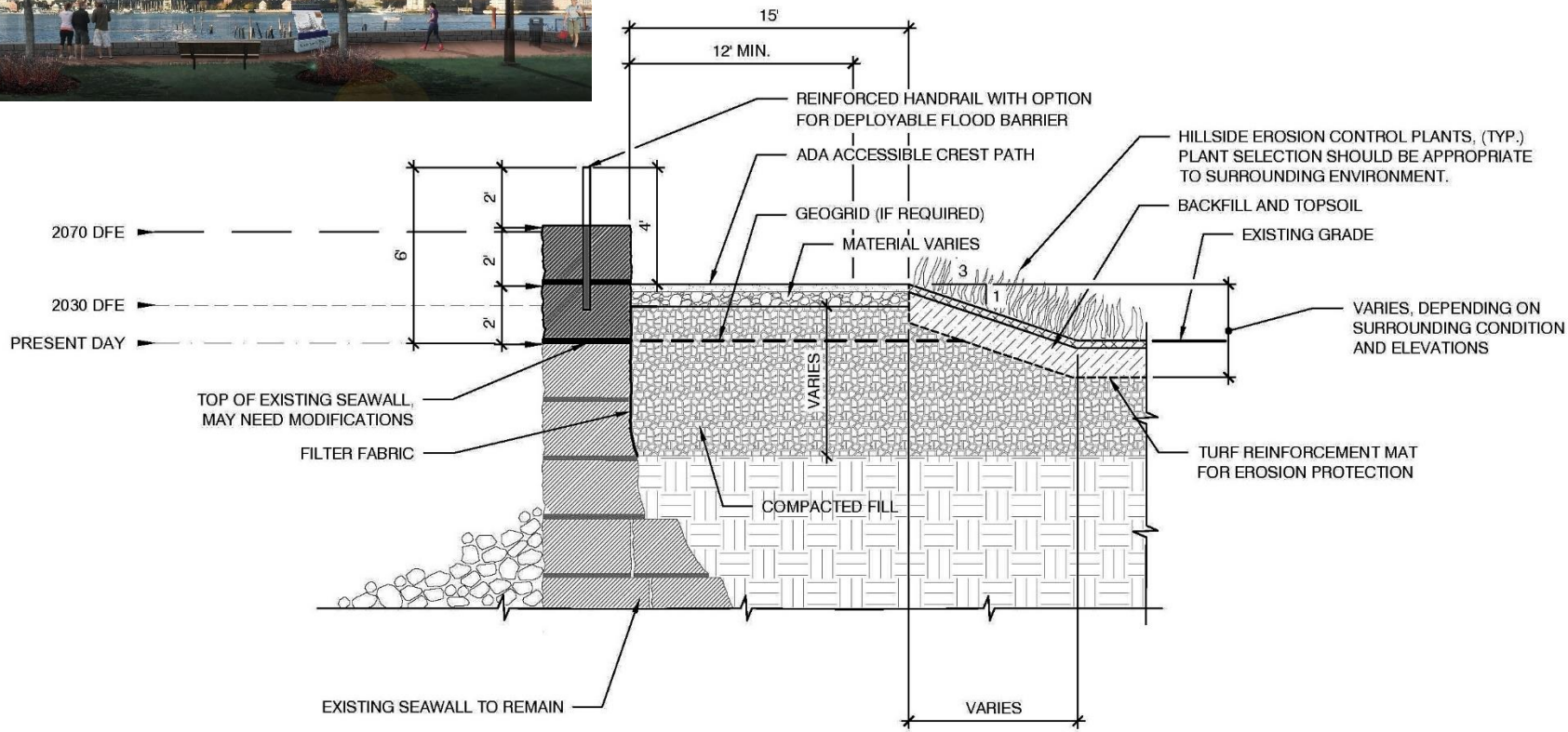
Wet Floodproofing



https://emilms.fema.gov/IS0280/unit5-lesson-summary.htm

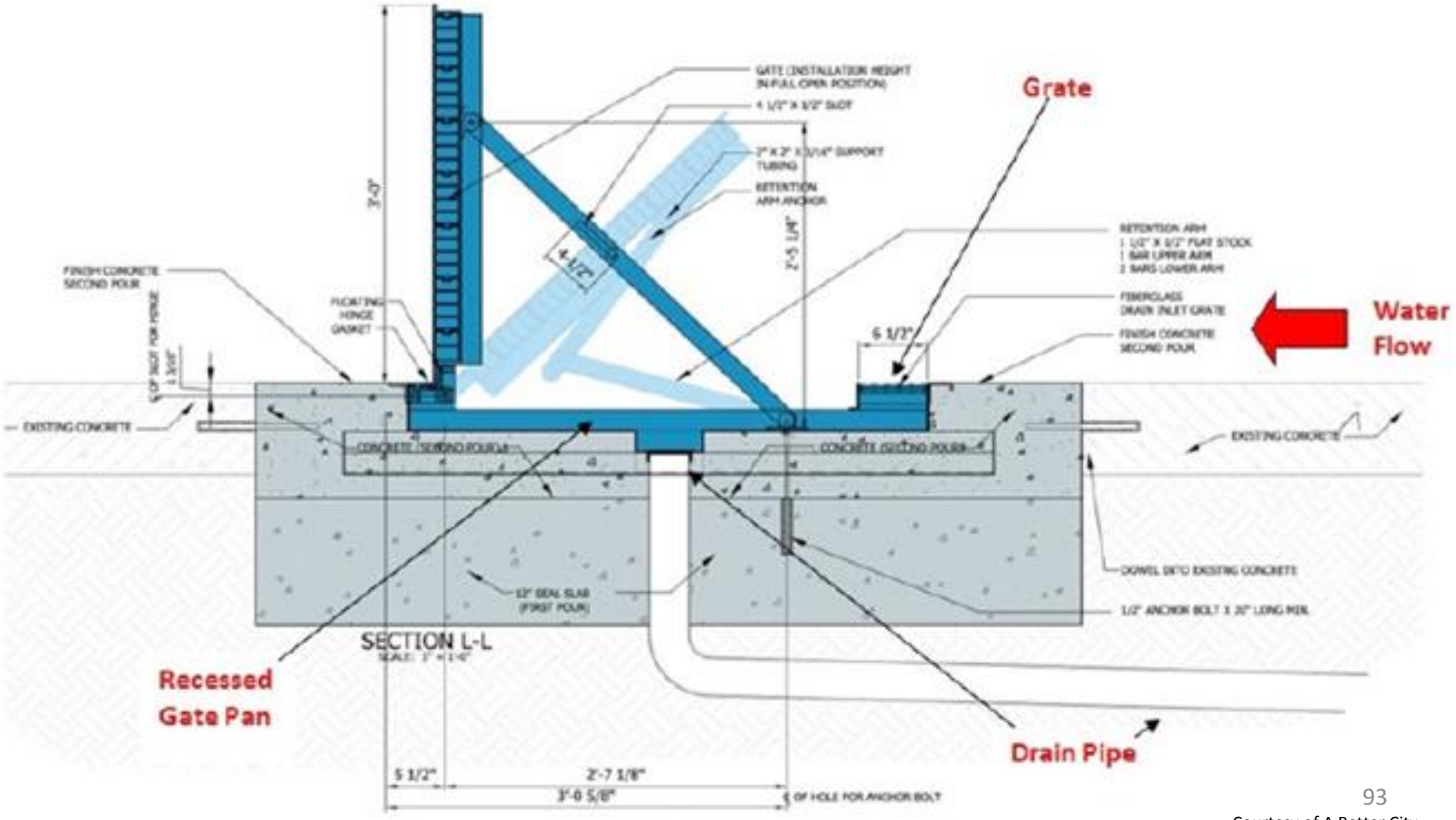
Raised Buildings

Flood Walls



HARBORWALK BARRIER SEAWALL SAMPLE SECTION

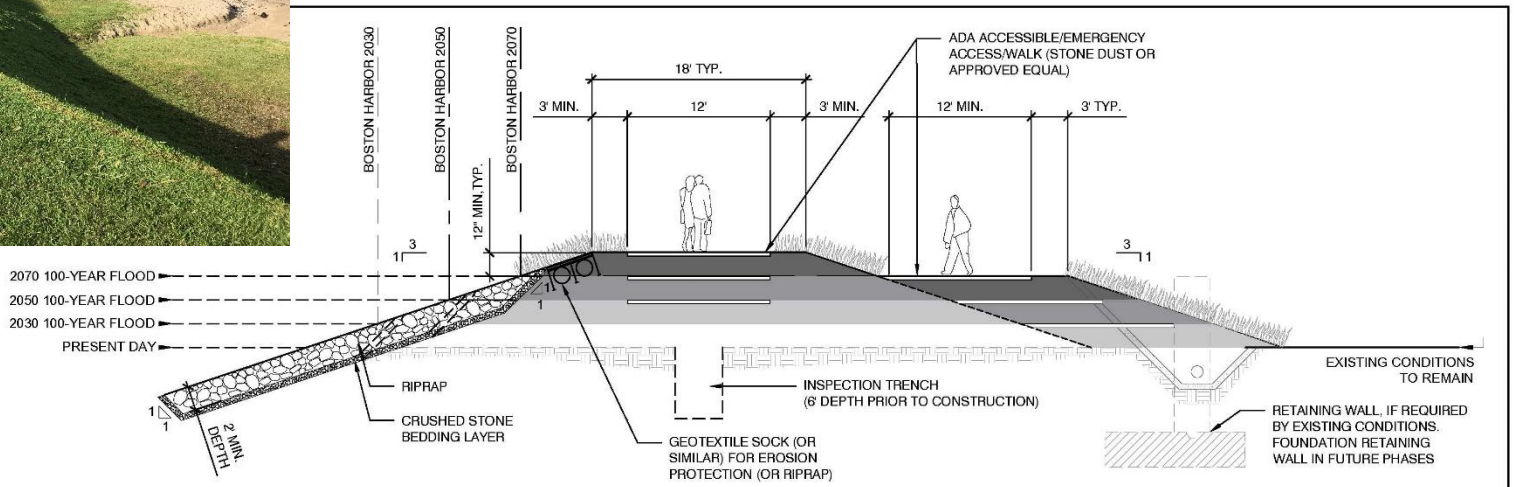
Deployable Flood Barriers



Courtesy of A Better City

Preventing Sewer Backflow

Vegetated Berms



OVERALL VEGETATED BERM (HT. VS. TIME)
SCALE: N.T.S.

VEGETATED BERM (Crest, slope, and possible access path)

Elevation (+__ft)	Crest Width	Slope Width	Access Path Width	Total Width (no Access Path)	Total Width (with Access Path)
1	18	6	Not Recommended	24	24
2	18	12	15	30	45
3	18	18	15	36	51
4	18	24	15	42	57
5	18	30	15	48	63
6	18	36	15	54	69

Slope
3 H
1 V

NOTES:

- SIMILAR WALL CONSIDERATIONS AS FOR RAISED ROADWAY BARRIER OPTION
- SALT TOLERANT/EROSION CONTROL
- URBAN OR NATIVE PLANT PALLET
- URBAN PLANTS SHOULD BE TOLERANT OF POLLUTANTS (SMOG, OILS, ETC.)
- NATIVE PLANTS SHOULD BE CONSIDERED WHENEVER POSSIBLE
- DIMENSIONS ARE BASED OFF SLOPE TABLE AND DESIRED PROTECTION LEVELS
- HILLSIDE EROSION TYPE PLANTS SHOULD BE USED FOR LANDSIDE SECTIONS. SELECTION SHOULD BE APPROPRIATE TO SURROUNDING HABITAT/ECOSYSTEM
- SUBBASE OF WALKWAY SHOULD SUPPORT VEHICLE LOADS (SERVICE AND EMERGENCY)

VEGETATED BERM - TYPICAL SECTION

Weston & Sampson

DRAFT

CONTRACT NO.	DRAWN BY:	DETAIL NO.
######	L. WADLINGER	T-004
DATE 4/20/2018	SCALE AS NOTED	SHEET 4 OF 5

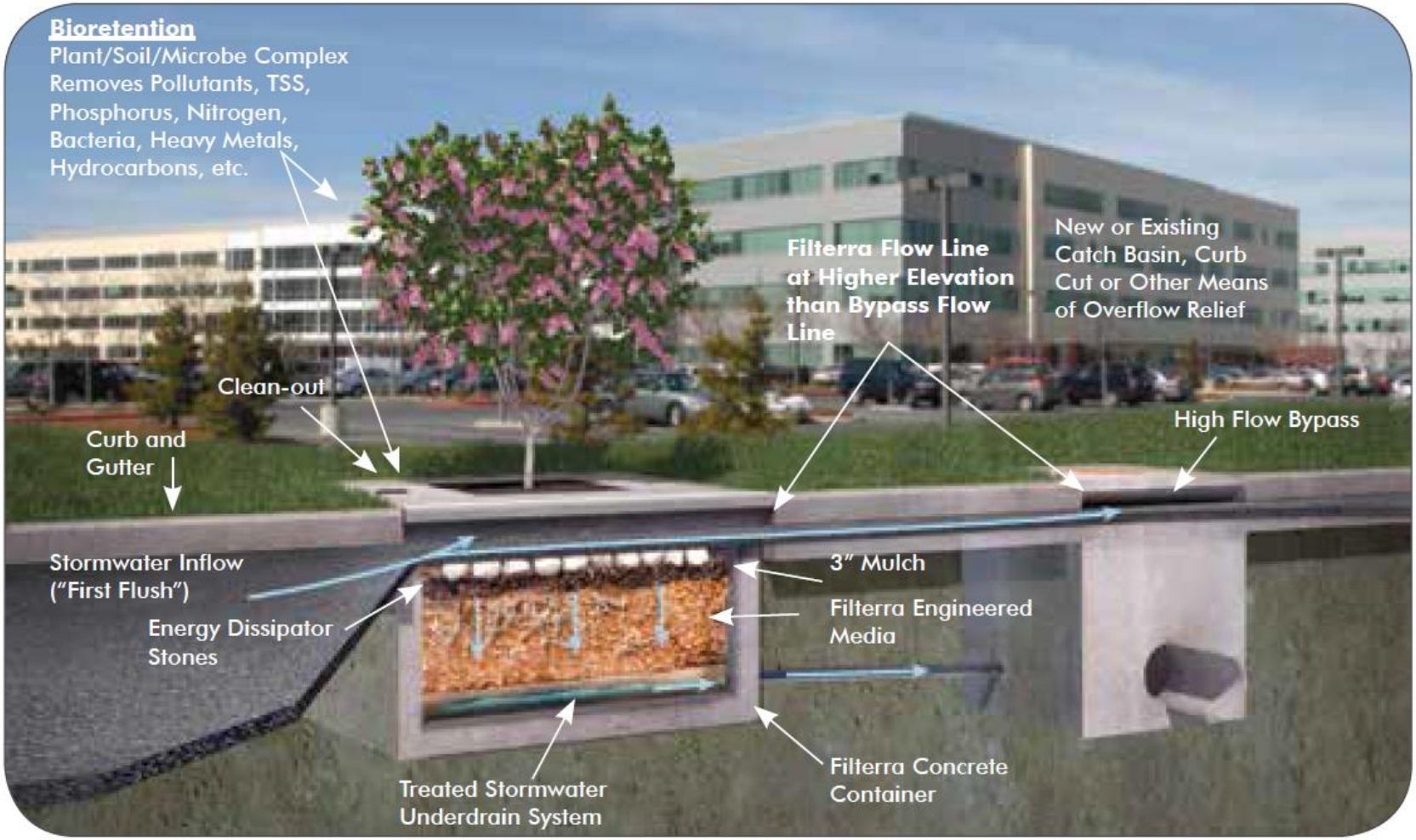
Multi-Purpose Flood Storage

Low Impact Development (LID)

