



Gloucester
Community Resilience
Workshop Summary of Findings

Prepared for:

Executive Office of Energy and Environmental Affairs
Municipal Vulnerability Program (MVP)

Prepared by:

MAPC and the City of Gloucester
06/30/2018



Gloucester Harbor (Credit: USHarbors.com)

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1. Overview

The need for municipalities, regional planning organizations, the state and federal agencies to help improve resiliency and adaptation to extreme weather events, as well as mounting natural hazards is strikingly evident along the coast of Massachusetts. Recent events such as this past winter's string of storms and a new trend towards extreme weather events have reinforced this urgency and compelled leading communities like the City of Gloucester to plan and mitigate potential risks through a community driven process. Ultimately, this commendable type of leadership will reduce the exposure of Gloucester's citizens, infrastructure and ecosystems and shall serve as a model for cities and towns across the Commonwealth of Massachusetts.

In September 2016, Massachusetts Governor Charlie Baker signed Executive Order 569, instructing state government to provide assistance to cities and towns to complete climate change vulnerability assessments and resiliency action plans. The Order lays out a comprehensive approach to further reduce greenhouse gas emissions, safeguard residents, municipalities and businesses from the impacts of climate change, and build a more resilient Commonwealth. Entitled *Establishing an Integrated Climate Change Strategy for the Commonwealth*, Executive Order 569 represents the collaboration between the Office of the Governor, the Executive Office of Energy and Environmental Affairs, the Executive Office of Public Safety and Security, and key state, local and environmental stakeholders.

The goals of the program and of the Gloucester Resilience workshop are to:

- Define extreme weather and natural and climate related hazards;
- Identify existing and future vulnerabilities and strengths;
- Develop and prioritize actions for the community; and
- Identify opportunities to take action to reduce risk and build resilience.

The City of Gloucester employed a unique “anywhere at any scale”, community-driven process known as the Community Resilience Building (CRB) Workshop (**Figure 1**) (www.CommunityResilienceBuilding.com). The Risk Matrix and the Coastal Resilience Tool were integrated into the CRB Workshop process to provide both decision-support and risk visualization for the City of Gloucester. Using this workshop process, rich with information, experience, and dialogue, the participants produced findings which are outlined in this summary report. The summary of finding transcribed in this report, like any that concern the evolving nature of risk assessment and associated action helps to advance and guide future investigation and prioritization. The City of Gloucester's leadership on community resilience building will benefit from the continuous and expanding participation of all those concerned.

Specifically, this summary report seeks to:

- 1) Provide an overview of Gloucester’s top climate-related hazards (**Section 2.1**), concerns and challenges (**Section 2.2**), strengths (**Section 2.3**), and proposed actions to improve the City of Gloucester’s resilient capacity (**Section 2.4**);
- 2) Highlight the Community Building Workshop Project Teams (**Section 3.2**), participants (**Section 3.3**), and outcomes of resiliency recommendations; and,
- 3) Compile supporting outreach materials developed for the Community Resilience Building Workshop (**Appendix B**).



Figure 1: View of Community Building Resilience Workshop from Above (Kyrouz Auditorium)

2. Summary of Findings

2.1 Top Hazards for Gloucester

During the Workshops, participants from the community were asked to identify the top hazards for the Gloucester region (**Box A**). Coastal flooding, storm surge and sea level rise were identified by the City and as the top hazards by the majority of the participants. Extreme weather events in the form of winter storms, snow, high winds, extreme heat, fire, and drought were also listed universally across most workshop teams. According to the participants, these hazards are already having a direct impact on several neighborhoods, natural areas (e.g., streams, wetlands, beaches, and, parks), roads, and other critical facilities within the City of Gloucester (**Box B**).

Box A: Top Hazards for Greater Gloucester Region

#1 Coastal Flooding/Storm Surge/Sea Level Rise

#2 High Winds

#3 Extreme Cold/Winter Storms/ Snow

#4 Heat/Fire/Drought

Box B: Gloucester's Vulnerable Areas

Neighborhoods: Inner Harbor, parts of Downtown, East Gloucester, Back Shore, Riverdale, and Lanesville

Ecosystems: Good Harbor/Wingaersheek/Coffins Beaches, Marshes and Dunes, Annisquam River, and Great Marsh salt marsh

Roads: East Main Street, Rogers Street, Parker Street, Washington Street, Thacher Road, and Atlantic Road

Facilities: Waste Water Treatment Plant, Thacher Road and Good Harbor Sewage Pump Stations, Transportation, Shelters and Cooling Stations, Nursing Homes, Library and Museums, Schools, Gas Stations, Affordable, Sewage Treatment, Marinas, Hotels, Seawalls, and Parks

2.2 Current Concerns and Challenges Presented by Hazards

The City of Gloucester currently has several concerns and challenges related to the impact of natural hazards on the community's social, environmental, and infrastructure resources as identified below. Many of these were brought to the forefront during the recent experiences with extreme flooding during the winter of 2017-18 that saw a string of Nor'easters, extreme cold, high winds, and coastal flooding.

2.2.1 Societal Vulnerability Opportunities



Figure 2: Participants Identifying Social Vulnerability Opportunities

With large portions of the City's residential neighborhoods within areas prone to flooding, emergency management planning and access, addressing isolation due to storms and the ability to evacuate residents and commuters during emergency events were identified as key societal concerns (**Figure 2**). This included the inability to get emergency services to certain places due to flooding of major transportation routes, key intersections and surface streets (**Figure 3**). Updating the City's existing emergency communications and emergency planning with particular regard for areas that could be cut off or lose power by coastal flooding; areas subject high wind events such as hurricanes; as well as developing a database of vulnerable populations including those in senior and affordable housing settings; developing a manually-based Neighbor Helping Neighbor system; and providing in-school sheltering options with updated and backed-up air conditioning and/or heating were also noted as top challenges.

