City of Marlborough
Community Resilience Building Workshop
Summary of Findings
February 7, 2019

Municipal Vulnerability Preparedness Program
Summary of Findings

OVERVIEW

Recent years have seen notable weather extremes in Marlborough. The winter of 2015 brought record-breaking snow, resulting in delays and shutdowns in MBTA service. The following year, Marlborough was under a drought warning from August to November 2016. The winter of 2018 once again brought severe winter storms with a succession of four nor'easters pummeling the City in March. In March 2010 rainfall was so significant that a federal disaster was declared for eastern Massachusetts, resulting in $59 million in assistance to individual households and $26 million in reimbursements to the state and municipalities. Globally, the years 2012 through 2017 all rank among the ten hottest on record.

In 2017, the Commonwealth of Massachusetts inaugurated the Municipal Vulnerability Preparedness (MVP) program to assist municipalities in planning for and implementing strategies to adapt to predicted changes in our warming climate. The predicted changes include both increased flooding from large rain events and a greater likelihood of drought, increased extreme heat days and heat waves, and increased flooding from sea level rise.

The City of Marlborough, seeking to be proactive in addressing future climate threats, applied for a state grant to complete the Community Resilience Building (CRB) Workshop under the MVP. Upon completion of the plan and certification by the MVP program, the City of Marlborough will be eligible to apply for MVP action grants to address identified natural hazards and climate risks.

The City of Marlborough partnered with the Metropolitan Area Planning Council (MAPC) to complete the MVP. The MVP Core Planning Team identified and recruited community stakeholders to participate in the one-day CRB Workshop. Twenty-seven people representing Marlborough City staff, members of Marlborough Boards and Commissions, and representatives of Marlborough community organizations gathered on February 7. (See Workshop Participants page 8). The Workshop's central objectives were to:

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

Materials provided for the workshop included local and regional data for changes in temperature, precipitation, and sea level recorded to date, as well as future projections to the end of the century. Posters provided data and mapping specific to Marlborough infrastructure, demographics, and natural resources (see Appendix).

The participants considered Marlborough's strengths and vulnerabilities focusing on infrastructure, society, and the environment. Working in small groups and then together as a large group they prioritized actions designed to increase Marlborough's resilience to future extreme weather events.

Top Hazards and Vulnerable Areas

The Core Planning Team identified the top climate hazards facing Marlborough. Based on the review of workshop materials, the team identified flooding, heat waves, severe storms (wind, snow, ice) and drought as the climate hazards of greatest concern facing Marlborough. Flooding, drought, and severe storms have all affected Marlborough in recent years. City demographics, and the heat and tree canopy mapping pointed to extreme heat as an additional key concern.

Top Hazards

- Flooding
- Severe Storms (wind, snow, ice)
- Drought
- Extreme Heat
-

Current Concerns and Challenges Presented By Hazards

Participants and City officials noted the increasing frequency and intensity of storms, including nor'easters that brought damaging winds and snowfall, heavy rain events, and the recent period of drought. The principal challenges from nor'easters are the threat of power outages and, secondarily, difficulty clearing snow. Heavy rains result in flooding when local streams as well as locations where stormwater drainage capacity is exceeded. The status and capacity of Fort Meadow Dam and private dams are a concern, as is the location of the water treatment plant within a floodplain area. The recent drought sparked questions about backup water supplies as well as concerns about heat impact, emergency climate events and response, and local access to

food for some Marlborough residents. As these issues are not new, the City of Marlborough through its emergency management activities and past hazard mitigation planning, has taken many steps to prepare for extreme weather and prevent harm to people and property. Workshop participants shared concerns that climate projections will heighten current challenges and elevate new concerns.

AREAS OF CONCERN

Geographic:

Participants showed concern about dam safety in light of more severe precipitation events experienced under climate change. According to data provided by the Massachusetts Department of Conservation and Recreation and the City, there are four dams located in Marlborough. The Tyler Street Dam and the Lake Williams Dam and Spillway are owned by the MA DCR and are classified as high hazard dams. The Hager Dam is privately owned and is classified as a high hazard dam by DCR. Lake Williams Dam and Spillway are owned by the City and is classified as a high hazard dam. DCR defines high hazard dams as those "located where failure or mis-operation will likely cause loss of life and serious damage to homes(s), industrial or commercial facilities, important public utilities, main highways(s) or railroad(s).[1] Also noted was the location of one of the City's water treatment facilities within a floodplain area.