An innovative, ecosystem-based approach to land development and stormwater management

Porous Asphalt and Permeable Pavers

Street Trees & Tree Box Filters



Rain Garden in a median strip of a townhouse project. Please note the depressed curb and grate inlet structure

Stormwater Detention & Retention

Culvert Widening to Improve Saltmarsh Habitat

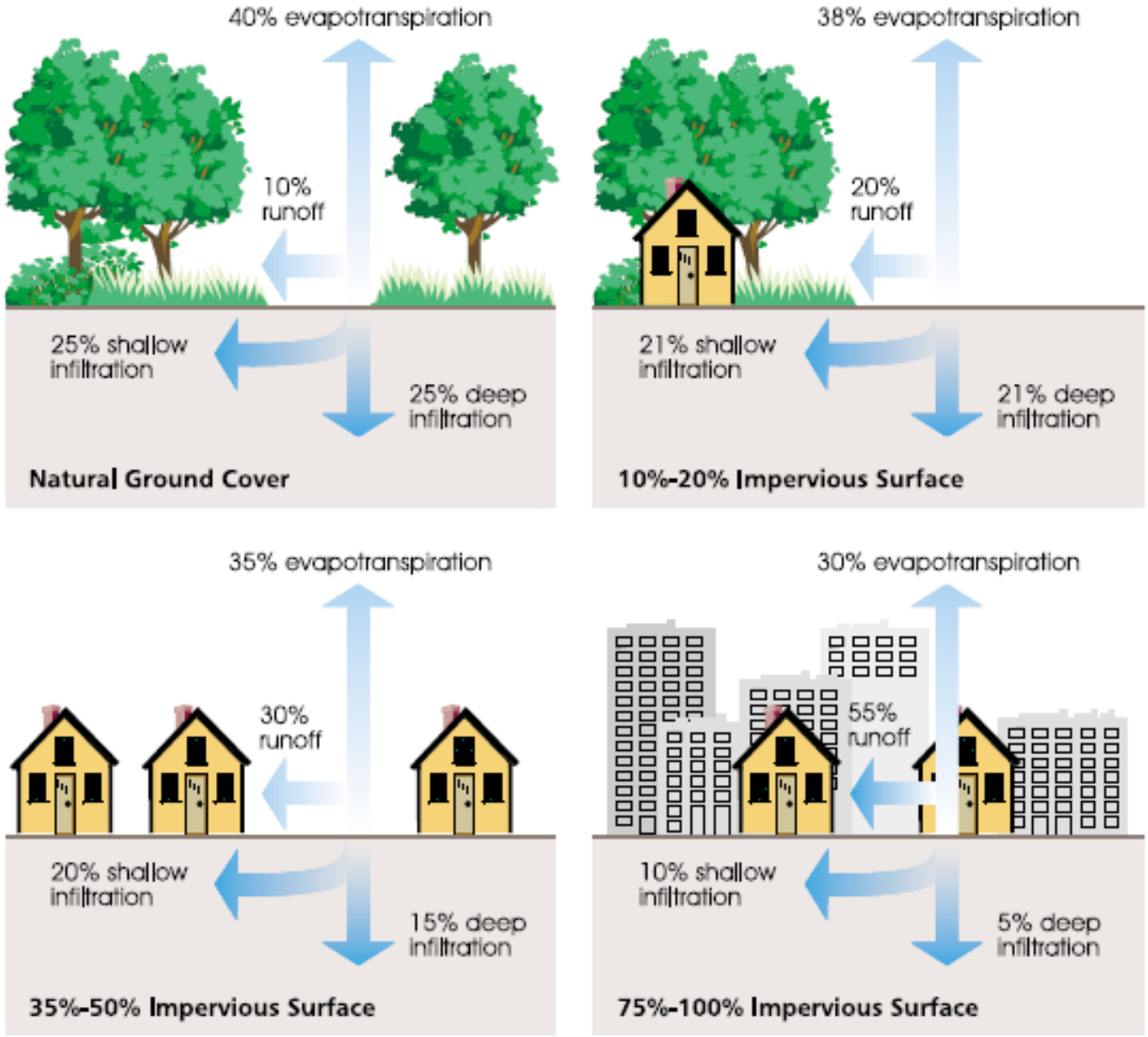
Assessment of Tidal Restrictions from Undersized Culverts

Seawall Repair

Living Shorelines

Cloudburst Streets

Reduce Impervious Areas

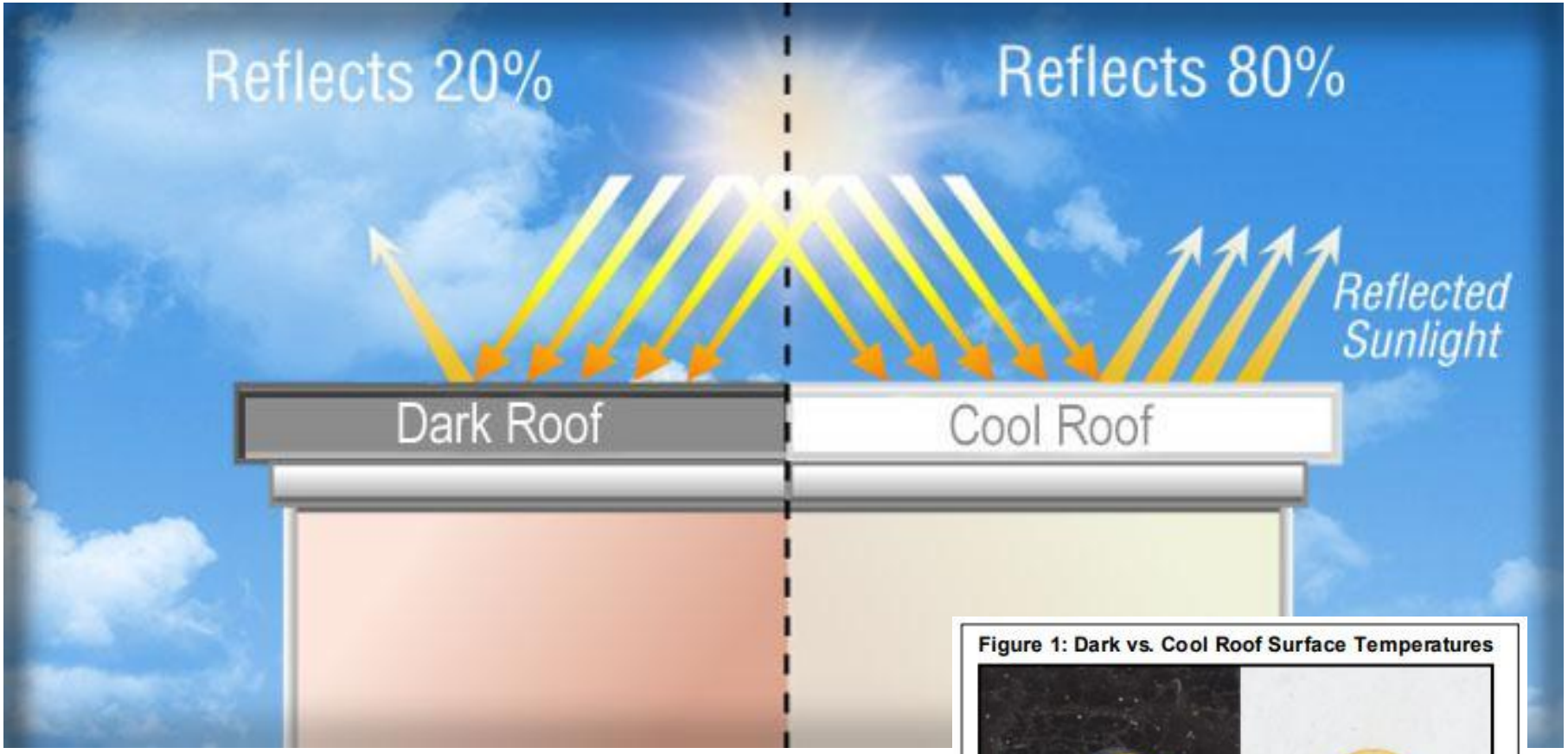


Source: Federal Stream Corridor Restoration Handbook (1998)

Green Roofs


Substrate
Drainage/Root Barrier
Insulation
Waterproof Barrier
Roof

Cool Roofs



Source: Heat Island Group at Lawrence Berkeley National Laboratory

Figure 1: Dark vs. Cool Roof Surface Temperatures

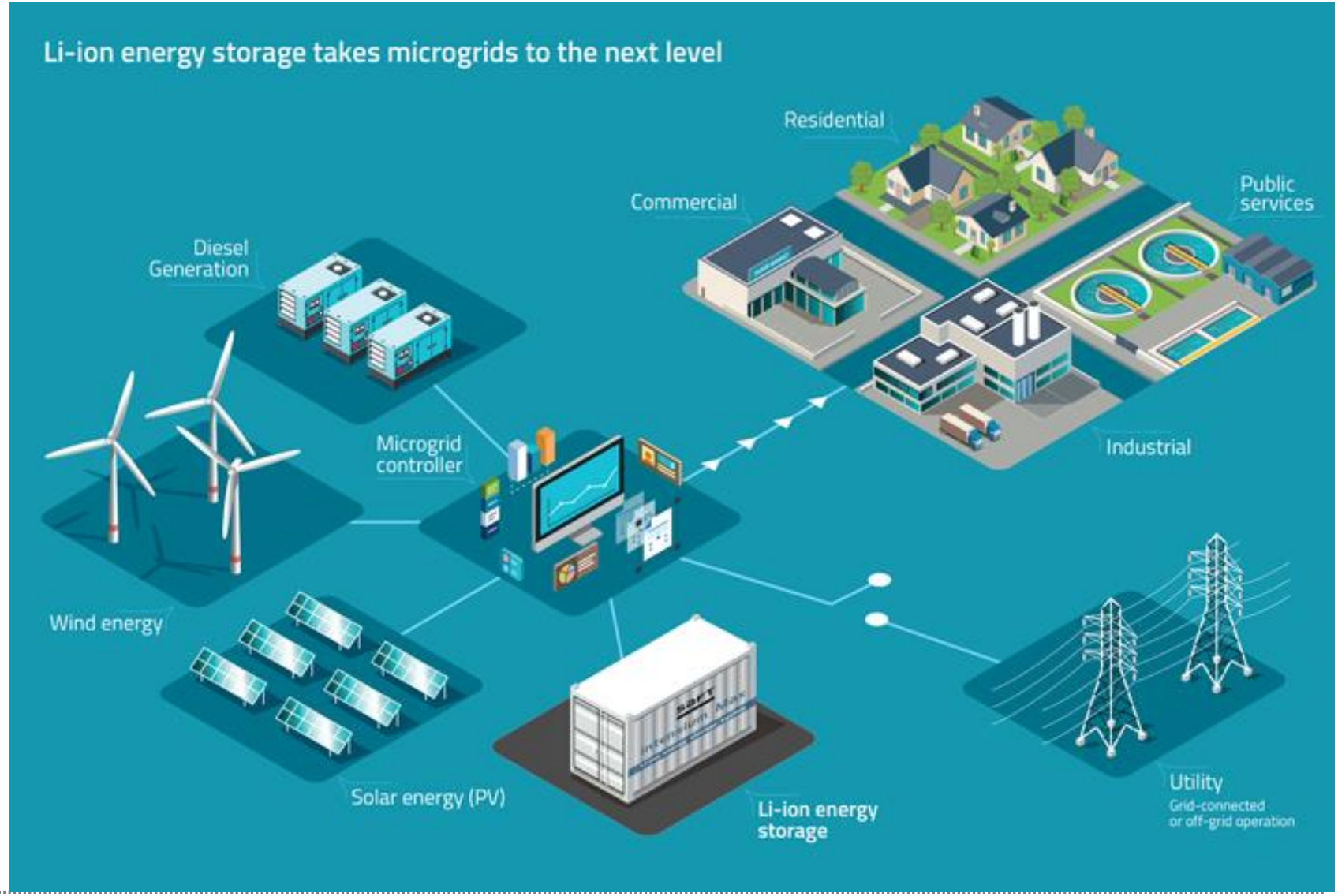
A dark roof (left) becomes much hotter than a cool white roof (right) on a sunny afternoon.