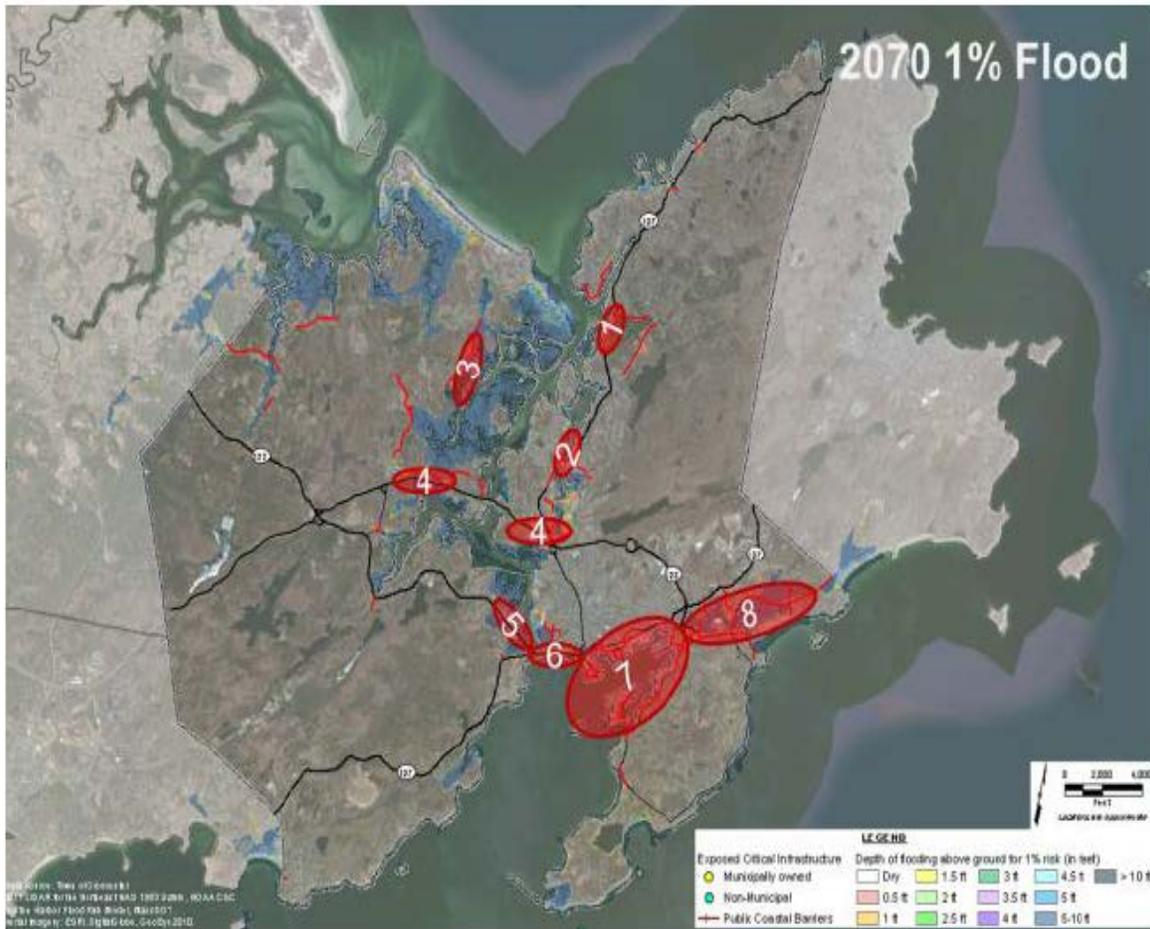


Figure 3: Roadways at Risk in 2070 in 1% Flood (Gloucester Climate Change Vulnerability Assessment and Adaptation Plan - 2015)

Particularly, concerns were raised around the vulnerable populations such as the homeless and lower income elderly in low-lying residential areas, with Veterans Way being cited as one area being subject to housing and isolation issues. The homeless population in Dogtown as also cited as a vulnerable group and special concern was raised around making sure that adequate heating and cooling shelters are available to all that need them. The Action shelter, Rose Bake Center, and West Parish School were the three shelter locations identified. Despite the awareness of the challenges presented by coastal flooding, concerns were voiced pertaining to raising existing structures in flood prone coastal areas and the associated visual impacts on the existing community character.

2.2.2 Infrastructure Vulnerability Opportunities

Infrastructure Features	Location	Ownership	Notes
Waste water treatment plant	Essex Ave	City	Check for backup plan
Wastewater Storage System for Harbor	Water Harbor	City/State/Port	Check for backup plan
Waste water treatment plant	Water Harbor	City/State/Port	Check for backup plan
Wind turbines	City	City/State/Port	Check for backup plan
High School	City	City	Review out - some kind of storm gate to slow water flow Raising walking area by river's mouth New high school location?
Inner harbor	City	City/Port	Check for backup plan
DPW yard	City	City	Check for backup plan
Bridge (Blyman Canal)	Causeway	Public	Check for backup plan
Rt. 128	City	State	Check for backup plan
Roadway to Rocky Neck	City	State	Check for backup plan
Hospital	City	City	Check for backup plan
Access to schools	City	City	Check for backup plan
Coast Gloucester Stop & Shop	City	Private	Check for backup plan
Fire houses in zone	City	City	Check for backup plan
City's math area	City	City	Check for backup plan
Tidegate	City	City	Check for backup plan
Transportation - line flooding	City	City	Check for backup plan
Gas station	City	City	Check for backup plan
Down town zoning	City	City	Check for backup plan
Magnolia pier	City	City	Check for backup plan
Seawall	City	City	Check for backup plan

Figure 4: Identified Impacted Infrastructure Resources

The impact of flooding and storm surge on critical facilities and infrastructure such as the Essex Avenue wastewater treatment facility, seawalls, revetments, breakwaters (Dogbar and Lane's Cove) and low-lying local and state roads including, but not limited to, Thacher Road, Essex Avenue, Stacey Boulevard, Washington Street, Parker Street, Shore Road, Atlantic Road, East Main Street, Rogers Street, Commercial Street, Rocky Neck Avenue, and Causeway Street were noted as key infrastructure vulnerabilities (Figure 4). Associated with many of these areas was aging stormwater infrastructure that does not remove stormwater and storm surge quickly enough, or is already submerged under extreme storm conditions. Also noted were gas stations without power, the East Gloucester Stop and Shop Plaza, the Harbormaster's Office, the Coast Guard Station, key electric substations such as Rogers Street, all sewer pump stations, the Rose Baker Senior Center, the High School, private piers and pilings, City and privately-owned dams, power lines, MBTA commuter rail line, access to Addison Gilbert Hospital during emergency events, the Blynman Bridge (state owned), access to the A. Piatt Andrew Bridge from Grant Circle, all waterfront gas and electric lines, commercial freezers, oil, and propane storage tanks.

The current low-lying location of the DPW facility leaves it vulnerable, as is the Mill River tidal gate on Washington Street. The status of existing power and generator capacity and fire-fighting access under emergency conditions were also discussed as vulnerabilities. Existing local rules (zoning, code enforcement) and state (Building Code) regulations and policy governing infrastructure and buildings in regard to climate change were also seen as key vulnerabilities. The considerations of these impacts lead to discussions on the economic costs of recovery and business interruption, especially fishing-related and smaller businesses in the downtown. Associated risks to public health and safety included potential for disease outbreaks due to overflowing and standing sewage, surface and ground water contamination, leaching from landfills during high tides, mold outbreaks in flooded basements, mobilized debris in the streets and clogging storm drains, and the potential for release of toxic materials and other storage facilities in flood-prone areas.