High heat areas shown in orange on the Natural Resources map (see Appendix) were identified as a concern. The areas are included in the hottest 5% of land area in MAPC's 101-City region. They were identified using thermal satellite imagery. As the map makes clear, these areas have relatively less tree cover. They tend to have more pavement and dark roofs. The majority of these areas are located in eastern part of the City along Route 20.

City woodlands were felt to be more vulnerable to brush fires as high winds, invasive species and increased temperatures have left more brush and dead trees available for potential fires.

[1] 2016 Marlborough Natural Hazard Mitigation Plan, pg. 23

Societal:
Populations identified include: seniors and seniors who live alone, non-English speaking communities, low-income residents, renters, and people with health problems or disabilities. Also noted were populations living in nursing homes, residential facilities, senior housing and public housing. Participants were particularly concerned with barriers to emergency communication, and recognized that some residents have fewer resources to prepare for, endure, and recover from, severe weather events. Access to reliable and healthy food sources for many of the same populations was also a concern. Overall, the need for better communication on climate change preparation and emergency response between local, state and federal official and those populations with limited awareness or constrained access to information and resources was stressed.

Environmental:
Better management of both forest and the preservation/acquisition of open space to help mitigate the effects of climate change, particularly near areas prone to flooding or high heat were noted concerns. Participants noted the need for improvement in both reducing the amount of salt entering the City's water supply and the need for better stormwater management and prevention, as well as heat island prevention. The need to update zoning to better protect critical remaining open space areas such a wetlands, floodplains, farms, subdivisions or redevelopment areas was a concern.

Infrastructure:
The need to update or replace one of the City's fire stations on the west side of the City was highlighted as was the need to protect one of the City's water treatment plant facilities from flooding. The Maple Street and Boundary Street drainage infrastructure needs to be improved to prevent flooding and there was concern about private drainage detentions not being maintained properly and being more prone to flooding. Participants stressed the need to look and plan for the overall water system-supply, treatment, waste water, storm water and infrastructure in an integrated fashion to ensure long-lasting safe operation.

Locations without generators or sufficient backup power were highlighted. City facilities identified included: City pump stations, water and waste water treatment plants, nursing homes, Senior Center and hospital if needed.

Other locations noted were: senior housing, assisted living and other group residential facilities, and gas stations. As noted above, the dams and downstream locations were also a key concern.

CURRENT STRENGTHS AND ASSETS

Workshop participants identified numerous Marlborough strengths and assets that will support resilience to future climate impacts.

- Current emergency plan and clear evacuation routes to Route 495 and Rte. 20 and signage
- Marlborough Hospital is located on high ground in City and is part of the City's Comprehensive Emergency Management Plan
- The City has a strong inventory of critical facilities, equipment, City staff, leadership, strong collaboration across departments, community organizations and emergency planning capacity
- Neither Police or Fire Departments are located in areas prone to flooding
- The City has backup generating capacity for sewer pump stations, waste water treatment plant, MWRA facilities, city hall and fire department
- Marlborough has a trail/rail trail system
- Marlborough has a fleet of new buses and COA shuttles in good condition available for emergency use
- Marlborough has strong public health programs
- Elder housing is not located in a flood prone area
- The City maintains a homeless shelter
- Marlborough conducts proscribed burns to reduce the threat of brush and forest fires
- The City has a backup water supply
- Marlborough has a Forestry Department
- The City uses social media and Reverse 911 extensively to communicate with residents
- There are extensive areas of protected wetlands and buffer zones in the City
- There is a new, LEED certified public library
- There are several strong NGO organizations serving the community
- A corporate CHP system with backup power exists
- There is a local food pantry

Top Actions to Improve Resilience

Each of the four workshop groups identified vulnerabilities and suggested solutions. There was considerable overlap between the elements suggested actions. Each group then identified their three highest priorities for each of the three categories, which were reported out to the larger group and recorded by MAPC. Participants then voted for the top action in each of the three categories using sticky dots. See Appendix A to for final results.

Top Actions

Environmental

Update zoning and building codes: Local rules and the state building code should be updated to incentivize for clean energy and best energy efficient building practices.

Open Space: Maintain existing open space areas and prioritize future open space areas in climate vulnerable areas; help limit climate change impacts to surrounding areas by increasing the use of open space as a buffer against the effects of flooding, extreme heat, and lack of wildlife habitat.