Source: U.S. Department of Energy Guidelines for Selecting Cool Roofs

Cooling Centers

Source: The Mercury News

Renewable Micro-Grids



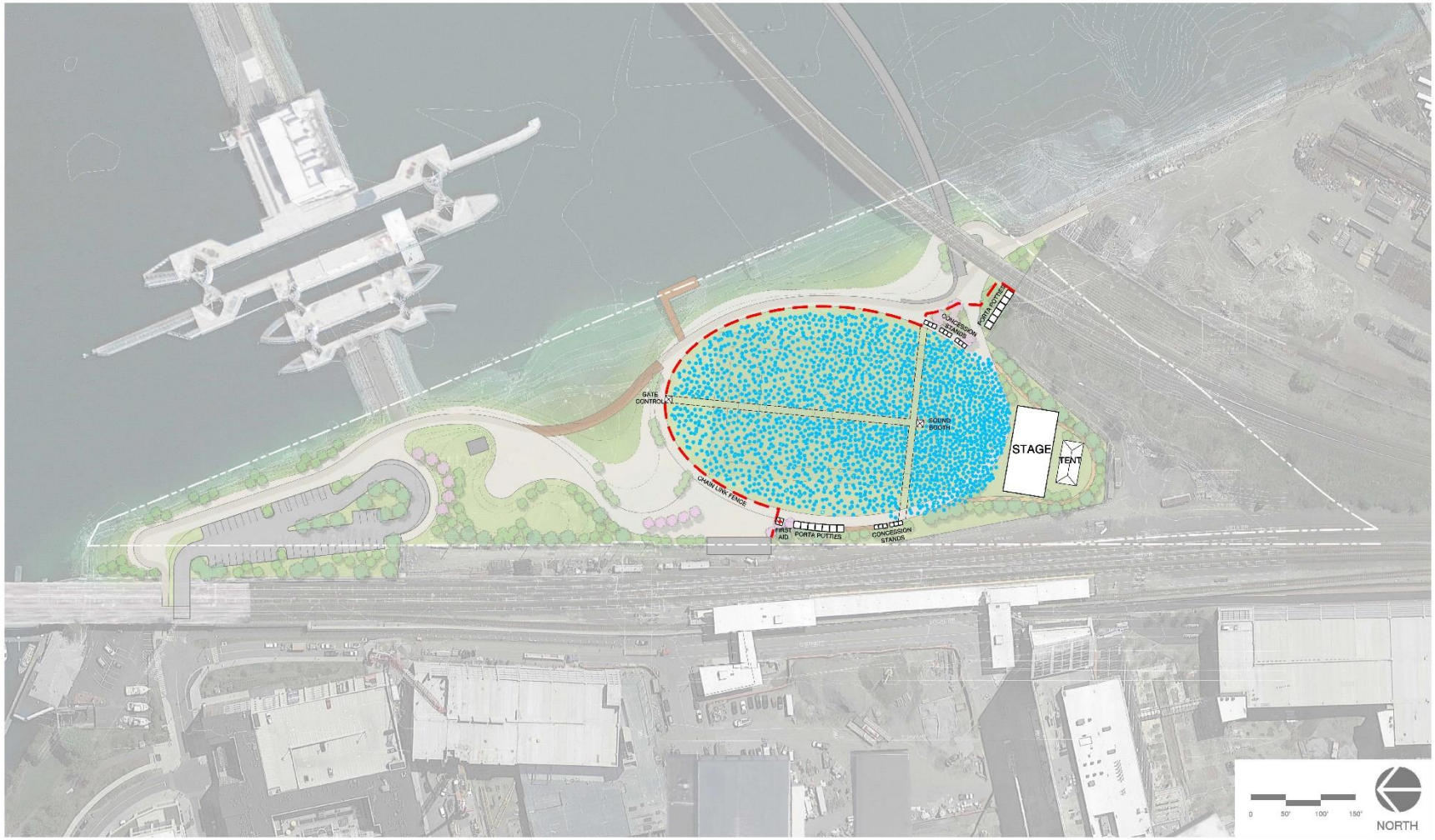
Source: altenergymag.com

Regional Resiliency Efforts

(Examples include transportation & water supply)

Landscape Design to Accommodate Water

Draw Seven Park, Somerville – Existing Conditions



CONCEPT #1 - CROWD DIAGRAM

DRAW SEVEN PARK

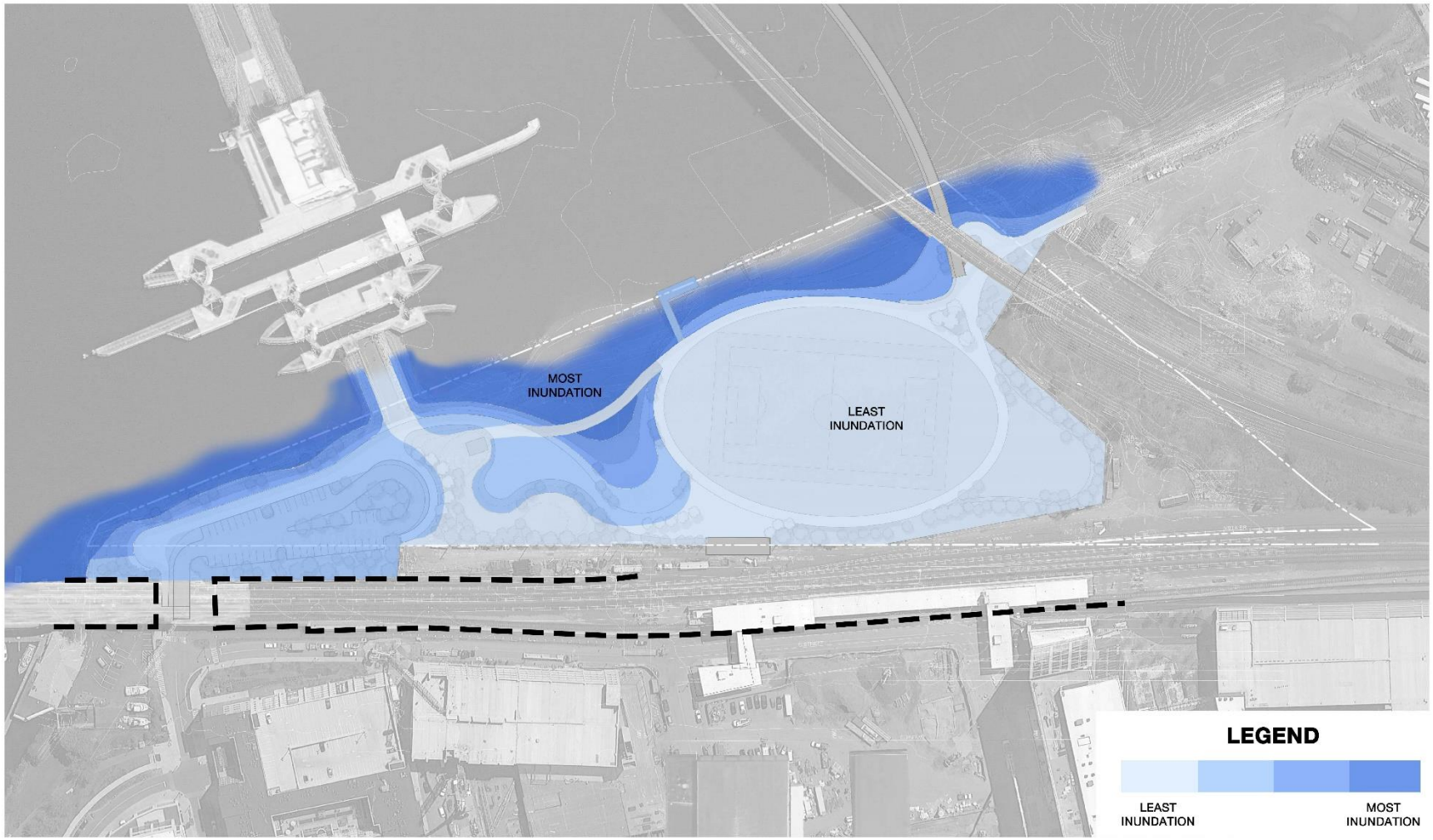
February 2018

dcr Massachusetts

Weston & Sampson transform your environment

Landscape Design to Accommodate Water

Draw Seven Park, Somerville – Flooded Conditions



CONCEPT #1 - INUNDATION DIAGRAM

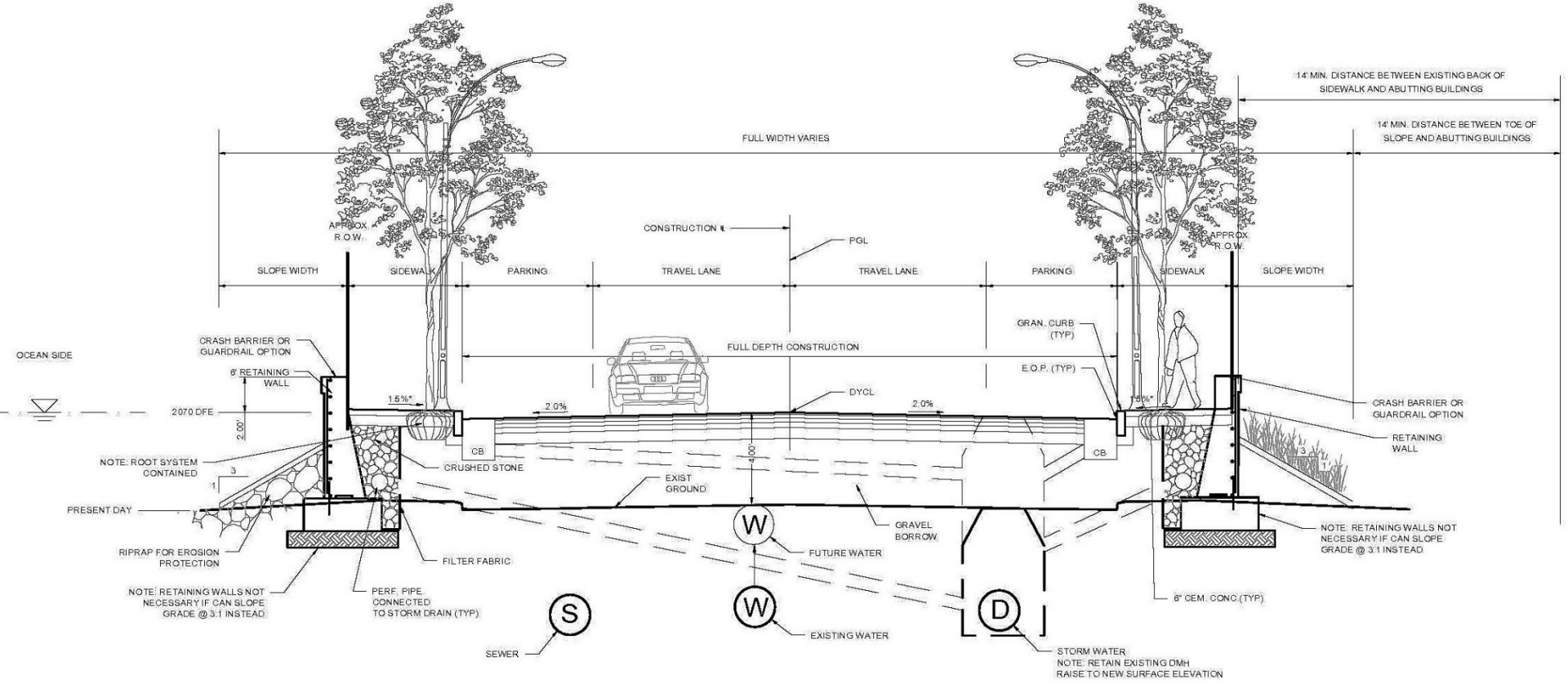
DRAW SEVEN PARK

February 2018

dcr Massachusetts

Weston & Sampson
transform your environment

Raised Roadways



SAMPLE SECTION

Retrofitted Floodproof Doorways

Re-evaluate Local Regulations & Policies

BROOKLINE MUNICIPAL VULNERABILITY PREPAREDNESS (MVP) ACTION PROJECT

town of brookline, massachusetts

Weston & Sampson will audit the Town of Brookline's stormwater, floodplains, zoning bylaws, public way design guidelines, wetlands bylaws, and Department of Public Works' Site Plan Review Checklist to identify opportunities to mandate higher standards for climate resiliency and to identify any conflicts these standards might have with State policy. Our approach is centered around the promotion of nature-based solutions and strategies such as green infrastructure, low impact development (LID), open space protection, and floodplain protection. The project is funded by a Municipal Vulnerability Preparedness Action Grant from the Massachusetts Executive Office of Energy & Environmental Affairs.

Weston & Sampson will identify opportunities for incorporating standards into the Town of Brookline's bylaws and other planning instruments to increase the town's resilience against the effects of climate change, including increased temperatures as well as increased precipitation frequency/intensity and associated flooding. Implementation of this project will help to reduce risk of climate change impacts to public infrastructure, private property, natural resources, and human safety and welfare. The project's specific recommendations for bylaw amendments as well as sustainability standards for site plan review will be targeted at new and renovated projects across all building sectors: residential, multifamily and affordable housing, commercial, and institutions.

Weston & Sampson's deliverables, identified as priority action items in the town's "Climate Vulnerability Assessment," will include: recommendations for new or amended town bylaws and regulations mandating LID measures, LID Best Management Practices - narrative and Site Plan Review checklist - that targets owners and developers of new and renovated residential, multifamily, and commercial properties, and assists in educating them of the overall benefits to the environment and the value in protecting their properties from climate change impacts. The standards and checklists will serve as imperative components of the "Site Plan Review" ordinance that the town will be adopting and are intended to limit storm and flood damage, mitigate stormwater runoff, reduce impervious surfaces, and improve ecosystem resiliency.

- convene a core team of leaders from departments, boards, and commissions
- review existing By-laws
- conduct literature review of examples from other municipalities
- develop and evaluate alternatives
- develop draft recommendations; workshop them with town's Boards, Commissions, and Departments.
- develop final recommendations and assist with preparation of package to town meeting
- conduct community outreach

client contact

Maria Morelli
Senior Planner,
Climate Action/Land Use
Town of Brookline
Department of Planning & Community Development
mmorelli@brooklinema.gov
617-730-2670

westonandsampson.com

Weston & Sampson

15-Minute Break!