2.2.3 Identified Environmental Vulnerability Opportunities



Figure 5: Identification of Environmental Hazards.

Participants raised many concerns regarding environmental features and climate change impacts including preservation of beach and marsh systems that serve as storm and flooding buffers and serve as critical habitat (**Figure 5**). Good Harbor Beach was singled out as an area that needs more study and protection going forward. Many raised the issue of ensuring adequate water supply and atmospheric cooling for the City by protecting and better managing the watershed areas that surround the drinking water reservoirs, including completing an assessment of the City's forest land through an inventory of its trees and removing dead trees to reduce the threat

of brush fire hazards in North Gloucester, Dogtown, West Gloucester and, Pole's Hill. Some comments supported reinstating a City forestry department and designating a City tree warden. Other issues raised included impacts to the fishing industry from climate change, the impact of marine invasive, loss of eel grass beds and overall loss of salt marsh as low marsh converts to open water environments and high marsh is limited by human development to migrate further inland. Species migration impacts and serious public health concern regarding tick and mosquito related diseases were also raised, as well as the impact on freshwater wells due to saltwater intrusion related to sea level rise.

2.2.4 Current Strengths and Assets within Gloucester

The City of Gloucester views its recent experiences with increasingly extreme weather patterns and hazard events as ongoing issues to be addressed boldly and with urgency. Actions that the City has already initiated are focused on several key areas of prepared- ness:

- Local hospital presence in Addison Gilbert Hospital and the new urgent care facility at Gloucester Crossing.
- The City's existing all-call RAVE emergency communications system, with a commitment to add more lighted signs with emergency messages and info.
- US Coast Guard Station present, full-time Harbormaster and professional Fire Department.
- Strong commercial fishermen community and advocacy organizations: Fishermen's Wives, Mass Fishermen's Association, and Mass Lobstermen Association
- Great Marsh and barrier beach natural systems largely intact and serving to protect the City and provide habitat.
- Several major grocery stores all located on high ground.
- Strong neighborhood identity and cohesiveness. Some neighborhoods (Annisquam and Lanesville) have begun Neighbor-to-Neighbor type communication work and preparation for storm events/possible isolation already.
- Established HAM radio system in place with expansion proposal identified.
- Strong conservation and preservation ethic and organizations for public/private woodland management and wetlands management efforts - Essex County

Greenbelt, Cape Ann Trail Stewards, and Cape Ann Vernal Pond Team.

- Strong social services network: faith-based community of churches, sheltering facilities, social services and local assistance.
- Ample water supply surrounded and maintained by undeveloped watershed land.
- Strong City-wide dam maintenance program in place with recent extensive updating of the Babson Reservoir Dam.
- North Shore Community Action Plan.
- CATA public bus system.
- Planning capacity for climate change and natural hazards: The City completed a climate change vulnerability assessment and adaptation study in 2015 (**Figure 6**); it includes recommendations/costs on how to protect key City assets. This includes an outline of a flood barrier options that could protect the most densely populated areas of the City during extreme storm events. Gloucester also completed a FEMA-required Natural Hazard Mitigation Plan in 2012 which allows the City to apply for hazard mitigation grants from FEMA. The City is planning to update its plan in 2018.

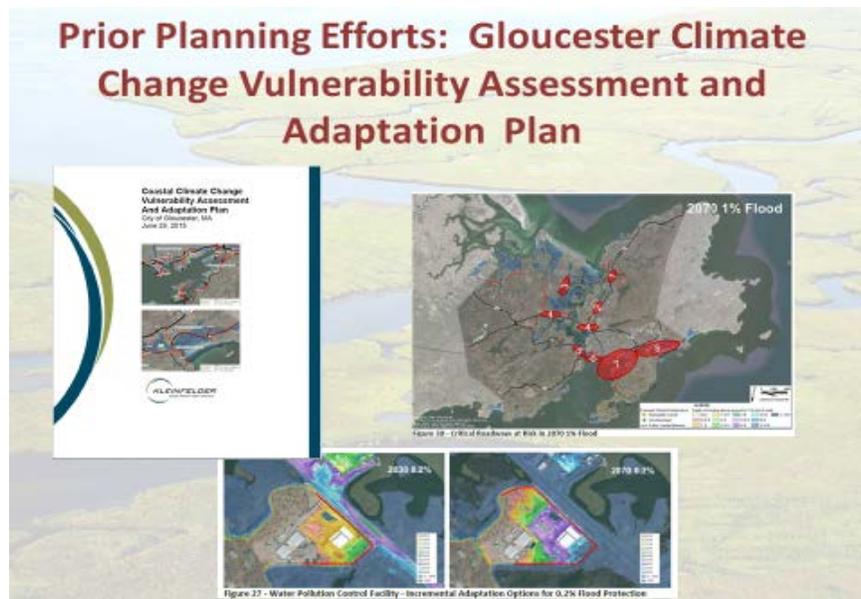


Figure 6: Imagery from Vulnerability Assessment and Adaptation Plan (2015)

2.3 Top Recommendations to Improve Gloucester’s Resilience to Hazards

The responses from the Workshop’s participants regarding recommended actions to

reduce exposure to natural hazards fell into three categories-societal, infrastructure, and environmental actions. Pervasive throughout the discussion was the need to proactively manage the risk posed by these hazards as well as the need to comprehensively assess the return on actions within an economic, societal, and ecological context. Please refer to **Appendix A** to see how participants voted on specific recommendations.

2.3.1 Societal Recommendations

Societal actions focused on making a comprehensive assessment of the City's zoning and land use policies to see how they could be improved for increasing climate resiliency and adaptability. Many favored amending building codes to require higher elevations above flooding levels for new buildings or reconstruction, as well as revamping downtown residential and commercial zoning standards to make them more climate resilient going forward. The incorporation of green infrastructure was seen as a positive adaptation approach that can reduce surface runoff to stormwater system while enhancing the aesthetics of Gloucester.

Land use policies that increase setbacks and explore incentives to reduce the placement of structures in vulnerable areas were recommended, particularly in identified redevelopment areas and transportation routes across the City. Redevelopment in general was viewed as a key long-term opportunity to adapt the City to flooding (**Figure 7**). Closely related were other actions to incorporate the City's existing communication system with a well-designed evacuation plan that could address both evacuation, Neighbor-to-Neighbor programs, and sheltering in place.