Forestry Management- Additional funding should be directed towards City forestry management, tree planting, pest control and overall health maintenance.

Social

Zoning Review and Update: Focus on reviewing and amending zoning to protect against negative impacts to wetlands and floodplains. Review and amend zoning for housing, particularly for any housing in a low-lying or flood prone areas.

Communications Plan: Draft a climate change preparation and emergency evacuation and action plan with sections dealing with internal communication by City departments as well a multi-media community-based preparation and action plan that includes getting the word out to non-English speaking residents and other vulnerable populations such as seniors, assisted living, low income, homeless shelters, and those without landlines- in multiple formats.

Food Access: Identify vulnerable populations (seniors, low income, those without landlines, immigrants, people who don't speak English) who may not be getting full access to local food pantries and help provide information about and assistance in access to these food resources. Consider establishing mobile food pantry services.

Infrastructure

Utilities Plan- Coordinate with gas, electric and communications utilities on actions needed to improve local utility resilience in light of climate change; develop emergency preparation and action responses prior to the occurrence of extreme climate events.

Water Infrastructure- Conduct a comprehensive review of the City's water supply, water delivery, sewer and storm drain infrastructure(including roadways) for climate resilience improvements, examining back up water resources to the current MWRA/Milham Reservoir water supplies, determining whether a water supply feasibility study is needed, improving and increasing adherence to existing and future stormwater regulations, incorporating Green Infrastructure policies and regulations, and addressing fixes to outdated stormwater drainage structures to the greatest degree possible.

Fire Protection- Upgrade the West Side Fire Station.

Other Highly Ranked Actions

- Investigate and address adequacy of backup generators for City pump stations, water and waste water treatment plants, nursing homes, Senior Center and hospital if needed. Provide backup power so seniors are not displaced in an emergency.
- Senior housing does not have generators. Five locations identified. Provide backup power so seniors are not displaced in an emergency.
- Increase overall communications between City n department and boards with non-English speaking residents, with a particular focus on Brazilian residents at churches, social clubs and using social media; focus on getting people signed up for Reverse 911 outreach.
- Provide information on the correct use of salt for de-icing to area businesses and residents to decrease salt in water supply sources.
- Work to improve power grid protection by increasing tree-trimming and dead tree removal from around electric power lines and other utility areas. This could also be part of the Utilities Plan noted above.
- Address flooding within the Maple Street and Boundary Street areas with upgrades to municipal storm drain infrastructure; this could also be part of the Water Infrastructure priority noted above.
- Protect the Westerly Waste Water Treatment Plant from flooding; this could also be part of the Water Infrastructure priority noted above.
- Increase immediate improved compliance with existing stormwater management regulations.
- Increase maintenance of drainage detention basins; reach out to basins owned/operated by homeowners associations if basins are not being properly maintained.
- Consider increasing shade tree requirements for parking and landscaping regulations; research adopting a City tree preservation ordinance.
- Consider expanding current wetland buffer zones to increase flood storage capacity and stormwater infiltration.
- Map City paved area hot spots and have discussions with City leadership about how to address heat related issues.
- Identify the lead manager for Emergency Management and help the public become aware of that person and how to contact her or him.
- Identify how many commuters come to Marlborough each day and how their needs would be addressed under an emergency management plan. Investigate multi-modal commuting possibilities and provide incentives for transit, ride sharing and bikes/scooters.

Other Actions

- Ensure maintenance of all existing public and private dams; incorporate projected increase in storms and precipitation intensity as part of maintenance schedule, updating every 5-10 years.
- Introduce climate resilience training into school curriculums.
- Continue to maintain and improve the City trail and rail trail system.
- Maintain and increase public cooling areas such as beach areas, swimming pools, wading pools and splash pools.
- Incentivize water conservation measures such as rain barrel use.
- Establish a plan for backing up City IT resources.
- Research establishing mutual aid compacts with neighboring communities on climate resilience actions and make the public aware of progress and agreements.
- Make climate resilience understanding and preparation part of the City Health Department's ongoing mission.
- Investigate options to make City-owned buildings more energy efficient to reduce electrical loads and become more independent.
- Research adding Green Infrastructure and solar parking canopy at UMass Memorial Hospital.
- Pursue LEED certification, back-up power generation and space for a solar installation for the new public library.
- Explore increasing multi-modal transportation opportunities- especially new bike lanes and safety measures- and access to the Southborough commuter rail line.
- Maintain current bus shuttle system and incorporate measures for emergency climate events.
- Obtain more cots for City emergency shelter.
- Continue to monitor City drinking water reservoirs.
- Assure incentives to maintain farmland.
- Maintain Route 495 viability and access during emergency events by continuing the public/private 495 Partnership group and maintaining access to data.
- Engage with Marlborough shopping malls about increasing shade in parking lots and incorporating solar parking canopies.
- Affordable housing-provide climate risk and vulnerability in housing plans and projects