Define Community Actions

Identify Priority Actions

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.com

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S					Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Societal									
Environmental									

Wrap-up & Closing Remarks

thank you

westonandsampson.com

Weston & Sampson SM

transform your environment

APPENDIX C

Participant Matrices

Table 1
Table 2
Table 3
Table 4
Table 5
Final Matrix, Page 1
Final Matrix, Page 2

TABLE #1

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	SLR/COASTAL/ EROSION	EXTREME PRECIPITATION	EXTREME STORMS	EXTREME TEMPS	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
WATER - PUBLIC/PRIVATE; TANKS IN FP ●	TOWNWIDE	MUNICIPAL/ PRIVATE	V			ADD ADDITIONAL SUPPLIES		L	
SEWER - PUMP STA + LINES; SS - FLOODING	TOWNWIDE (~50%)	MUNICIPAL	V	FLOODPROOF P.S. BACKFLOW	"	"		M	
RELIABLE POWER/COMMUNICATION/CELL ●●●	TOWNWIDE	PRIVATE	V			BACKUP POWER, CRITICAL FACILITIES ●		H	
GAS (?)	TOWNWIDE	PRIVATE NATIONAL GRID	V	NATIONAL GRID EVALUATION - STUDY/SURVEY	"	"		H	
ROADS/TRANSPORTATION (1A/FERRY ROAD) ●●●	"	MUNICIPAL/ STATE/REG	V	RAISED ●●●	DRAINAGE IMPROVEMENTS	DRAINAGE	X	H	
POLICE STATION	SITE SPEC.	TOWN	V	DRY FLOODPROOFING?	"	"		L	
Societal									
SENIOR CENTER - SHELTER/COOLING CENTER	UPTOWN	TOWN	S			UPGRADE GENERATOR		M	
SCHOOLS/SHELTERS - EDS SITE, P.O.D. POINT OF DISTRIBUTION	SPEC.	TOWN	S						
~~ASSISTED LIVING - GREAT MEADOW VILLAGE~~		~~STATE~~	~~V~~						
AFFORDABLE HOUSING - GREAT MEADOW VILLAGE	BEACH RD, OLD COUNTY RD	PRIVATE	V			CHECK GENERATOR		L	
SALISBURY BEACH CENTER	SP. BEACH	PRIVATE	V	MAINTAIN DUNES		MAINTAIN DUNES ●		H	
TOWN HALL (POWER/COMMUNICATION ISSUES) ●●		TOWN	V	X	X	BACKUP POWER - GENERATOR ●●		H	
Environmental									
GREAT MARSH	MARSH	P/S/M	V/S						
BEACH FRONT		STATE/PRIV.	V	MAINTAIN DUNES		MAINTAIN DUNES ●●		H	
MERRIMACK RIVER		?	V	MERRIMACK RIVER BEACH ALLIANCE				H	
STREAMS/BROOKS		PRIVATE	V						
FORESTS - GREEN SPACE, GW RECHARGE		PRIVATE	V/S				MAINTAIN FIRE ROADS	M	

TABLE #2

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	SLR, COASTAL STORM SURGE, EROSION	EXTREME PRECIPITATION (LOTS OF RAIN AND DROUGHT)	EXTREME STORMS - WIND, ICE, NOR'EASTERS	EXTREME TEMPERATURES	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
ROADS (STATE, LOCAL, ETC. BEACH ROAD, ROUTE 1A, FERRY ROAD)	TOWN	STATE, LOCAL, PRIVATE	V	RAISED ROADS, ALTERNATIVE TRANSPORTATION OPTIONS	ALTERNATIVE TRANSPORTATION OPTIONS, INFRASTRUCTURE UPDATES	MAINTENANCE, ROAD/STORM SERVICES (PLOWING, SAND)	SALT + SAND (ROAD TREATMENT) AND MAINTENANCE	H	O-MAINTENANCE, L-RAISED ROADS, S-STUDIES
UTILITIES	TOWN	PRIVATE, TOWN, STATE	V	STUDIES (GPS), $, MAINTENANCE, QUICK RESPONSE FROM UTILITY COMPANIES	MAINTENANCE, $, ALTERNATIVE TECHNOLOGY (RAIN COLLECTION), ALTERNATIVE PRODUCTS (MICROGRID), UPDATING EXISTING (PUT UTILITIES UNDERGROUND)	MAINTENANCE, $	MAINTENANCE, $	H	S -RESPONSE, O - MAINTENANCE, L PLAN
BUILDINGS, INCLUDING THE BEACH ENTERTAINMENT CENTER	TOWN	MUNICIPAL, STATE, PRIVATE	V/S (ONE SHELTER)	RETREAT, ELEVATE, INCREASE PERMEABILITY, INCREASE DUNES, SAND MINING	RETAIN WATER (BLUE ROOFS, RAIN BARRELS), RETROFIT BUILDINGS, WATER CAPTURE	FLOOD SHIELDS, GENERATORS, ALTERNATIVE POWER SOURCES	SHADE, COOLING CENTERS, TREES	H	S
STATE RESERVATION	BEACH CAMPGROUND	STATE, LOCAL, PRIVATE	V/S (DESTINATION AT-RISK)	NOURISHMENT, BEACH MANAGEMENT, EDUCATION, BIODIVERSITY, DEDICATED BEACH ACCESS, UPLAND FACILITY	WATER QUALITY MONITORING, OUTREACH, NOTIFICATION	MAINTENANCE	MAINTENANCE, SHADE, COOLING CENTERS, VISITORS DURING STORMS ARE A LIABILITY	H	O
BRIDGES, TIDE GATES	TOWN	STATE + MUNICIPAL	V/S	STUDIES, MAINTENANCE, ALTERNATIVE ROUTES, REPLACEMENT	TIDE GATES: O&M PLAN	O&M PLAN	FREEZING: O&M FOR TIDE GATES	H	L-STUDY OPPORTUNITIES TO CHANGE INFRASTRUCTURE
COMMUNICATION	TOWN	TOWN, PRIVATE	V/S (WIFI + FIBER)	EMERGENCY RESPONSE, CLEAR MESSAGE, STUDIES (GPS), MAINTENANCE	UPDATING TECHNOLOGY			H	S
Societal									
ELDERLY POPULATIONS	TOWN	PRIVATE, MUNICIPAL, STATE	V/S (LOCAL KNOWLEDGE)	EVACUATION PLAN AND INFRASTRUCTURE, NOTIFICATION, SHELTERS, $	ALTERNATIVE WATER SOURCES	ROAD ACCESS TO BEACH	SHADE, TREE PLANTING	H	O
LOW INCOME COMMUNITIES	TOWN	PRIVATE, MUNICIPAL, STATE	V					H	
TRANSIENT POPULATIONS (RENTERS, HOMELESS, LIVING IN A CAMPGROUND OR MOTEL)	TOWN	PRIVATE	V					H	
TOURISM	TOWN	STATE, LOCAL, PRIVATE	S					H/M	
MUNICIPAL SERVICES (FIRE, POLICE)	TOWN	MUNICIPAL	S	PROTECT THE BUILDINGS, STAFFING, TRAINING, EQUIPMENT, GENERATORS, COMMUNICATION				H	
CHILDREN	TOWN	N/A	S/V (THEY'RE THE FUTURE)	PLAN, NOTIFY, SHELTERS				H	
Environmental									
BEACH, MARSH, OCEAN	EASTERN SIDE	STATE, TOWN, PRIVATE	S/V	PRESERVATION, BOULDERS/SEAWALL, $ FOR NOURISHMENT, MANAGEMENT PLAN	BIODIVERSITY, DROUGHT-RESISTANT PLANTS, MONITOR FIRE RISK	NOURISHMENT, PROTECT THE DUNES (1ST LINE OF DEFENSE)	BIODIVERSITY	H	O/L
RIVER	TOWN, SOUTHERN BORDER	MUNICIPAL, PRIVATE	S/V	POTENTIAL ADDITIONAL SEAWALL, NOURISHMENT, RETREAT	WATER CONSERVATION, EDUCATION, NOTIFICATION, OUTREACH, DREDGING	N/A	MONITORING AND NOTIFICATION	L/H	S/L (EVACUATION ROUTE)
FOREST	TOWN	PRIVATE, MUNICIPAL, STATE	S/V	N/A	ALTERNATIVE WATER SOURCE, MAINTAIN TRAILS, OUTREACH	TRAINING, MAINTENANCE	RISK, NOTIFICATION, EQUIPMENT	M	L
WATER (AQUIFER, WELLS)	TOWN (WESTERN SIDE FOR AQUIFERS)	MUNICIPAL, PRIVATE	S/V	N/A	ALTERNATIVE SOURCES, PLANNING, SURVEYING, $, MONITOR IMPERVIOUS	GENERATORS, MAINTENANCE, EMERGENCY PREPAREDNESS		H	O/L
FARMLAND	WESTERN SIDE	PRIVATE	S/V	N/A	ALTERNATIVE IRRIGATION	PROTECTING INFRASTRUCTURE		M/H	L
UPLAND WETLANDS (BVW)	TOWN	PRIVATE	S/V	N/A	ENFORCEMENT, LOCAL REGULATIONS, EDUCATION			H	O

TABLE #3

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	SLR, Coastal Surge, Erosion	Extreme Precip, Drought	Extreme Storms	Temp	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Beach Road + other at-risk roads	Townwide	State + town	V	Study to evaluate at-risk roads + evacuation routes		Raise roads		H	L
Evacuation Routes	Flood-prone Areas	"	V	Plan + model, set priorities	Plan/model/study areas, set priorities, em. response	Model/study, set priorities for em. response		H	O
Wastewater Infrastructure (and on-site systems)	Townwide	Town, private	V	Expand/upgrade sewer, find funding		Plan for resiliency (flooding plant)		H	L
Wells	TW	"	V	Upgrade for saltwater intrusion	Find new sources		Same as drought	M	O
Shelter	Center	Town, private	V			Need generator, increase capacity,	Generator	H	S
Power Supply/Infrastructure	TW	Private	V	Protect utilities from erosion		Explore redundancy	Explore alternative sources	M	L
Societal									
Commercial Economic Vulnerability	TW	Private	V	Education/funding for resiliency				M	S/L
Shelter Accessibility	TW		V	Emergency transport, Communication system, Planning	→	→	→	H	O
Transient/Homeless Population	TW		V	"	→	→	→	H	O
Elderly/Low-Income Population	TW		V	"	→	→	→	H	O
Agriculture	TW	Private	V	Preservation, tax subsidies	Adaptation planning techniques		Adaptation planning techniques	M	O
Public Health (vector + microbe)	TW		V	Education	Mosquito Control	Warning system for sewer overflows	Mosquito control	H	O
Environmental									
Invasive Species (degradation of natural areas)	TW		V	Restoration	→	Identify + elim. restrictions		H	O
Loss of Salt Marsh	TW		V	Restoration		Id + eliminate restrictions		H	O
Saltwater Intrusion	TW		V	Study + monitor				L	L
Loss of Beach	Coastal	State	V	Regular beach nourishment a vegetation. Grants for house raising/buoyancy	Diversity of vegetation (dune)	Education/outreach	Public/private partnership to restore beach/dunes	H	S
Aquifer	TW		V	Expand sewer	→		Promote water conservation	H	L
Overwash	Coastal	State + town	V	Protection for existing infrastructure		Coordinate Response		H	S

TABLE #4

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	Sea Level Rise, Coastal Surge, Erosion	Extreme Precipitation	Extreme Storms	Extreme Temperatures	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Police station & Fire station	Beach road	Mun	S						
Transportation Fac. - Roads ●●	Ferry Rd, Beach Rd, Rt. 1, S.B. Access	Mun	V	Raise sections of Beach Rd/Rt.1A & install barriers	Improve drainage capacity - Beach Rd & Rt. 1A	●●●		H	L
Dams/Tide Gate	Various inc. Bridge Rd	Mun	V/S	Upgrade dams/tide gate infrastructure. ID locations for additional tide gates →		●		M	S/L
Sewage Treatment		Mun	S						
Stormwater ●●	Beach area, Ferry Rd, town-wide	Mun	V	Englarge Ferry Rd culvert	Install infiltration gallery			H	L
Power grid - planning area	Town-wide	National Grid	S						
Societal									
Seasonal Population - 4-5X pop. in summer	Beach	DCR & Town	V		←	Protocals for communication/Code Red - public info center		H	S
Elderly - Assid. Living / Nursing Homes	Beach Rd, 19, 3, 23		V		←	Warming/cooling center, evacuation protocols needed		H	S
Schools/Shelters ●			S			Food service capacity, cots needed →		M	L
Mobile Home Park		Priv.	V						
Special needs youth			V						
Motels - off-season transient population	Var. - Beach Rd	Private	V						
Environmental									
Great Marsh ●			S/V	Study options for marsh buffer protection, resilience ●				H	O
Black Water Creek (new flood wall?)			S/V	Assess impact of floodwall; extend floodwall south →				M	both L
Beach - Dunes ●●●●●		Town/State	S/V	Beach nourishment strategies, public education/ advocacy ●		●●●		H	O
Merrimack River			S/V						
Aquifers - 8 wells permited	Area	Mun	S/V						

TABLE #5

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	Extreme Temperatures	Extreme Storm Events	Storm Surge / Erosion / Flooding (Coastal Surge)	Extreme Precipitation	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Well Water	inland	town	V				Drought: Investigate new areas for more wells in new aquifer, renegotiate price for interconnections		
Water Tanks	town-wide	"	V		Wind: increase tree maintenance around trunk			M	
Underground Utilities	"	town, gas/telephone are private	V	Obtain + maintain redundant generators, to continue to use pumpstations. Replace eroding pipes in coastal areas.				H	O/S
Roadways/Public Safety Access	"	"	V		Beach Road, Bridge Road, Ferry Road, NEB, Liberty Street, 1st, March. Investigate flooding solutions + present findings to state. Investigate feasibility of raising town-owned roads. Invest in boats/train water search + rescue/have access to high water vehicles			H	L
Municipal Buildings	"	"	V	Continue HMGP Application process →					S
Residential/Commercial	"	Private	V		Stay active in CRS + require compliance with ordinance				
Societal									
Senior Housing / Asst. Living	inland	Private	V	increase communication, increase evacuation potential/plan, ensure power is maintained				H	
Elementary Students	"	Triton	V/S		create evacuation plan in conjunction with town's current HMP, fortification or evacuation			H	
Boys + Girls Club	"	Private	V/S		"			H	
Farm animals / pet daycare / feline	"	Private	V		increase shelter space to accommodate a room for pets			L	
Shelter / COA	"	Town	V/S	Obtain + maintain a generator. Currently used as a cooling station	Create mass evacuation plan, increase accessibility + resources →			H	
Low + Moderate Income Housing	"	Private, YWCA	V		Create evacuation plan in conjunction w/ HMP			H	
Environmental									
Beach/Shoreline	shoreline	state	V/S			beach nourishment to replenish eroding dunes			
Aquifer	inland	town	V			Investigate zoning to prevent development around aquifer. Collaborate w/ Seabrook to drain less from it.			
Trails / Parks	town-wide	state/town	V/S			experiment with different water levels to see impacts of flooding gate			
Agriculture	inland	private	V	Continue Agricultural Commission engagements. Create educational program on shortened season.					
Forest / Trees	inland	private/town	V/S						
River	inland/beach	state/town	V			contract with river clean up groups (Clean River Project)			