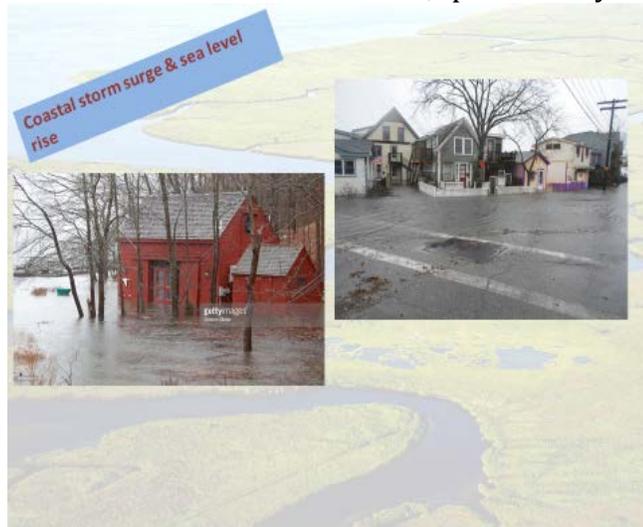


Figure 7: Examples of Storm-Induced Damage

Identifying and creating a database of vulnerable populations including low-income, elderly, and the homeless would be critical as would be creating simple, manual back up communications systems for when power was not available. Another key part of the evacuation and communications strategy would be to develop shelter in place

options for key schools for emergency situations, tying in with the surrounding Neighbor-to-Neighbor programs when needed. This would require upgrading heating and cooling systems at key schools. The City's current Middle School shelter is currently seen as the City's model shelter, while the High School shelter is seen as needing improvement.

2.3.2 Infrastructure Recommendations

For infrastructure, the top concern was adapting the Essex Avenue wastewater treatment plant for climate change. Ideas included existing berm next to the plant and building up from it to protect it from flooding as well as increasing the plant's sump pump system, and sealing off all interior conduits. Discussion of strategies on how to address low lying bridges and roads included prioritizing key road sections for elevation and recognizing that the state owns the Blynman Bridge- which is in line to be replaced and could be elevated at that time- and working more closely with MassDOT officials to coordinate closely on shared state and local roads, developing emergency signage and alternate routes to key infrastructure such as police, fire and DPW facilities as well as to keeping access to Addison Gilbert Hospital and Route 128 open.

The elevation of the Gloucester commuter rail bridge over the Annsquam River was felt to be a strength as well as having second commuter rail station located in West Gloucester. Development of key road closure communication, alternative transportation options, signage and the development of alternative emergency routes would be closely aligned with the development of an overall evacuation, communications and sheltering plan outlined above. Identifying how to assess and best protect Gloucester High School and its parking and stadium were key infrastructure concerns. A key short term action was to increase the height of the seawall abutting the school. Moving the school to a different location was also discussed. The hurricane barrier system outlined in the City's 2015 climate assessment and adaptation study would protect the school and the downtown but comes at a very high cost. Some also felt that the current Dogbar Breakwater should be made taller and extended.

2.3.3 Environmental Recommendations

Top environmental concerns included the need to address forest management from the perspective of overall water supply, climate resilience and cooling, fire management and stormwater control. Gypsy moth and winter moth controls, tree

replanting, maintain fire road access, working with local conservation groups such as the Cape Ann Trail Stewards and Greenbelt, and keeping an inventory of existing and diseased trees were also identified as being key parts of the overall management of Gloucester's forested lands for climate resilience. Participants felt that the City needed to invest more resources towards restoring its Forestry Department and re-instituting the tree warden's position in order to accomplish this task effectively.

Further developing the City's efforts to maintain its barrier beaches and dunes, particularly in working with beachfront property owners was seen as critical for climate adaptation. Several comments supported the creation of a robust and well-funded City beach management plan that would lay out dune and beach grass protection strategies. Some attendees favored conducting an adaptation study with specific recommendations for the Good Harbor Beach dune and marsh system, one of the most heavily used beaches on the North Shore. Streamlined permitting in support of allowing increased water flow in and out of the City's salt marshes to reclaim wetlands and marshes, as well as the protection of land adjacent to the marshes to allow for their migration and the additional need for flood storage capacity were also seen as critical to the overall environmental efforts.

3. Conclusion

In summary, the day-long Community Resilient Building Workshop held on April 12, 2018, generated a vast amount of useful information. Through this collaborative process, the workshop was able to highlight connections between natural hazards and the City's planning and mitigation efforts. Moreover, the Workshop will allow the City to better understand and prioritize resiliency efforts, and evaluate the strengths of its existing infrastructure, natural resources, and social capital. Moving forward, the information gained will be essential to support the City's application for additional technical assistance and resources to supplement municipal resiliency and adaptation planning efforts. This section seeks to acknowledge the efforts and support of those involved with this process, highlight the project teams, and identify workshop participants.

3.1 Acknowledgement

The Metropolitan Area Planning Council (MAPC) and the City of Gloucester would like to thank the Commonwealth's Executive Office of Energy and Environmental Affairs, particularly, the Municipal Vulnerability Program (MVP), directed by the Assistant Secretary of Climate Change Kathleen Theoharides. Through the MVP Program, Gloucester was able to secure resources through a competitive grant process which were used to convene and carry out the Community Resilience Building Workshop. MAPC and the City have collaborated extensively over the years, and look to future efforts. Lastly, both the City and MAPC are appreciative of all those who participated, bringing areas of opportunity and strengths to light.

3.2 Workshop Project Team: Organization and Principal Contact

Gloucester's respective regional planning agency, The Metropolitan Area Planning Council (MAPC) was selected by the City following a comprehensive RPQ process to organize and facilitate the Gloucester's Community Building Resilience Workshop. MAPC's project manager Sam Cleaves (Principle Planner) worked directly with the City's respective counterpart Gregg Cademartori (Director of Planning).

To support this engagement effort, MAPC utilized several other members of its professional leadership:

Martin Pillsbury, Environmental Planning Director

Elise Harmon, Digital Communications Specialist
Heidi Stucker, Regional Planner II
Ann Herbst, Senior Regional Environmental Planner

3.3 Workshop Participants: City of Gloucester, Organizations, and Other Entities

City of Gloucester:

Bevan Worell, Gloucester Public School
Bill Sanborn, Building Inspector
Carol McMahon, Assistant Emergency Management Director
Chris Sicuranza (Former Director of Constituent Services)
Elizabeth Schuster, Gloucester Public Schools
Gregg Cademartori, Planning Director
Jen Holmgren, City Councilor
Jill Cahill, Community Development Director
Jim Destino, Chief Administrative Officer
Joseph Aiello, Gloucester Fire
Karin Caroll, Public Health Director
Ken Hecht, City Councilor
Ken Whittaker, Conservation Agent
Larry Durkin, Environmental Engineer
Micheal Hale, DPW Director
Paul Lundberg, City Councilor
Rachel Rex, Gloucester Public Schools
Scott Memhard, City Councilor
Sefatia Romeo Theken, Mayor
Thomas Ciarametaro Jr., Harbor Master
Valerie Gilman, City Councilor

Gloucester Board and/or Committee Members:

Beverly Bookin, Planning Board
Damon Cummings, Climate Resiliency Working Group Member
Dan Morris, Open Space & Recreation Committee
David Garner, Zoning Board of Appeals
Doug Cook, Planning Board
Francis Wright, Zoning Board of Appeals
Hank McCarl, Planning Board
Linda Brayton, Clean Energy Commission
Linda Stout-Saunders, Clean Energy Commission
Mark Ring, Fisheries Commission
Rob Gulla, Conservation Commission
Tony Gross, Waterways Board

Action, Inc.:

Jen Beloff
Peggy Stack

Bruce Tarr's Office:

Barry Pett

Coastal Zone Management:

Kathryn Glenn

Essex County Greenbelt:

Christ LaPointe

General Public:

Phil Cusumano

**Gloucester Harbor Community
Development Corporation:**

Rich Hersey

Gloucester Marine Genomics Institute:

Jennifer Hale

Harborlight Community Partners:

Andrew DeFranza

Lahey Hospital & Medical Center:

Geoffrey Thomas

Metropolitan Area Planning Council:

Sam Cleaves
Martin Pillsbury
Elise Harmon
Heidi Stucker
Ann Herbst

Massachusetts Audubon:

Jack Clarke
Liz Duff
Stephanie Covino

Northeast Seafood Coalition:

Vito Giacalone

UMass:

Katherine Kahl

United States Coast Guard:

Richard Klein

3.4 Recommended Report Citation

City of Gloucester (2018) Community Resilience Building Workshops Summary of Findings. Metropolitan Area Planning Council and the City of Gloucester.

Appendix A: Workshop Votes for Resiliency Recommendations.

1. Societal

- Look at updating zoning regulations for climate resiliency improvements
 - 25 Votes
- Develop evacuation planning – address isolation in neighborhoods during severe events
 - 17 Votes
- Update emergency action plan & system: develop communication strategies, focus on areas that will become isolated, address vulnerable populations, address schools air conditioning needs
 - 16 Votes
- Improve emergency communications systems
 - 7 Votes
- Storm water management assessment downtown
 - 2 Votes
- Partner with research institutions that help fisheries
 - 2 Votes
- Neighbor to neighbor communications systems, more use #'s on residences
 - 1 vote
- Focus on vulnerable pops: who, where, needs
 - 3 Votes
- Senior housing vulnerability & protecting
 - 0 Votes
- Small business disruption - marine & non-marine
 - 0 Votes

2. Infrastructure

- Address Waste Water Treatment and Pumping Stations
 - 23 Votes
- Address low-lying roads and bridges, major thorough fares
 - 17 Votes
- High School, Protect (Raise area)
 - 13 Votes
- Overall assessment of transportation needs
 - 2 Votes
- Update Council on Aging & school's backup generators
 - 6 Votes
- Air conditioning & heating updates in Gloucester low-income & public housing
 - 0 Votes

- Elevate buildings, zoning for
 - 2 Votes
- Fortify energy infrastructure, substations
 - 4 Votes

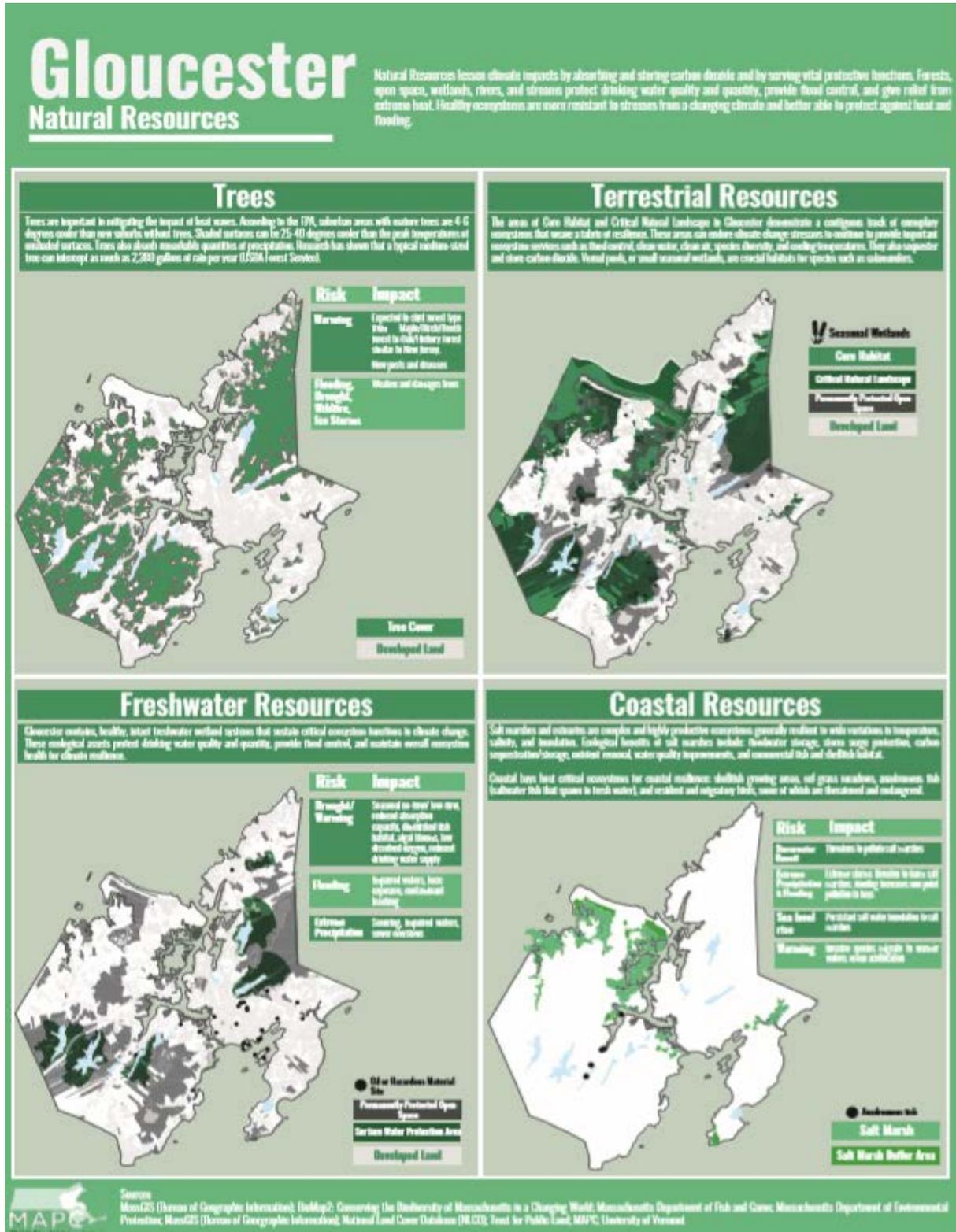
3. Environmental

- Forest and watershed management and protection
 - 19 Votes
- Beaches – habitat, endangered species (protect), dune management, work with property owners/educate
 - 17 Votes
- Streamline permitting
 - 10 Votes
- Zoning to re plan Wetlands & Marshes
 - 9 Votes
- Good Harbor Beach adaptation study
 - 5 Votes
- Protect & maintain forest & access
 - 2 Votes
- Marshes protect & mitigate damage
 - 1 Vote
- Mitigate salt water infiltration
 - 0 Votes
- Assessing drinking water supply
 - 2 Votes

Appendix B: Developed Workshop Materials

Please see the Department of Community Development’s website for full-detail images (B:1-4).