3/25/16 Listening Session summary

Approximately fifteen members of the public attended the Marlborough MVP Listening Session held at City Hall on March 26, 2019. Marlborough staff outlined the MVP process, described expected climate change impacts to the City, and reviewed the prioritized climate change actions generated by participants at the 2/7/19 Marlborough MVP workshop. Participants were then given a chance to ask questions, review posted Marlborough climate maps and posters as well the climate resilience actions generated at the 2-7-19 workshop. They then placed dots on their top three climate resilience actions. From the 2-7 workshop prioritized actions, a comprehensive review of water infrastructure gained the most support, followed by equal support for updating zoning and building codes to incentivize for clean energy, and maintaining and prioritizing

additional open space. Forestry management, zoning review and update of wetlands and floodplains regulations, developing a communications plan, increasing food access, creating a utilities plan and upgrading the West Side Fire Station all received limited support. Other highly ranked actions from the workshop that received support included ensuring that all senior housing facilities and City sewer pump stations have back-up electrical generators, increasing overall communications between City staff and non-English speakers, providing more information on the correct use of road salt near water supply sources, increasing shade tree requirements for parking and landscape regulations, increasing public awareness of emergency management leadership and how to reach them. A new action was also added at the Listening Session: finding ways for the City to incentivize climate-friendly behavior by offering rebates on taxes and fees.

CRB WORKSHOP PARTICIPANTS

City of Marlborough - MVP Workshop 2-7-19

TABLE #			
Public Safety			
1	Asst. Fire Chief	Fred Flynn	215 Maple Street
3	Emergency Management	Eric Williams	
Elected Officials			
4	Mayor's Exec. Aide	Nick Milano	140 Main Street
City Officials			
3	Police Chief	David Giorgi	355 Bolton Street
1	Building Commissioner	Jeffey Cooke	140 Main Street
3	Library Director	Margaret Cardello	35 West Main Street
Utilities			
3	City of Marlborough	John Murphy	135 Neil Street
4	City of Marlborough	Ted Scott	135 Neil Street
2	City of Marlborough	Tom DiPersio	135 Neil Street
2	National Grid	Robert Moran, Jr.	245 South Main Street
Building and Housing			
4	The Campus at Marlborough	Jim Green	100 Campus Drive
1	Hancock Associates	Joe Peznola	315 Elm Street

Community and Economic Developer			
1	MEDC Director	Meredith Harris	91 Main Street
4	Dow	Paul Connor	455 Forest St.
3	Boston Scientific*	Jennifer Veilleux	300 Boston Scientific Way
3	Boston Scientific*	Timothy Nelson	30o Boston Scientific Way
3	GE Health	Cynthia Blais	100 Results Way
Environmental			
4	Conservation Agent	Priscilla Ryder	140 Main Street
1	OARS - Executive Director	Alison Field-Juma	23 Bradford Street
Planning			
4	Planning Board - Chair	Dr. Barbara Fenby	1 Cullinane Drive
2	Local Emergency Planning	Craig Bernier	250 Campus Drive
Parks, Recreation and Cultural			
1	Recreation Director	Chuck Thebado	239 Concord Road
2	Recreation	Zach Lambert	239 Concord Road
2	Historical Commission	Bob Fagone	135 Neil Street
Human and Social Services			
2	Council on Aging - Director	Trish Pope	40 New Street
3	Director Board of Health	Cathleen Liberty	140 Main Street
1	Public Health Nurse	Patty Moran	140 Main Street

CRB Workshop Project Team

Marlborough Core Team

Tom DiPersio	Engineering, Project Lead
Krista Holmi	Engineering, Primary Contact
John Murphy	Engineering
Tim Cousins	Engineering
Ted Scott	DPW
Kevin J. Breen	Fire
Priscilla Ryder	Conservation
Cathleen Liberty	Public Health