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	Sea Level Rise, Coastal Surge, Erosion	Extreme Precipitation	Extreme Storms	Extreme Temps	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Roads	●●●	●●●●●	●●●	Boats, training, emergency management plan, Beach Rd, Ferry Rd, Route 1A, Raising roads, Drainage Improvements, Alternative transport	Drainage, catchment to reduce surface flooding	Drainage	Maintenance		
Reliable power				Backup sources		Backup power, equitable facilities			
State reservation (facilities)			●●●	Beach nourishment, studies, O&M, tide gates	WQ monitoring		Shade		
Buildings (Ent. Center)				Retreat, dunes, elevate, sand mining, increase perm, sea walls					
Wells			●●	New sources		●	New sources of water, protect current water sources		
Communication						Equitable facilities			
Societal									
Town Hall (all critical municipal facilities)					●●●	Backup power			
Business, Salisbury Beach Center			●●	Maintain and create dunes		Maintain and create dunes			
Tourism				Evacuation plan, notification, infrastructure					
Municipal services			●●	Protect buildings, staffing, training					
Children			●	Education					
Shelter					●●●	Emergency transport, communication, planning, power, staff, equipment, evacuation, sustaining people	●●●		
Environmental									
Beachfront		●●●	●●	Education + advocacy, maintain dunes, seawall, nourishment	●	Maintain dunes, regular renourishment	Diversify plan species	H	O
Marsh		●	●●	Eliminate restrictions	Study options for buffer protection + resilience	●	Drought resistant plants, biodiversity	H	O
Aquifers				Expand sewer in critical areas					
Overwash				Prevent exposed utilities					

FINAL GROUP MATRIX, PAGE 2

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	SLR, Surge, Erosion	Precip			Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Tide Gates/Bridges/Culverts			●	Evaluate + study addition of tide gates					
Utilities - underground (gas, sewers, water) ●●					Redundancy back-up				
Societal									
Environmental									

APPENDIX D

Annotated Maps from Participants

FIGURE 1

TOWN OF SALISBURY

2070 INUNDATION PROBABLILITY

OCTOBERER 2018 SCALE: NOTED

Weston & Sampson

FIGURE 1

TOWN OF SALISBURY

HAZARDS AND RESOURCES

OCTOBER 2018 SCALE: NOTED

Weston & Sampson

FIGURE 1

TOWN OF SALISBURY

HAZARDS AND RESOURCES

OCTOBER 2018 SCALE: NOTED

Weston & Sampson

APPENDIX E

Core Team Meeting Notes

Meeting September 5, 2018
Meeting September 26, 2018
Meeting: November 29, 2018

Town of Salisbury
Municipal Vulnerability Preparedness Planning Grant Project
Core Team Meeting
Wednesday, September 5, 2018
10:00 am – 12:00 pm

1. Introductions — 5 minutes

2. MVP Program Overview — 10 minutes
   a. MVP Planning
      i. Municipal and Stakeholder Driven Process
      ii. Workshop to identify strengths and vulnerabilities
      iii. Matrix and report identifying Key Actions
   b. MVP Action or CZM Resiliency

3. Core Team Role — 15 minutes
   a. Define goals.
   b. Develop schedule.
   c. Organize implementation of the Community Resilience Building Workshop.
   d. Determine how information and decisions from Workshop will be used.

4. Define Project Goals, for example: — 15 minutes
   a. Start a new conversation/identify next steps OR augment other planning needs (such as hazard mitigation plan, master plan, sustainability plan, capital improvement plan)
   b. Identify at-risk neighborhoods, employers/employees, natural resources, infrastructure, and other community features OR focus on a single segment of a municipality, town department, business sector, or system?

   Examples:
   "This will be a new initiative to immediately integrate community-derived priorities into a natural hazard mitigation plan and 5-year capital improvement budget."

   "This will augment an existing inter-department directive to meet both resilience and sustainability targets."

   "This will help build resilience by generating greater awareness, prioritization, and ideally launch action plans in five at-risk neighborhoods within three years."

5. Community Resilience Building Workshop — 15 minutes
   a. Overview of climate projections
   b. Map of key resources/List of assets and infrastructure
   c. Discuss strengths & vulnerabilities
   d. Prioritize actions
   e. Risk Matrix
6. Data Needs and Sources — 15 minutes

a. Applicable Reports and Materials
    i. Merrimack Valley Region Multi-Hazard Mitigation Plan Update (2016)
    ii. Great Marsh Coastal Adaptation Plan (2017)
    iii. Salisbury Master Plan (2008)
    iv. Emergency operation plans
    v. What else?
b. Critical Assets and Infrastructure

W&S Action Item: Review materials and incorporate into Workshop
Salisbury Action Item: Identify and provide any additional resources

7. List of Workshop Attendees, for example: 15 minutes
    a. Salisbury Town Government (Town Manager, Board of Selectmen, Planning & Development, Public Works, Conservation, Health, Inspection Services, Fire, Police, Emergency Management Agency, and more)
    b. State Government (DCR, CZM, MassDEP, State Representative Jim Kelcourse, State Senator Kathleen O'Connor Ives, State Senator Bruce Tarr, Merrimack Valley Planning Commission)
    c. Federal Government (US Army Corps of Engineers)
    d. Institutions (Boys & Girls Club)
    e. Businesses (Chamber of Commerce, realtors, and more)
    f. Neighborhood/Community/Environmental Groups (Salisbury Beach Partnership, Salisbury Beach Betterment Association)

W&S Action Item: Draft invitation to stakeholders
Salisbury Action Item: Finalize list of invitees; send invitation and track RSVPs (W&S could send and track RSVPs, if desired)

8. Stakeholder Survey 10 minutes
    a. Solicit more in-depth input from stakeholders prior to Workshop(s)

W&S Action Item: Prepare and administer survey (phone calls or SurveyMonkey), track responses

9. Schedule 15 minutes
    a. Project – before the snowbirds fly
    b. Workshop(s)
        i. One 8-hour or two a-hour meetings
        ii. Weekday or Weekend
        iii. Day or Evening

Salisbury Action Item: Determine format and schedule of Workshop

10. Wrap Up and Next Steps 5 minutes

Town of Salisbury
Municipal Vulnerability Preparedness (MVP) Planning Grant Project
Core Team Meeting Notes
Wednesday, September 5, 2018
10:00 am – 11:30 am

Attendance

Salisbury
Neil Harrington, Town Manager
Lisa Pearson, Project Manager and Planning
Lisa DeMeo, Public Works
Michelle Rowden, Conservation
Scott Vandewalle, Building
Robert Cook, Emergency Management
Scott Carrigan, Fire

Weston & Sampson
Chris Perkins, Principal in Charge
Kathy Baskin, Project Manager

Discussion

MVP Program Overview (Kathy)

- Year 1: MVP Planning Grant Process
  - 70+ municipalities in 2017-2018
  - 80+ municipalities in 2018-2019
  - Municipal and stakeholder driven process
  - 8-hour Community Resiliency Building Workshop to identify strengths, vulnerabilities and strategies
  - Development of Risk Matrix to identify Key Actions
- Year 2 and beyond: MVP Action or CZM Resiliency Grant
  - Implementation of Key Actions
  - MVP program ties into other funding programs; MVP certified communities receive extra points awarded on other EEA grant/loan applications
  - Discussed CZM Coastal Resiliency Grant application and other funding sources
  - Ferry Road does not have a sufficient Benefit Cost Ration to qualify for FEMA funds
  - Senior Center needs up to date shelter code

Core Team Role (Kathy)

- Core Team defines goals and develops schedule
- Organizes implementation of the Community Resilience Building Workshop
- Determines how information and decisions from Workshop will be used
- Reviews recommendations and prioritizes Action Items

Define Project Goals

- Items to consider when developing goals:

- Need to increase the level of understanding of people who are affected by coastal surge that other areas of town are also of concern (Ferry Road/March Road, Ring's Island area) (Michelle)
- Impacts of climate change are not limited to flooding and erosion, but also include precipitation and temperature (droughts and high temperatures affect framers and local wells and contribute to wildfire risk)
- Flooding is directly related to the physical characteristics of the town (ocean and marsh); infrastructure was constructed without consideration of vulnerability from flooding (Neil)
- This situation affects the Town's ability to access people who do not have power; residents are at risk, road access is limited,
- Along Beach Road, can get 4 to 6 feet of flooding twice yearly; need to keep emergency apparatus on the beach.
- Ferry Road and Ring's Island become isolated during flooding.

Community Resilience Building Workshop

- Components of the Workshop are:
  - Provide an overview of climate projections
  - Use of large map depicting key resources, assets and infrastructure
  - Discussion of strengths and vulnerabilities
  - Prioritization of key actions
  - Use of the Risk Matrix to organize ideas

Data Needs and Sources

- Reports and materials previously identified by Weston & Sampson
  - Merrimack Valley Region Multi-Hazard Mitigation Plan Update (2016)
  - Great Marsh Coastal Adaptation Plan (2017)
  - Salisbury Master Plan (2008)
  - Town of Salisbury- 2012/2013 Community Development Strategy (https://www.salisburyma.gov/sites/salisburyma/files/file/file/caccommunitydevelopmentstrategy.pdf)
  - Salisbury Master Plan Volume 1: Existing Conditions and Trends, February 2008 (https://www.salisburyma.gov/sites/salisburyma/files/file/file/pbmasterplan_volume1existing.pdf)
  - Salisbury Master Plan Volume 2: Implementation Plan, October 2008 (https://www.salisburyma.gov/sites/salisburyma/files/file/file/pbmasterplan_volume2implementation.pdf)
- Additional reports and materials
  - Emergency operation plan (Bob to provide)
  - DCR's Salisbury Beach Management Plan (2008) https://www.mass.gov/files/documents/2016/08/pf/salb-mgt-plan-final-sept-2008-text-only.pdf)
  - Town of Salisbury Harbor Plan – Phase 1 (https://scholarworks.umb.edu/uhi_pubs/8/)
  - Open Space Plan (recently updated)
  - Draft Tree Management Plan
  - Water System Master Plan (10 years old)

List of Workshop Attendees

- Lisa Pearson has developed a preliminary list of invitees for the Workshop
- List will be screened and narrowed; Lisa will assign contact information to the invitees

Municipal Staff
Neil Harrington
Lisa DeMeo
Tom Fowler
Scott Carrigan
Scott Vandewalle
Bob Cook
Michelle Rowden
Lisa Pearson
Bart
Jack
Liz Pettis

Volunteers
Selectmen
Planning Board
Board of Health
Conservation Commission
ZBA
Agricultural Board
Kristine Harrison

Local Builders
Steve Paquette
Ben Leggairs
Dan Gelinas

Outside groups
Pettengill House
Boys and Girls Club
Assisted Living
Housing Authority
Beach Betterment
Chamber
Beach Partnership
Citizens for Change
Marist Center
Sheriff's office
Merrimack Valley Planning Council
Politicians offices (if they are interested)
Rings Island Water
Rings island taxpayers (Jerry)
Coastal Trails
PTA
Storm Surge
CZM
DCR
Realtors
Local Engineers/Architects
Nuke plant?
MEMA
Eric Hutchins, NOAA
Eric Durluth, US Fish & Wildlife Service
Ed Reiner (EPA)
Georgeann (DER)
US Army Corps of Engineers
MRBA
Parker River Watershed Association
Kristen Grubs (Ipswich River)
Seabrook Water
DOT
Rocky Morrison (Clean Rivers Project)
Blue ocean society
Greg Moore (UNH)
Merrimack River Watershed Council
YWCA
Housing Authority
Amesbury Emergency Management (Amesbury Fire Chief)

Stakeholder Survey

- Weston & Sampson will prepare and administer a survey to solicit more in-depth input from stakeholders prior to Workshop

Schedule

- All day Workshop on a weekday from 8:00 am to 4:00 pm
- Tentatively set for October 10, 2018
- If that does not work with the Police Chief and Town Manager, Kathy Will send out Doodle Poll

Salisbury Action Items:

- Determine date of Workshop
- Finalize list of invitees; send invitation and track RSVPs (W&S could send and track RSVPs, if desired)
- Provide information/data sources:
    - Emergency operation plan (Bob to provide)
    - Town of Salisbury Harbor Plan – if there are other phases besides Phase 1
    - Open Space Plan (updated)
    - Draft Tree Management Plan
    - Water System Master Plan

W&S Action Items:

- Send project goal ideas to Lisa
- Prepare survey questions for SurveyMonkey-type survey to Workshop invitees
- Draft invitation to Workshop invitees
- Review list of additional information, request those reports/sources that are not available online

Next Meeting September 26, 2018 at 10:00 am

Town of Salisbury
Municipal Vulnerability Preparedness Planning Grant Project
Wednesday, September 5, 2018, 10:00 am – 12:00 pm
Core Team Meeting Sign-In Sheet

Name	Affiliation	Email Address
Kathy Baskin	Weston + Sampson	baskink@wseinc.com
Michelle Rowden	Conservation	Conservation@Salisburyma.gov
Lisa Pearson	Planning	Lpearson@salisburyma.gov
Scott Vandewalle	Building	bldginsp@salisburyma.gov
Neil Harrington	Town Manager	nharrington@salisburyma.gov
Robert Cook	EMD	sema@SalisburyMA.gov
Scott Carrigan	Fire Chief	scarrigan@salisburyma.gov
CHRIS PERKINS	WESTON & SAMPSON	perkinsc@wseinc.com
LISA DEMEO	DPW	ldemeo@salisburyma.gov

Town of Salisbury
Municipal Vulnerability Preparedness Planning Grant Project
Core Team Meeting
Wednesday, September 26, 2018
10:00 am – 11:30 am

1. Introductions — 5 minutes

2. Workshop Participants — 15 minutes
   a. List of Invitees and RSVPs
   b. Table assignments
   c. Email confirmation and online survey

   W&S Action Item: Finalize survey based on Salisbury input, coordinate on table assignments
   Salisbury Action Item: Review survey, finalize list of participants, email survey, table assignment

3. Workshop Materials — 45 minutes
   a. Draft Agenda
   b. Climate Change Projections
   c. Draft Powerpoint
   d. Draft Map for Discussion
   e. Other

   W&S Action Item: Finalize Workshop materials based on Core Team input
   Salisbury Action Item: Help to fill mapping gaps related to community assets, vulnerabilities

4. Workshop Staffing — 10 minutes
   a. Facilitators – Weston & Sampson
   b. Note-Takers – Town of Salisbury (Core Team)

   W&S Action Item: Identify five table facilitators
   Salisbury Action Item: Identify five table note-takers

5. Other — 10 minutes
   a. Lunch and Refreshments (recommendations on lunch caterers)
   b. Room Logistics
   c. Possible Outreach to Press by Town

6. Wrap Up and Next Steps — 5 minutes

Town of Salisbury
Municipal Vulnerability Preparedness (MVP) Planning Grant Project
Core Team Meeting Notes
Wednesday, September 26, 2018
10:00 am – 11:30 am

Attendance

Salisbury
Neil Harrington, Town Manager
Lisa Pearson, Project Manager and Planning
Lisa DeMeo, Public Works
Michelle Rowden, Conservation
Scott Vandewalle, Building
Robert Cook, Emergency Management

Weston & Sampson
Kathy Baskin, Project Manager

Discussion

Workshop
The Community Resilience Building Workshop is scheduled for October 10, 2018 from 8:30 am to 4:30 pm in the Selectmen's room at Salisbury Town Hall.