B-1: Gloucester’s Natural Resources



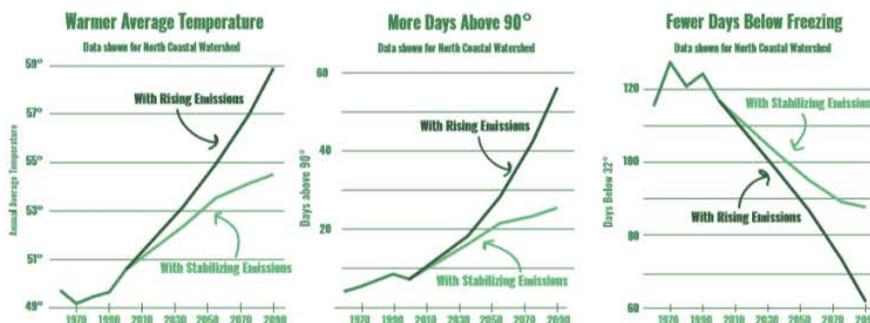
B-2: Climate Change Projections for Gloucester

Climate Change

Gloucester and the North Coastal Watershed

Our climate is regulated by "greenhouse gases (GHGs)" that trap heat, including carbon dioxide, methane, and nitrous oxide. In the past century, the combustion of fossil fuels, our primary energy source in the age of industrialization, has increased the concentration of GHGs in the atmosphere, which has caused global temperatures to rise. If people stabilize GHG emissions, global temperatures may rise more slowly. If emissions continue increasing at the same rate, we can expect more extreme changes in the climate.

Higher Temperatures



As the climate changes, Gloucester can expect...

More Large Storm Events

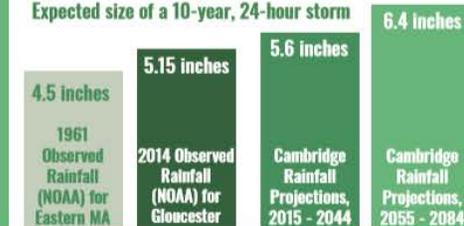
In addition to increasing annual precipitation, climate change will bring more large storm events.

This will lead to more stormwater flooding, as most stormwater drainage has been sized to 1961 standards.

10-year, 24 hour storms refer to the 24-hour rainfall total for the biggest storm expected in a 10-year period.

Storm drains built for 1961 standards will be inadequate

Expected size of a 10-year, 24-hour storm



More Annual Precipitation

But less in the summer and fall...



While total annual rainfall and large rainfall events are projected to increase, summer and fall rain is projected to decrease slightly.

And more frequent droughts...

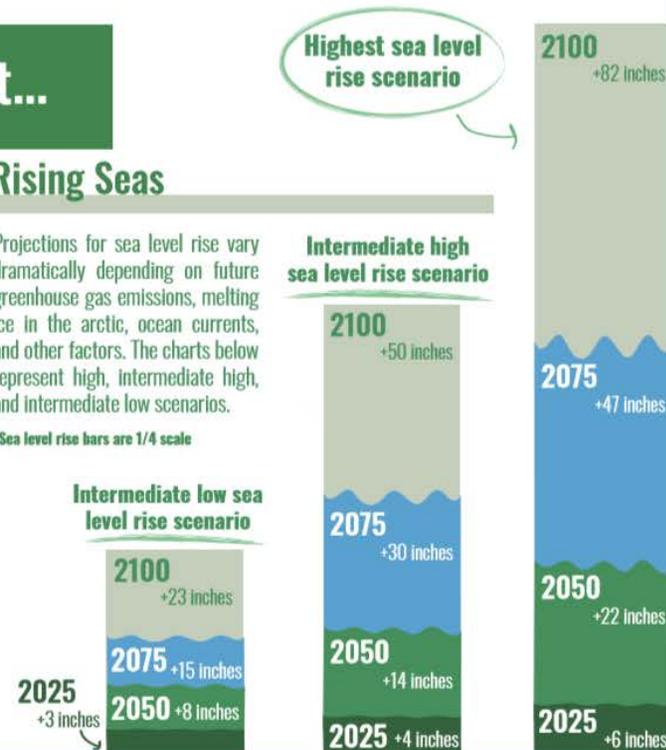
Due to the combined effects of earlier snowmelt, less rain, and higher temperatures, summer and fall droughts may become more frequent.



Rising Seas

Projections for sea level rise vary dramatically depending on future greenhouse gas emissions, melting ice in the arctic, ocean currents, and other factors. The charts below represent high, intermediate high, and intermediate low scenarios.

*Sea level rise bars are 1/4 scale



Sources: Massachusetts Executive Office of Energy and Environmental Affairs; Northeast Climate Science Center; National Ocean and Atmospheric Administration TP 40; National Ocean and Atmospheric Administration Atlas 14; Cambridge CCVA as cited by Boston Research Advisory Group 2016; Massachusetts Office of Coastal Zone Management, "Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning 2013"

B-3: Gloucester's Social Vulnerability

Gloucester Social Vulnerability

Social vulnerability refers to social, economic, demographic, or health factors that may make groups of people less resilient to climate change impacts. Certain vulnerabilities tend to be correlated; for example, older adults are more likely to have a disability and live alone than younger adults.

Our strategies for adapting to a changing climate should protect these populations in addition to our natural and built environment.

Who is most at risk from climate change impacts?

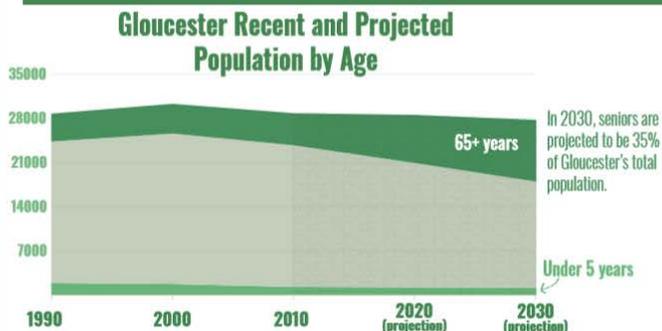
People who may be more susceptible to negative health effects: These can include older adults, young children, pregnant women, people with disabilities, and people with pre-existing health conditions, as they are more likely to be physically vulnerable to the health impacts of extreme heat and poor air quality caused by climate change. Individuals with physical mobility constraints, such as people with disabilities and seniors, may need additional assistance with emergency response.