Workshop Participants
Lisa Pearson and her staff have sent out invitations to the Workshop. The Core Team discussed the list and verified that specific people or entities were invited (such as the Harbor Master).

Lisa and Kathy will coordinate next week on the list of Invitees and RSVPs. The group discussed sending an email confirmation with date, time, location, and other logistics to those who have accepted the invitation. We could also send the online survey to participants. Outreach to participants prior to the CRB Workshop will depend on whether there is available time to allow for meaningful input between their RSVPs and the Workshop date. We will want to make table assignments to those

Salisbury Action Item: Call invitees who have not responded, finalize list of participants, email survey, and make table assignments.
W&S Action Item: Follow up with Salisbury on RSVPs, coordinate on table assignments

Workshop Materials

- Draft Agenda: Kathy reviewed the general schedule of the workshop describing the sequence of events.
  - Draft Powerpoint: The Core Team reviewed the draft workshop presentation which includes existing hazards, existing climate change, climate change projections, features that will be vulnerable or offer strength to the community under climate change, and types of actions that can be taken to alleviate impacts. Comments included:
  - We want to be sure that the presentation is lively and engages the participants so they don't get sleepy or distracted.

- It is important to educate people about climate change impacts; unfortunately, a big storm can be the best educator.
- Michelle gave an example of a 2015 Nor'easter during which a neighborhood was hit hard. Two houses had been connected by a wall that directed the water in a way to caused scour around the foundations. This went on until the water punched through the wall. The homeowners were educated and now understand that the wall contributed greatly to the damage of 4 to 5 homes.
- Bob mentioned that the cooling center was used this summer.
- Bob and Lisa DeMeo offered to give anecdotes about impacts/threat to people, buildings, and infrastructure.
- Lisa DeMeo offered to send relevant photos to Weston & Sampson from Town for CRB Slide Show

- Draft GIS Map for Discussion: The Core Team reviewed the large GIS map of the assets and vulnerabilities. Suggestions included:
  - Make colors less similar (light blue and aqua, for example) so they do not blend together, making areas hard to distinguish
  - Use hatching
  - Make font size of labels larger
  - Separate out information into two maps
  - Kathy asked for locations of mobile home parks and low-income housing areas

W&S Action Item: Finalize Workshop materials based on Core Team input
Salisbury Action Item: Help to fill mapping gaps related to community assets, vulnerabilities

Workshop Staffing

- Weston & Sampson will provide five table facilitators for the Workshop
- The Town of Salisbury will identify five table scribes/note-takers for Workshop from Town

Salisbury Action Item: Identify five table note-takers

Other

- Lunch: Lisa and Kathy developed a list of food and beverages for morning and afternoon snacks and lunch.
- Room Logistics
  - Kathy would like to tour the meeting space in advance to note locations of electrical outlets, locate tables and chairs, and decide on room configuration.
  - Weston & Sampson will bring laptops and projector. There is a screen in the room.
- The group discussed possible outreach to the local press by Town officials. Lisa P will look into this.

Town of Salisbury
Municipal Vulnerability Preparedness Planning Grant Project
Wednesday, September 26, 2018, 10:00 am – 11:30 am
Core Team Meeting Sign-In Sheet

Name	Affiliation	Email Address
Kathy Baskin	Weston + Sampson	baskink@wseinc.com
Lisa Pearson	Planning	Lpearson@salisburyma.gov
Neil Harrington	Town Manager	nharrington@salisburyma.gov
Robert Cook	EMD	SEMC@SalisburyMA.GOV
Lisa DeMeo	DPW	ldemeo@salisburyma.gov
Scott Vandewalle	Building	bldg inspe salisburyMa.gov
Michelle Rowden	Conservation	Conservation@Salisburyma.gov

Town of Salisbury
Municipal Vulnerability Preparedness Planning Grant Project
Core Team Meeting
Wednesday, November 29, 2018
10:00 am – 10:45 am

1. Introductions — 5 minutes

2. Review Draft Municipal Vulnerability Report and Priority Actions — 20 minutes

3. Public Listening Session — 5 minutes
   Date and Location Options
   Public Comment Period and Posting Report Online

4. Proposed Listening Session Format — 10 minutes

5. Wrap Up and Next Steps — 5 minutes

Listening Session Guidance

Each community must complete at least one public listening session with the whole community invited and should have a clearly articulated list of priority next steps and actions and how to implement these.

General guidelines for (-60 min) MVP public listening sessions include:

- Schedule and post listening session using best practices or requirements for posting public meetings in the municipality
- Ensure listening session is open to the public in a central, easily accessible location in the municipality (city/town hall, public library, community center, etc.)
- Ensure that the core team is present and ideally elected officials
- Provide a speaker(s) to present an overview of the Summary of Findings Report
    - Speaker(s) should be from the core team members and/or elected official(s)
    - Service provider for the respective municipality should not be the principal speaker(s)
    - Speaker(s) to review purpose, intent, objectives, and outcomes of workshop process
- Provide a question and answer period for members of the concerned public
    - Core team member(s) and/or service provider(s) respectfully listen and record responses from public
    - Provide clarification about Findings
- Provide opportunity for members of the concerned public to contribute in writing further input at the listening session
- Provide web link to Summary of Findings report at the listening session

Acceptable alternative formats include:

- A public listening session can take place at a selectmen meeting only if they are open and promoted for public attendance, with similar allotment of time (-60 min) for the MVP listening session portion

Town of Salisbury
Municipal Vulnerability Preparedness Planning Grant Project
Public Listening Session
Wednesday, September 26, 2018
6:30 pm – 8:00 pm

Agenda

1. Introductions – Neil Harrington, Town Manager and Lisa Pearson, Project Manager and Planning Director

2. MVP Program Overview – Kathy Baskin, Weston & Sampson

3. Summary of Findings Report and Priority Actions – Kathy Baskin, Weston & Sampson and Lisa Pearson, Project Manager and Planning Director

4. Questions and Answers – All

5. Conclusions – Neil Harrington, Town Manager and Lisa Pearson, Project Manager and Planning Director

TOP RECOMMENDATIONS TO IMPROVE RESILIENCE

After listing vulnerabilities, hazards, and possible actions, participants ranked their recommendations from high to low priority. A summary of findings from the final group matrix is included below.

6.1 Highest Priority

- Protecting roads is a high priority item. Strategies could include designing alternative modes of transportation; training and emergency management planning; raising roads and protecting Beach Road, Ferry Road, and Route 1A. There should also be regular maintenance programs and work to improve drainage and reduce surface flooding.
- Providing and preparing shelters. This will require emergency transportation options, communication, planning, reliable power, adequate staffing and equipment, evacuation routes, and the materials and facilities needed to sustain evacuated residents.
- Protecting the beachfront. Strategies could include education and advocacy, maintaining dunes, a seawall, regular beach nourishment, and diversifying plant species.
- Protecting the Marsh by implementing strategies that eliminate restrictions, studying options for buffer protection and resilience, increasing biodiversity, and planting drought-resistant species.
- Protecting critical municipal facilities and services by implementing strategies that provide backup power to Town Hall, protecting other municipal buildings, and providing adequate staffing, and training.
- Protecting the State Reservation through beach nourishment, studies, O&M, tide gates, water quality monitoring, and shade.
- Protecting wells by seeking new water sources and protecting current water sources.

6.2 Moderate Priority

- Protecting businesses, like at the Salisbury Beach Center, by maintaining and creating dunes.
- Educating children to prepare the next generation to tackle climate change.
- Evaluating and studying the addition of tide gates.
- Proacting underground utilities like gas, water, and sewers through redundancy and back-up power.

6.3 Lower Priority

- Reliable power sources, including backup power and equitable access to facilities with power.
- Protecting buildings, including the Beach Entertainment Center. This could involve strategies including retreat, elevation, seawalls, dunes, sand mining, and increased permeable surfaces.
- Improved communication before, during, and after extreme events.
- Disaster management specific to tourism, including a tailored evacuation and notification plan, and protecting related infrastructure.
- Protecting aquifers and expanding sewers in critical areas.
- Preventing exposed utilities.

Town of Salisbury
Municipal Vulnerability Preparedness Planning Grant Project
Core Team Meeting
Wednesday, November 29, 2018
10:00 am – 10:45 am

Attendance

Salisbury
Neil Harrington, Town Manager
Lisa Pearson, Project Manager and Planning
Lisa DeMeo, Public Works
Scott Carrigan, Fire

Weston & Sampson
Kathy Baskin, Project Manager

Discussion

Review Draft Municipal Vulnerability Report and Priority Actions

- The Team reviewed a draft list of the Draft MVP Report's recommended Actions, which were developed during the October 10, 2018 Workshop
- The Team proposed revisions to the language, to remove redundant Actions and to ensure that the Actions represented the intent of Workshop participants
- Actions were reorganized slightly, to differentiate between Priority Actions and Other Actions.
- Weston & Sampson will make the suggested changes and send the revision to Lisa Pearson for distribution.
- The Core Team will provide comments on the draft report.
- The draft report will be made available to the public for public comment period associated with the Listening Session.

Public Listening Session

- The Core Team selected Monday, December 10, 2018 from 6:30 pm - 7:30 pm for the date and time of the Public Listening Session.
- The Town will post the draft report on its website and will provide a public comment period.

Proposed Listening Session Format

- Weston & Sampson reviewed a draft agenda for the Listening Session.
- The agenda will be revised to reflect the date and time selected for the meeting.

Town of Salisbury
Municipal Vulnerability Preparedness Planning Grant Project
Wednesday, November 29, 2018, 11:00 am – 12:00 pm
Core Team Meeting Sign-In Sheet

Name	Affiliation	Email Address
Kathy Baskin	Weston + Sampson	baskink@wseinc.com
Lisa DeMeo	DPW Dir.	ldemeo@salisburyma.gov
Neil Harrington	Town Manager	nharringtn@Salisburyma.gov
Scott Carrigan	Fire Chief	scarrigan@salisbusyma.gov
Lisa Pearson		

APPENDIX F

Public Listening Session

December 10, 2018

https://www.newburyportnews.com/news/local_news/salisbury-hosts-climate-change-meeting-monday/article_752a1a86-a20f-595d-8d0d-b987426f1356.html

Salisbury hosts climate change meeting Monday

By Jim Sullivan jsullivan@newburyportnews.com Dec 6, 2018 Updated 6 hrs ago

SALISBURY — The effects of climate change and sea level rise will be on the agenda at a special municipal vulnerability planning session Monday night.

"Sea level rise alone is going to cause problems. There are communities all over the state that are looking at these issues, particularly coastal communities," Town Manager Neil Harrington said. "I think the state government recognizes that no community by itself will have the resources to be able to meet these challenges. So they will be making state grant money available over a long period of time."

About 50 town officials and residents attended an all-day municipal vulnerability planning seminar in September dealing with the effects of climate change on the town and its infrastructure, Harrington said.

Areas such as the Blackwater River, the Town Creek marshes, March Road, Jacqueline Drive, portions of Beach Road, North End Boulevard and Salisbury Beach were identified as potential trouble spots during the seminar.

"In most cases, this involves flooding issues in town," Harrington said. "They have identified vulnerable areas and some infrastructure concerns like power outages, bridges, tide gates, culverts, the Salisbury Beach Reservation, municipal facilities. There are a whole series of things that they went through."

Although Route 1, Route 1A and Beach Road are state property, he said those areas

could still be identified as "major problems."

"If there is ever a fire or a medical emergency on the beach, it would be very difficult for our municipal people to get through," Harrington said. "We also have flooding issues on Route 1 and there is significant flooding in the Ring's Island area."

Salisbury also has plenty of troublesome, low-lying areas, according to Harrington.

"There are many areas of town which get significant flooding during bad storm events," he said. "There are a lot of wetlands in town and the topography of the land and the natural conditions can lead to this."

The state has made planning for the effects of climate change a "high priority," according to Harrington, who added that "several millions of dollars" in state grant money is available to communities meeting certain criteria.

Among the state's criteria is a list of priorities, a draft report of which Harrington expects to present to the public during the session to be held Monday at 6:30 p.m. in the Colchester Room at Town Hall.

"This problem will not be able to be addressed overnight, so we need a long-term plan for it," he said. "That is what the whole goal is here, to put together a long-term, municipal vulnerability plan with specific goals in regards to when you want to be able to address certain vulnerable points."

An action plan would need to be adopted and submitted to the state for approval once the town presents its draft report. Harrington said he expects the town to submit its action plan in January.

"Once it is approved, you are then eligible for grants," Harrington said. "In the first round, we are eligible for up to $400,000 if our plan is approved."

Public comment will be allowed during the planning session Monday and a public comment period when written comments may be submitted to the town will continue until Jan. 4.

Staff writer Jim Sullivan covers Amesbury and Salisbury for The Daily News. He can be reached via email at jsullivan@newburyportnews.com or by phone at 978-961-3145. Follow him on Twitter @ndnsully.