People who may have more difficulty adapting to, preparing for, or recovering from extreme weather events: Socioeconomic characteristics such as income and race can influence vulnerability to climate change. Low-income people are often more susceptible to financial shocks, which can occur after extreme weather and which can impact financial security and the ability to secure safe shelter and meet medical needs. Social isolation can also influence vulnerability, as it limits access to critical information, municipal resources, and social support systems. People at the most risk for social isolation include those living alone and people with limited English language proficiency.

People who live or work in vulnerable locations: Historic or predicted floodplain, urban flooding locations, areas prone to wildfire, heat islands, neighborhoods prone to power outages. Outdoor workers, first responders, those working in hot indoor environments.

Older Adults and Young Children

Adults over 65 and children under 5 are more likely to develop health problems on very hot days or during heat waves. Older adults are also more likely to have disabilities or mobility constraints and may need additional assistance during emergencies. They are also more likely to live alone than younger adults.



People Who Work Outside

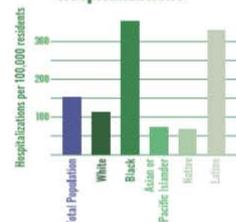


People who primarily work outside, such as parcel delivery people, construction workers, or farmers, may be at added risk from extra exposure to high heat and poor air quality.

People with Health Conditions

People who are already in poor health are more likely to be harmed by hot weather and resulting poor air quality.

Massachusetts Asthma Hospitalizations



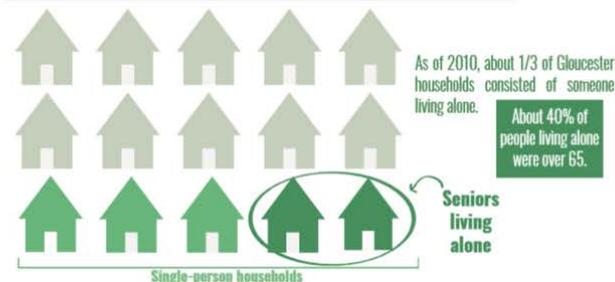
Low Income Households

Households that earn low incomes are more susceptible to financial shocks triggered by extreme weather, which can cause long-lasting financial insecurity and can make it hard to secure safe shelter, sufficient food, and medical care.

48% ± 4%
Households in Gloucester that are low-income

*A four-person household earning less than \$78,150 is considered low-income

People Living Alone



Communities of Color

Particular racial or ethnic groups may also be more likely to have certain social vulnerabilities than others. For example, Black and Latino populations have a much higher rate of asthma hospitalizations than other groups.

Gloucester is becoming more diverse...

Although over 94% of the town's population is white...

3x Populations of color have increased since 1990.

3x African American population increase since 1990

3x Latino population increase since 1990

4x Asian population increase since 1990



Sources: American Community Survey (ACS) 2012-2016; United States Census 1990, 2000, 2010; MAPC Projections; Massachusetts Department of Public Health Asthma Data, 2008-2012

B-4: Gloucester's Critical Infrastructure and Hazard Area

GLOUCESTER

Critical Infrastructure

Increasing large rainfall events and the rising sea level may subject roads, bridges, dams and buildings to more frequent or severe flooding. Areas that don't flood today may become vulnerable. FEMA flood zones reflect only current conditions, and do not generally capture stormwater flooding, or flooding that exceeds the capacity of current stormdrains and culverts. Power outages affecting infrastructure and communications may become more frequent as result of high energy demand during heat waves. Winter outages could be caused by ice storms if warming results in temperatures hovering around freezing. The potential for more intense hurricanes could cause outages due to falling trees. Finally, buildings, roadways, and railways can be stressed by extreme heat. Heat can cause damage to expansion joints on bridges and highways, and may cause roadways to deteriorate more rapidly.

Type of Critical Facility

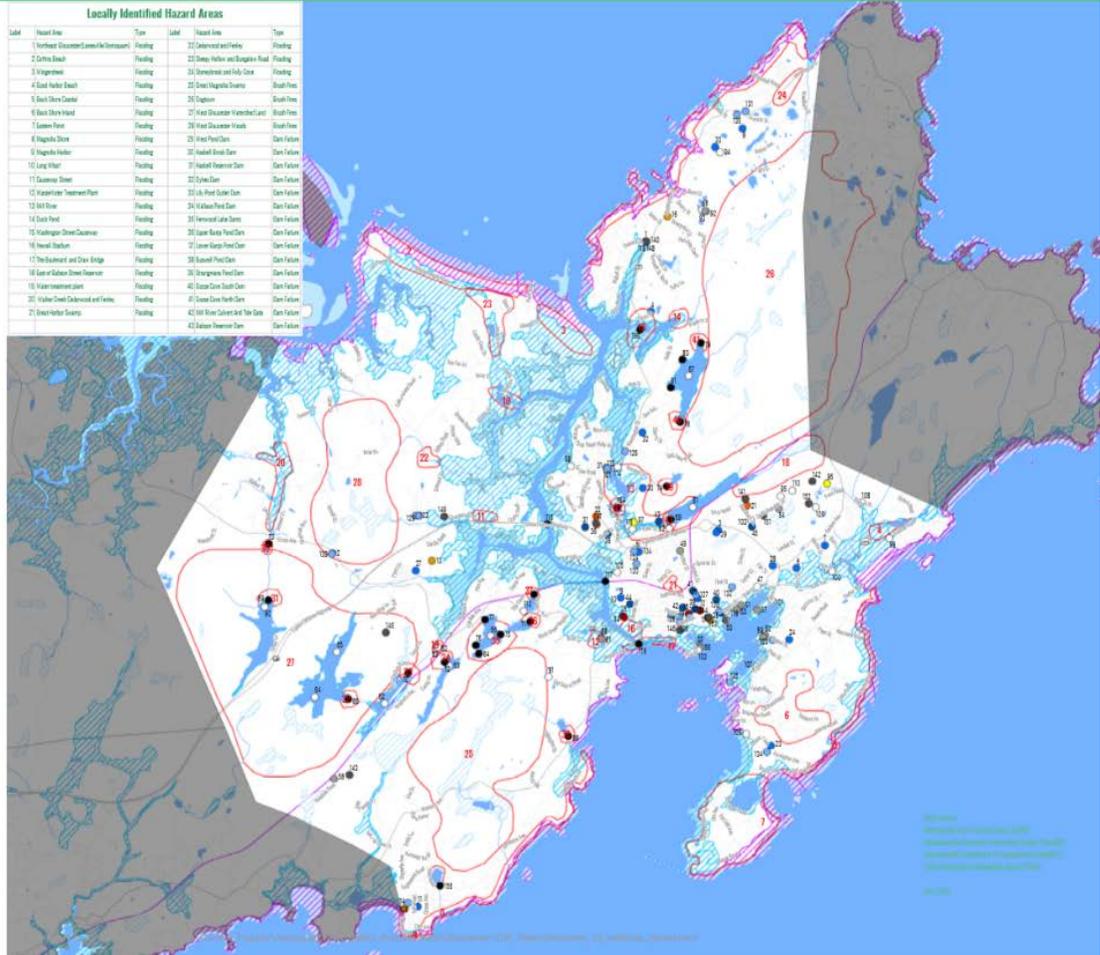
- Elder Care or Adult Day Care
- Child Care or School
- Church
- Emergency Operations
- Medical Facility
- Public Safety
- Municipal
- Bridge or Dam
- Communication Tower
- Hazardous Material Site
- Power Substation
- Water or Sewer Infrastructure