Town of Salisbury
Municipal Vulnerability Preparedness Planning Grant Project
Public Listening Session
Salisbury Town Hall
Monday, December 10, 2018
6:30 pm – 7:30 pm

Agenda

1. **Welcome and Introductions**
   5 minutes
   Neil Harrington, Town Manager
   Lisa Pearson, Project Manager and Planning Director

2. **MVP Program Overview** — 5 minutes
   Lisa Pearson, Project Manager and Planning Director

3. **Summary of Findings Report and Priority Actions** — 20 minutes
   Lisa Pearson, Project Manager and Planning Director

4. **Questions and Answers** — 20 minutes
   All

5. **Public Comment Period** — 20 minutes
   Lisa Pearson, Project Manager and Planning Director

6. **Conclusions** — 5 minutes
   Neil Harrington, Town Manager
   Lisa Pearson, Project Manager and Planning Director

Town of Salisbury
Municipal Vulnerability Preparedness Planning Grant Project
Public Listening Session
Salisbury Town Hall
Monday, December 10, 2018
6:30 pm – 7:30 pm

Meeting Notes

The MVP Public Listening Session began at 6:30 pm.

Welcome and Introductions

Lisa Pearson, Salisbury's Director of Planning and Development, and Salisbury's MVP Project Manager introduced the Core Team that guided the MVP Process, including organizing the Community Resilience Building Workshop, held on October 10, 2018, and preparing the draft Summary of Findings Report, which is available on the Town's website for review and comment, Member of the Core Team are:

Neil Harrington, Town Manager
Lisa Pearson, Planning Director
Scott Carrigan, Fire Chief
Robert Cook, Emergency Management
Lisa DeMeo, Public Works
Tom Fowler, Police Chief
Bob Roy, Police Department
Michelle Rowden, Conservation
Scott Vandewalle, Building

Ms. Pearson explained that the purpose of the Listening Session was to get the entire community involved and that, therefore, the Listening Session was being recorded in order to include viewers at home as well as those members of the public who were present.

MVP Program Overview

Ms. Pearson explained that the state's Municipal Vulnerability Preparedness (MVP) Program was created about 1.5 years ago to promote municipal resilience to climate change. Salisbury received a planning grant under the program and hired Weston & Sampson to assist. The MVP Program will enable Salisbury to:

- Plan for climate change resiliency
- Become a "certified MVP community"
- Apply for Action Grants to implement projects and increase resiliency

Community Resilience Building Workshop

Ms. Pearson described the October 10 Community Resilience Building Workshop, at which attendees:

- Defined extreme weather hazards and climate change impacts
- Identified key features
- Determined vulnerabilities and strengths
- Developed and prioritized actions
- Completed vulnerability assessments
- Next: Implement key actions

She noted that prioritizing actions was not easy because there are some many concerns and ideas

She noted that the Workshop included a diverse group of participants; even Seabrook Water attended. The town appreciated everyone's participation. There were representatives from the following groups:

Salisbury Municipal Government

- Board of Selectmen
- Building Inspector
- Conservation
- Council of Aging
- Emergency Management Director
- Fire
- Health
- Planning Board
- Planning and Development
- Police
- Public Works
- Zoning

Community Groups

- Citizens for Change
- Coastal Trails Coalition

Business

- Salisbury Beach Betterment Association
- Salisbury Chamber of Commerce
- Tom Saab Real Estate

Regional

- Merrimack Valley Planning Commission
- Seabrook Water

State

- MA Department of Conservation and Recreation
- MA Office of Coastal Zone Management

The top hazards identified at the Workshop were: 1) sea level rise, coastal storm surge, and erosion; 2) extreme precipitation: both heavy rain and drought; 3) extreme storms; including wind, ice, and Nor'easters; and 4) extreme temperatures.

Ms. Pearson reviewed vulnerabilities identified during the Workshop. She noted that this year, there were concerns with roads such as Beach Road and Broadway being washed out. She also noted concerns about icing in the winter, availability of reliable power, uncertainty about what the beach will look like after storms, and how to protect infrastructure and other resources. Vulnerabilities identified during the Workshop were:

Infrastructural

- Roads (Beach, March Rd, and Ferry Rd)
- Reliable power
- Beach
- Buildings
- Water Supply Wells
- Communication
- Utilities, including gas and sewer systems
- Bridges, tide gates, and culverts

Environmental

- Beachfront
- Marsh
- Aquifers
- Merrimack River

Societal

- Municipal services and facilities (emergency management, Fire Dept, Police Dept)
- Businesses
- Commercial/economic
- Children
- Shelter availability/accessibility
- Seniors, senior centers, assisted living facilities
- Low income communities
- Transient populations

Ms Pearson also listed strengths identified during the Workshop that will help the town move forward with resilience. Key buildings, such as the senior center, could be used as shelters; would need to look at the Building Code. Could it also be used as a cooking center? The new library can provide relief from heat. Areas to that contribute to tourism and economy, including the beach, and industrial and commercial areas, were identified as strengths. Public open space is also a strength. The Town will continue to protect open space and is seeking out funding to improve and protect forests, wetlands, the marsh, and ocean. Policies such as the tree bylaw to protect and strengthen the town. Fostering organizations like the Boys and Girls Club enriches childrens' education and helps them understand what will happen in the future with climate change. Strengths and assets identified during the Workshop were:

- Buildings used as shelters
- Cooling centers
- Areas that encourage tourism and contribute to the economy
- Public open space
- Landscape features that help manage stormwater and mitigate extreme temperatures, like trees and the 37.8% of forested land
- Programs fostering community resilience, like the Boys and Girls Club
- Children
- Elderly residents and their local knowledge
- Aquifers and wells
- Merrimack River, Black Water Creek
- Great Marsh and other wetlands
- Power grid
- Communication systems
- Sewage treatment
- Municipal services, including the Police and the Fire Station
- Farmland
- Infrastructure, including bridges and tide gates

Summary of Findings Report and Priority Actions

Lisa Pearson reported on the highest priority actions for increasing resilience to hazards and climate changes, as identified during the Workshop. They were:

- Protect roads as evacuation routes and investments
- Protect the beachfront including residents, existing buildings, environmental resources, and businesses
- Evaluate and study the addition of tide gates or other flood protection measures
- Provide and prepare existing shelters

- Disaster management, including evacuation and notification plan, and equipment
- Protect the marsh by eliminating restrictions and increasing buffers, biodiversity, and drought-resistant species.
- Protect critical services with backup power to Town Hall and Library and other critical municipal facilities; provide adequate staffing and training, and provide equitable access to facilities with power.
- Protect the State Reservation through beach nourishment, tide gates under the reservation road, and other related efforts
- Protect aquifers and current water sources

Public Comments, Questions and Answers

One public commenter, Lou Masiello, said to add "beach nourishment" to second bullet of high priority actions (protect beachfront). He feels is important to protect through beach nourishment as well as through other measures.

Tom Saab, a realtor and member of the public commented that his number one priority was to protect the beachfront. Without the beach, property values drop. A house valued at $1M recently dropped in value to $750k, as an example. Two weeks ago, there was a lot of erosion that took place. The storm only lasted 1.5 days but the town lost tens of thousands of dollars of investment in dunes. The dunes lost 6 to 8 ft and the storm was not even a significant one. People cannot afford to deal with this or don't want to deal with this. The next significant high tide expected on Christmas day. He read an historic piece from Hampton, NH in the 1930s that described how, after significant losses in 1932 and 1933, 3900 ft of sea wall was built in 1934. He feels the only hope is seawall or boulders. The town lost 2 homes during the last storm, who knows how many will be lost in the next storm. He urged the town to "think seriously about seawall or boulder wall."

A third speaker, Ray Champagne, said that being prepared for the storms should prioritize the location for emergency rescue. There are a tremendous number of elderly residents living at the beach. There is a lot of saltwater coming through Reservation Road. Need to find a gathering location in case people need to evacuate their residences. Route 286 is becoming a problem. The water is getting ready to come across from the beach inland. One of the first things that the town plans for should be gathering spots and evacuation. He is also an advocate of protecting buildings along the beach as they provide a large portion of tax base.

Ms. Pearson noted that the Police, Fire, and Emergency Management departments will be meeting to discuss evacuation as well as vehicles that can assist in evacuations. People on Plum Island are considering a warning system because the bridge will be flooded; need to be prepared for the worst scenario.

Another commenter, Lance Wisniewski, thanked the committee for its work, and the town for receiving the grant money. He is concerned about the availability of water. Projections show an increased number of users, but during summer, the town will have less water available because of heat and drought. His recommendations: 1st - consider water rates that promote conservation, 2nd – look at aquifers; are there ways to recharge stormwater? He wondered what the source of e.coli was in the water supply well. (Lisa DeMeo, Salisbury's DPW Director responded to the question about e.coli. The sources of e.coli was not able to be identified; one can only assume that it may have been related to septic systems.) Water supply needs more protection and at same time, the town needs a larger area to recharge stormwater. Lance also wanted to remind people about the tanker spill on Route 95. Gasoline discharged into the Merrimack River. This would have been bad if the spill had occurred near the water supply well. The town may want to consider using berms separating aquifer from Route 95.

The previous commenter, Lou Masiello, had another comment related to the long-range son to water issue. Amesbury, Newbury and other towns could consider desalination. They may want to look at constructing a regional plant and get assistance from state and federal governments on implementation and funding.

Public Comment Period

Ms. Pearson stated that the town will accept comments on the draft Summary of Findings Report until January 4, 2019. Commenters should send comments to Lisa Pearson at lpearson@salisburyma.gov or Lisa Pearson, Planning and Development Department, 5 Beach Road, Salisbury, MA 01952.

The draft report is on the town's website at: https://www.salisburyma.gov/sites/salisburyma/files/uploads/mvp_planning_project_report_public_review_draft_12062018_with_appendices.pdf. The town will print copies for people who do not want to download and print it themselves.

Next Steps

Next steps for the project are for the town to endorse the MVP Plan and send it to the state for approval. Then, the town will be able to apply for MVP Action Grants to increase resiliency through:

- Detailed Vulnerability and Risk Assessment
- Public Education and Communication
- Local Bylaws, Ordinances, Plans, and Other Management Measures
- Redesigns and Retrofits
- Nature-Based Storm-Damage Protection, Drought Prevention, Water Quality, and Water Infiltration Techniques
- Nature-Based, Infrastructure and Technology Solutions to Reduce Vulnerability to Extreme Heat and Poor Air Quality
- Nature-Based Solutions to Reduce Vulnerability to other Climate Change Impacts
- Ecological Restoration and Habitat Management to Increase Resiliency

Mr. Saab asked who determines what project is submitted to EEA for an Action grant application? He wants a study for a potential seawall and will reach out to the town about this. Before the RFR comes out, Salisbury can ask the agency for feedback on project ideas.

Lisa Pearson told the audience the Town looked forward to receiving public comments and thanked them for participating.

Community Resilience Public Listening Session

December 10, 2018 - 6:30pm to 8:00pm
Municipal Vulnerability Preparedness Program

Salisbury Town Hall, Colchester Room
5 Beach Road, Salisbury, MA 01952

Name	Affiliation (opptional)	Tel.	Email	Signature
Louis Masiello	Planning Bd	978-465-8741	thesummerwind300@comcast.net	[signature]
Joe Cosgrove	MVPC	978-374-0519	jcosgrove@mvpc.org	[signature]
Mary Kirk				
Lisa DeMeo	DPW			
Robert Roy	Salisbury Police	978 465-3121		
Chuck Takesian	Selectman	978 462 9320	Primuswashere@aol.com	[signature]
Freeman Condon	" "	9782700024		Freeman J Condon
Ray Champagne	BS/Home owner	978-771-9990	Pres.RAY@Comcast.net	[signature]
Tom Saab	Salisbury Beach Citizens for Change / Tom Saab Real Estate	978-821-6546		[signature]
John Longo		978 375-0622	johnj5000@yahoo.com	[signature]
Jean moats	Homeowner	978 465 8589	jjmoats@comcast.net	Jean moats
Vance Wisniewski	Citizen	978 764 3582	SCTVMC@GMAIL.COM	[signature]
Lisa Pearson	Resident	978 273 9131		
Michelle Rowden	Salisbury Conservation	978-499-0358	conservation@salisburyma.gov	
Kathy Baskin	Weston + Sampson	978-278-3524	baskink@wseinc.com	K Baskin

welcome

Community Resilience Building Workshop

Findings and Priority Recommendations

Salisbury, Massachusetts

Salisbury Core Team Leadership

- Neil Harrington, Town Manager
- Lisa Pearson, Planning Director
- Core Team
  - Scott Carrigan, Fire Chief
  - Robert Cook, Emergency Management
  - Lisa DeMeo, Public Works
  - Tom Fowler, Police Chief
  - Michelle Rowden, Conservation
  - Scott Vandewalle, Building

Source: MA Coastal Zone Management

Municipal Vulnerability Preparedness (MVP) Program

- State support for MA municipalities to:
  - Plan for climate change resiliency
  - Implement priority projects
- Goals
  - Become a “certified MVP community”
  - Apply for Action Grants to implement projects
  - Increase resiliency

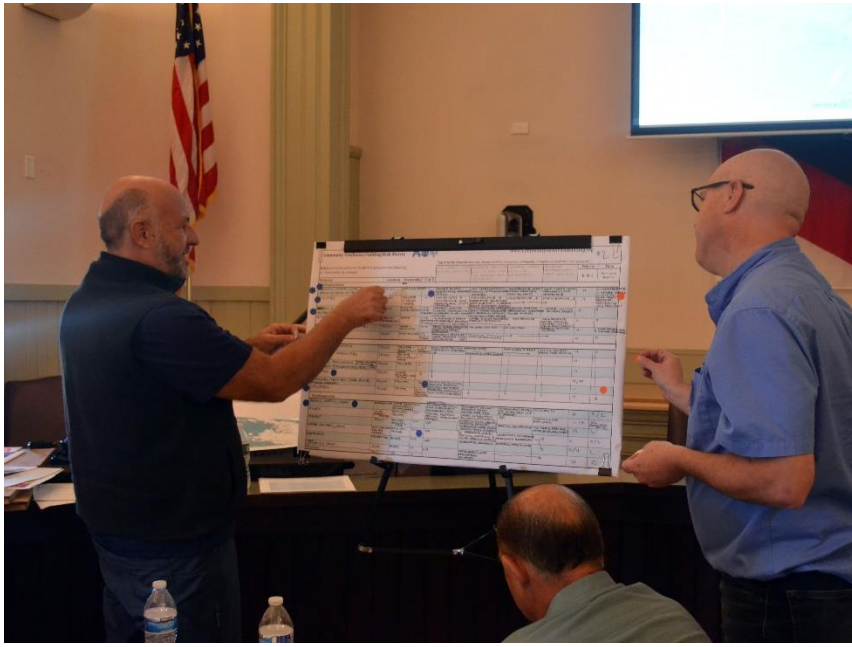
1. Engage Community
2. Identify Hazards
3. Assess Vulnerabilities and Strengths
4. Develop & Prioritize Actions
5. Take Action!