Hazards

- ⊕ A: 1% Annual Chance of Flooding
- ⊕ VE: High Risk Coastal Area
- ⊕ X: 0.2% Annual Chance of Flooding
- ▭ Locally Identified Hazard Areas

Label	Hazard Area	Type	Label	Hazard Area	Type
1	Northeast Gloucester (Lanes/Chickenshead)	Flooding	22	Delaware and White	Flooding
2	Centre Beach	Flooding	23	Deep Harbor and Douglas Road	Flooding
3	Village Green	Flooding	24	Greenwood and Holy Cross	Flooding
4	East Harbor Beach	Flooding	25	Great Village Swamp	Beach Erosion
5	East Shore Central	Flooding	26	Highway	Beach Erosion
6	East Shore West	Flooding	27	West Gloucester (Industrial/Land)	Beach Erosion
7	Green Point	Flooding	28	West Gloucester Woods	Beach Erosion
8	Hopkinton Brook	Flooding	29	West Point Dam	Dam Failure
9	Hopkinton Harbor	Flooding	30	West Point Dam	Dam Failure
10	Long Wharf	Flooding	31	West Point Dam	Dam Failure
11	Quincy Street	Flooding	32	West Point Dam	Dam Failure
12	Walden Treatment Plant	Flooding	33	West Point Dam	Dam Failure
13	Mill Street	Flooding	34	West Point Dam	Dam Failure
14	Dark Pond	Flooding	35	West Point Dam	Dam Failure
15	Walden Street/Quincy	Flooding	36	West Point Dam	Dam Failure
16	Newell Station	Flooding	37	Lower George Pond Dam	Dam Failure
17	The Boatyard and Draw Bridge	Flooding	38	Lower Pond Dam	Dam Failure
18	East of Gloucester Dam (Reservoir)	Flooding	39	Longfellow Pond Dam	Dam Failure
19	Walden Reservoir Dam	Flooding	40	Lower Pond Dam	Dam Failure
20	Upper South Oldwell and White	Flooding	41	Lower Pond Dam	Dam Failure
21	Deep Harbor Swamp	Flooding	42	Mill River Dam and Top Dam	Dam Failure
			43	Quincy Treatment Dam	Dam Failure

Name	Address	Latitude	Longitude
Gloucester High School	100 North Street	42.6188	-70.9211
Gloucester Middle School	100 North Street	42.6188	-70.9211
Gloucester Elementary School	100 North Street	42.6188	-70.9211
Gloucester Church	100 North Street	42.6188	-70.9211
Gloucester Hospital	100 North Street	42.6188	-70.9211
Gloucester Fire Station	100 North Street	42.6188	-70.9211
Gloucester Police Station	100 North Street	42.6188	-70.9211
Gloucester Town Office	100 North Street	42.6188	-70.9211
Gloucester Library	100 North Street	42.6188	-70.9211
Gloucester Senior Center	100 North Street	42.6188	-70.9211
Gloucester Child Care	100 North Street	42.6188	-70.9211
Gloucester Power Substation	100 North Street	42.6188	-70.9211
Gloucester Water Treatment Plant	100 North Street	42.6188	-70.9211
Gloucester Sewer Treatment Plant	100 North Street	42.6188	-70.9211
Gloucester Emergency Operations Center	100 North Street	42.6188	-70.9211
Gloucester Hazardous Material Site	100 North Street	42.6188	-70.9211
Gloucester Communication Tower	100 North Street	42.6188	-70.9211
Gloucester Bridge	100 North Street	42.6188	-70.9211
Gloucester Dam	100 North Street	42.6188	-70.9211
Gloucester Water or Sewer Infrastructure	100 North Street	42.6188	-70.9211



B-5: Workshop Agenda



City of Gloucester Municipal Vulnerability Preparedness Workshop

Thursday, April 12, 2018

8:30 am-2:30 pm

Gloucester City Hall

AGENDA

The Massachusetts **Municipal Vulnerability Preparedness Program** provides support for cities and towns in Massachusetts to plan for climate resiliency and prepare immediate action steps.

TIME	ACTIVITIES	WHO
8:30 AM	Registration and Refreshments	
9:00 AM	Welcome	Mayor Sefatia Romeo Theken
9:10 AM (10 mins)	Introductions & Overview of the Workshop	Sam Cleaves, MAPC
9:20 AM (40 mins)	Overview Presentation on Science, Past Planning Efforts and Outcomes, and Data Resources Q & A / Large Group Discussion	Sam Cleaves
10:00 AM (10 mins)	Instructions & Small Groups Work	
10:10 AM (50 min total: 5 min intros; 15 min/feature)	Small Group Exercise #1 Review Vulnerabilities and Strengths for Infrastructure, Societal, and Environmental Features	Small groups & MAPC facilitators Martin Pillsbury, Elise Harmon, Heidi Stucker, Ann Herbst, Sam Cleaves
11:00 AM	5 MINUTE BREAK	
11:05 AM (75 min total: 25 min/feature)	Small Group Exercise #2 Identify Community Actions to address vulnerabilities or protect strengths of Infrastructure, Societal, and Environmental Features Determine Top 3 Priority Actions for Each Feature	Small groups & MAPC facilitators
12:20 PM (40 mins)	LUNCH	
1:00 PM (30 mins)	Large Group Reconvenes Small Group Spokesperson Reports Top Priority Actions	Sam Cleaves & spokespersons
1:30 PM (45 mins)	Large Group Activity & Discussion Determine Overall Priority Actions (sticky dot activity) Top 3 Actions for Municipal Climate Resilience	Sam Cleaves & facilitators
2:15PM (15 mins)	Closing Remarks & Next Steps How will Gloucester use the recommendations/outcomes from the MVP/Hazard Mitigation workshop?	Sam Cleaves
2:30 PM	Adjourn	