What the MVP Program offers Salisbury

- Improved **resilience and preparedness** of natural and climate-driven hazards
- **Collaboration with stakeholders** about climate change, natural hazards and impact
- **Increased education, planning, and implementation** of priority actions

MVP Workshop

- Defined extreme weather hazards and climate change impacts
- Identified key features
- Determined vulnerabilities and strengths
- Developed and prioritized actions
- Completed vulnerability assessments
- Next: Implement key actions



Workshop Participants

Salisbury Municipal Government

- Board of Selectmen
- Building Inspector
- Conservation
- Council of Aging
- Emergency Management Director
- Fire
- Health
- Planning Board
- Planning and Development
- Police
- Public Works
- Zoning

Community Groups

- Citizens for Change
- Coastal Trails Coalition

Business

- Salisbury Beach Betterment Association
- Salisbury Chamber of Commerce
- Tom Saab Real Estate

Regional

- Merrimack Valley Planning Commission
- Seabrook Water

State

- MA Department of Conservation and Recreation
- MA Office of Coastal Zone Management

Climate Change Impacts

Higher Temperatures

More Extreme Precipitation

(More droughts, more floods)

Sea Level Rise & Coastal Surge

Goal: to protect infrastructure, environment, public health & safety, and economy

Top Hazards Identified at the Workshop

Sea level rise, coastal storm surge, and erosion

Extreme precipitation: both heavy rain and drought

Extreme storms; including wind, ice, and Nor'easters

Extreme temperatures

Vulnerabilities

Infrastructural

- Roads (Beach, March Rd, and Ferry Rd)
- Reliable power
- Beach
- Buildings
- Water Supply Wells
- Communication
- Utilities, including gas and sewer systems
- Bridges, tide gates, and culverts

Environmental

- Beachfront
- Marsh
- Aquifers
- Merrimack River

Societal

- Municipal services and facilities (emergency management, Fire Dept, Police Dept)
- Businesses
- Commercial/economic
- Children
- Shelter availability/accessibility
- Seniors, senior centers, assisted living facilities
- Low income communities
- Transient populations

Strengths and Assets

- ✓ Buildings used as shelters
- ✓ Cooling centers
- ✓ Areas that encourage tourism and contribute to the ecomony
- ✓ Public open space
- ✓ Landscape features that help manage stormwater and mitigate extreme temperatures, like trees and the 37.8% of forested land
- ✓ Programs fostering community resilience, like the Boys and Girls Club
- ✓ Children
- ✓ Elderly residents and their local knowledge
- ✓ Aquifers and wells
- ✓ Merrimack River, Black Water Creek
- ✓ Great Marsh and other wetlands
- ✓ Power grid
- ✓ Communication systems
- ✓ Sewage treatment
- ✓ Municipal services, including the Police and the Fire Station
- ✓ Farmland
- ✓ Infrastructure, including bridges and tide gates

Priority Actions

- Protect roads as evacuation routes and investments
- Protect the beachfront including residents, existing buildings, environmental resources, and businesses
- Evaluate and study the addition of tide gates or other flood protection measures
- Provide and prepare existing shelters
- Disaster management, including evacuation and notification plan, and equipment
- Protect the marsh by eliminating restrictions and increasing buffers, biodiversity, and drought-resistant species.
- Protect critical services with backup power to Town Hall and Library and other critical municipal facilities; provide adequate staffing and training, and provide equitable access to facilities with power.
- Protect the State Reservation through beach nourishment, tide gates under the reservation road, and other related efforts
- Protect aquifers and current water sources

Public Comments

- Comments accepted:
  - December 10, 2018 – January 4, 2019
- Send comments to Lisa Pearson
  - Email: lpearson@salisburyma.gov
  - Mail: Lisa Pearson
    Planning and Development Department
    5 Beach Road,
    Salisbury, MA 01952
- Access draft report at:

https://www.salisburyma.gov/sites/salisburyma/files/uploads/mvp_planning_project_report_public_review_draft_12062018_with_appendices.pdf

Next Steps

- Endorse Salisbury's MVP Plan
- Apply for grants
  - Detailed Vulnerability and Risk Assessment
  - Public Education and Communication
  - Local Bylaws, Ordinances, Plans, and Other Management Measures
  - Redesigns and Retrofits
  - Nature-Based Storm-Damage Protection, Drought Prevention, Water Quality, and Water Infiltration Techniques
  - Nature-Based, Infrastructure and Technology Solutions to Reduce Vulnerability to Extreme Heat and Poor Air Quality
  - Nature-Based Solutions to Reduce Vulnerability to other Climate Change Impacts
  - Ecological Restoration and Habitat Management to Increase Resiliency

thank you

Existing Climate Change

Increased Temperatures in Northeast

- Warmer annual temperatures - up 2°F since 1970
- Warmer winters - up 1.3°F per decade since 1970
- Decreasing winter snowpack
- Earlier flowering plants
- More frequent extreme summer heat

(Source: MA Coastal Zone Management)

Change in Precipitation

6-hour, 10-year event

- 1961 = 3.2 inches
- 2015 = 3.35 inches

24-hour, 100-year event

- 1961 = 6.5 inches
- 2015 = 8.40 inches

(Sources: NOAA TP-40 (1961) and NOAA Atlas Volume 10 (2015)

Sea Level Rise

Relative annual mean sea level

Source: Northeast Climate Adaption Science Center

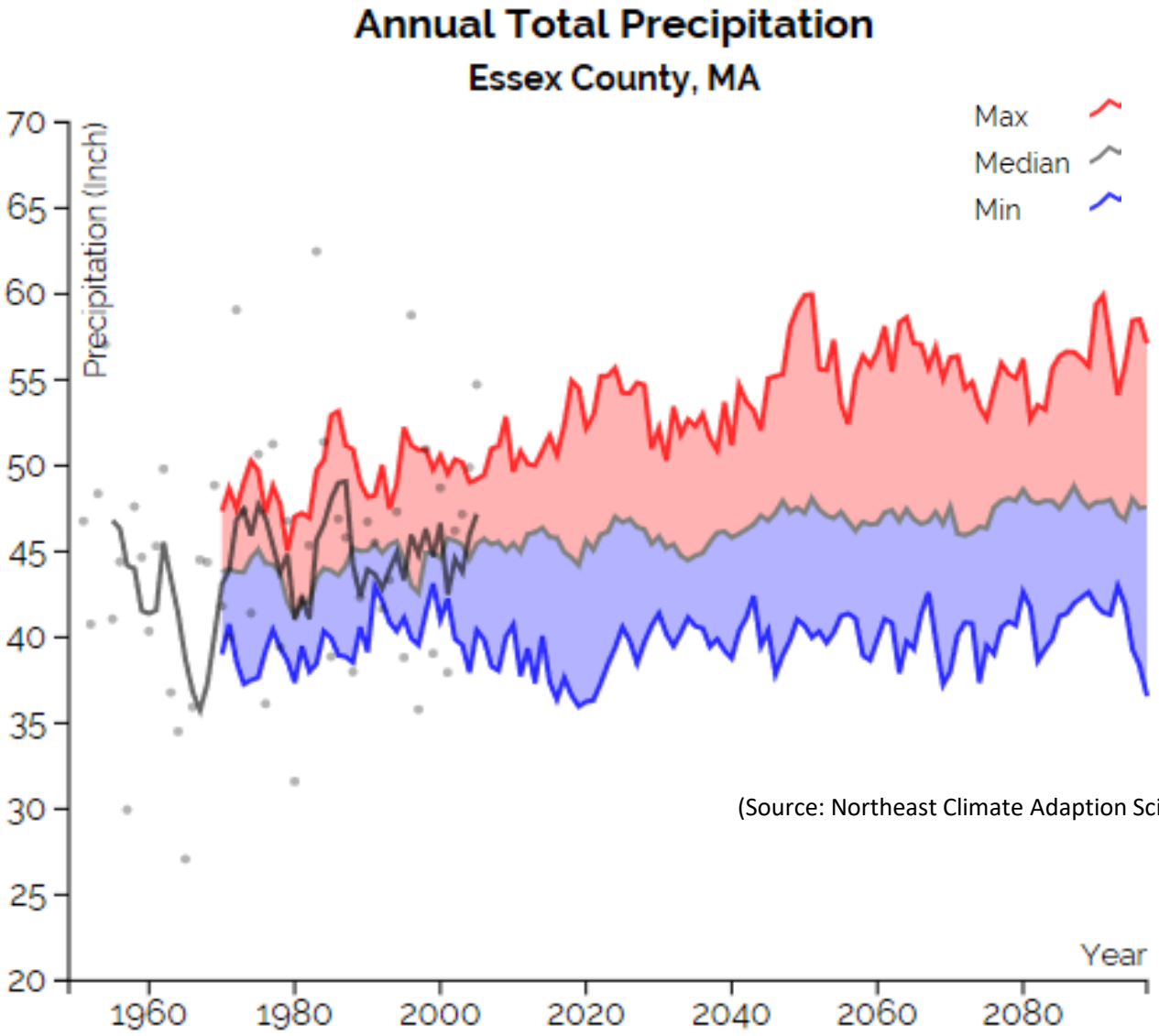
Predicted Climate Change

Increased Temperatures/Extreme Heat

	Observed Baseline	Projected Change 2050's	Projected Change End of Century
MA Average Temp (°F)	47.6	+2.8 to +6.2	+3.8 to +10.8
Salisbury Average Temp (°F)	48.1 to 49.7	+2.7 to +6.4	+3.5 to +10.9
Days with Temperatures Above 90°F	7 to 8	+7 to +33	+10 to +74
Days with Temperatures Above 100°F	<1 to 1	2 to 16	4 to 47
Days with Temperatures Below 32°F	121 to 148	-18 to -44	-23 to -66

(Source: NECSC, 2018)

Heavy Precipitation



(Source: Northeast Climate Adaption Science Center)

Boston Sea Level Rise Projections

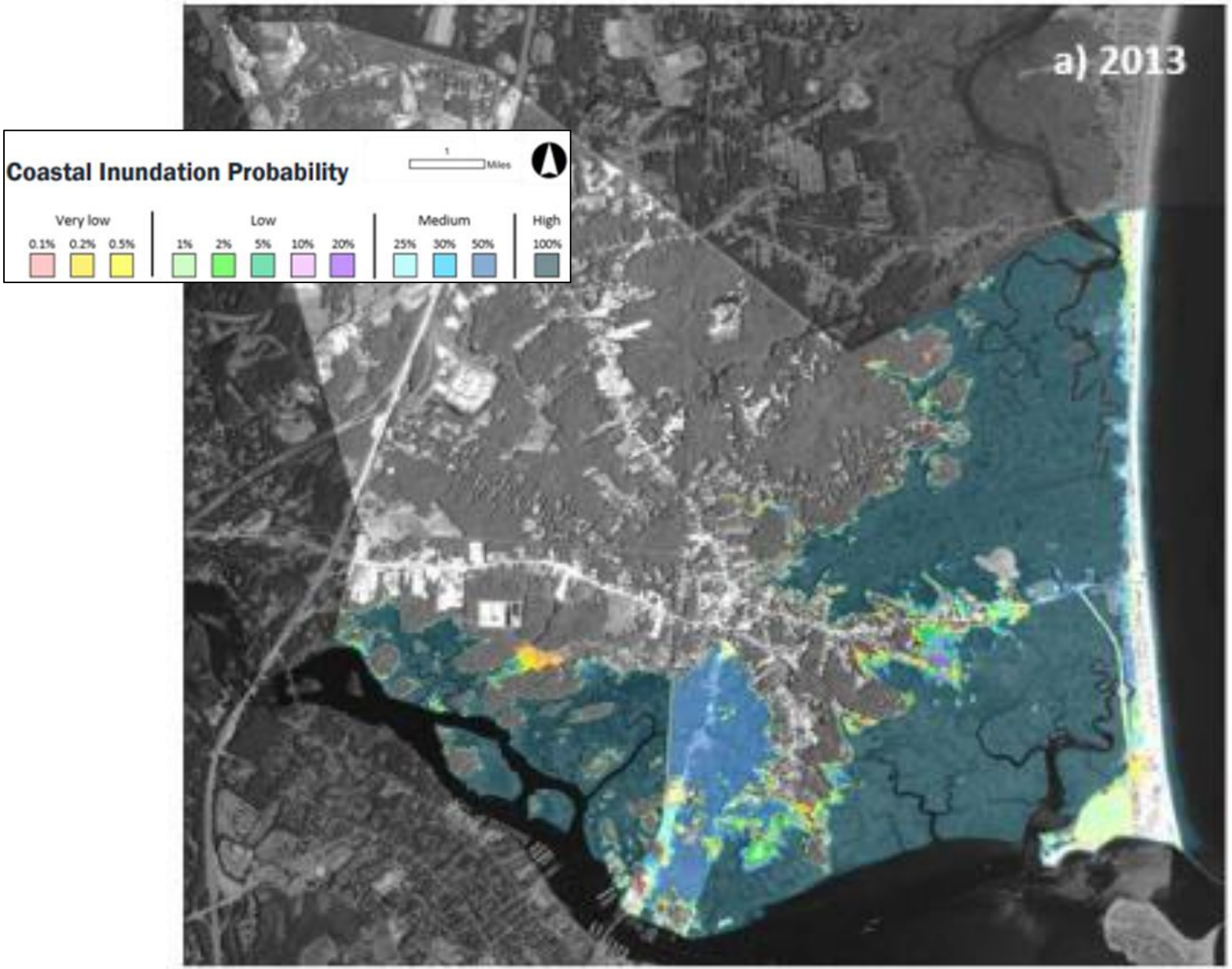
Threatens barrier buildings, infrastructure, beach and dune systems, and people

Emission Scenario	2030 (ft)	2050 (ft)	2070 (ft)	2100 (ft)
Intermediate	0.7	1.4	2.3	4.0
Intermediate-High	0.8	1.7	2.9	5.0
High	1.2	2.4	4.2	7.6
Extreme	1.4	3.1	5.4	10.2

- Increased coastal flooding
- Permanently inundated low-lying coastal areas
- Increased shoreline erosion

(Source: Northeast Climate Adaption Science Center)

Current Coastal Inundation



Projected 2070 Coastal Inundation