Facilitation Team

Sam Cleaves	Metropolitan Area Planning Council (Lead Facilitator)
Martin Pillsbury	Metropolitan Area Planning Council
Elise Harmon	Metropolitan Area Planning Council
Iolando Spinola	Metropolitan Area Planning Council
Sasha Shyduroff	Metropolitan Area Planning Council

Citation

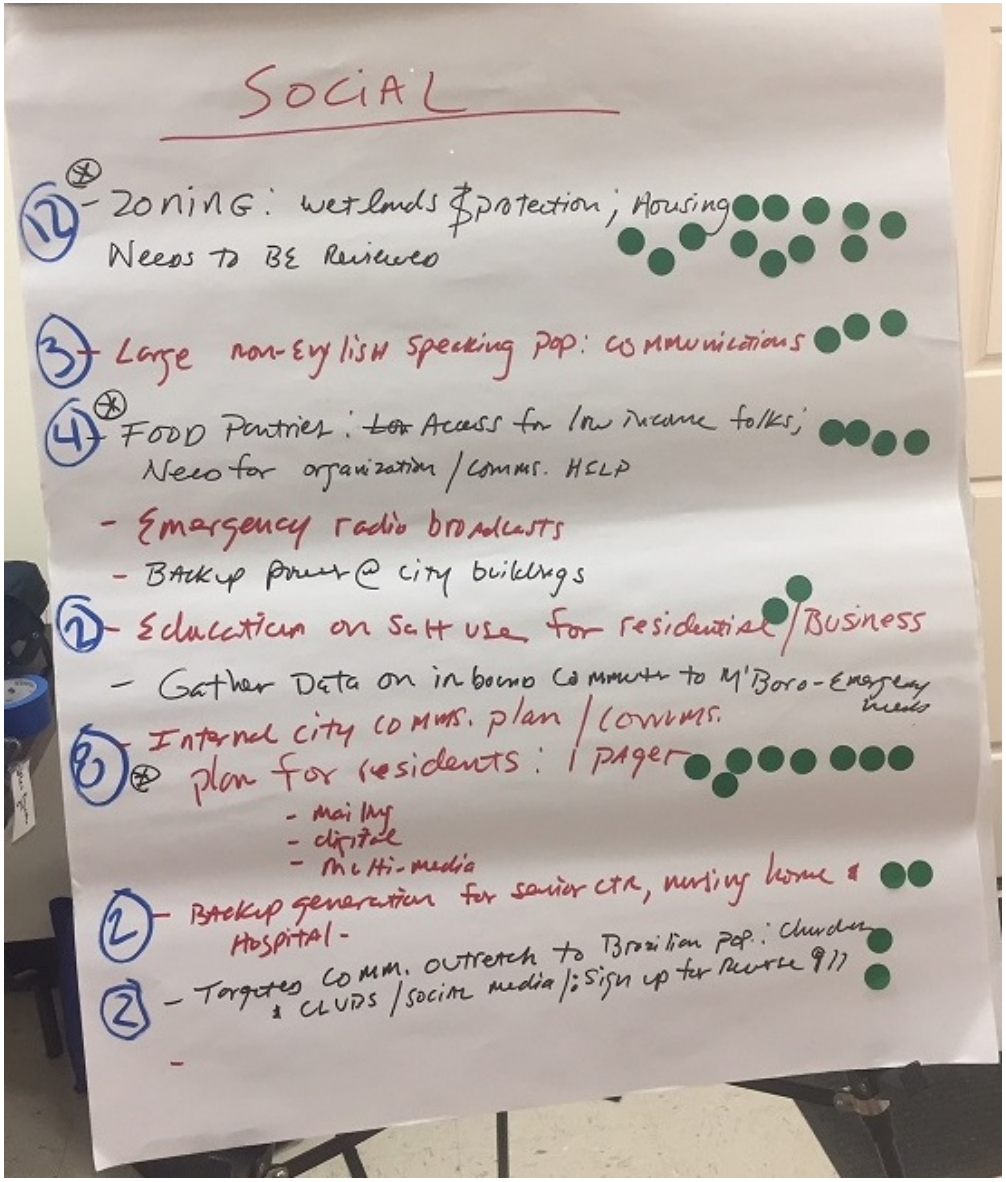
Metropolitan Area Planning Council. 2019. City of Marlborough Municipal Vulnerability Preparedness Program. Community Resilience Building Workshop Summary of Findings. Marlborough, Massachusetts

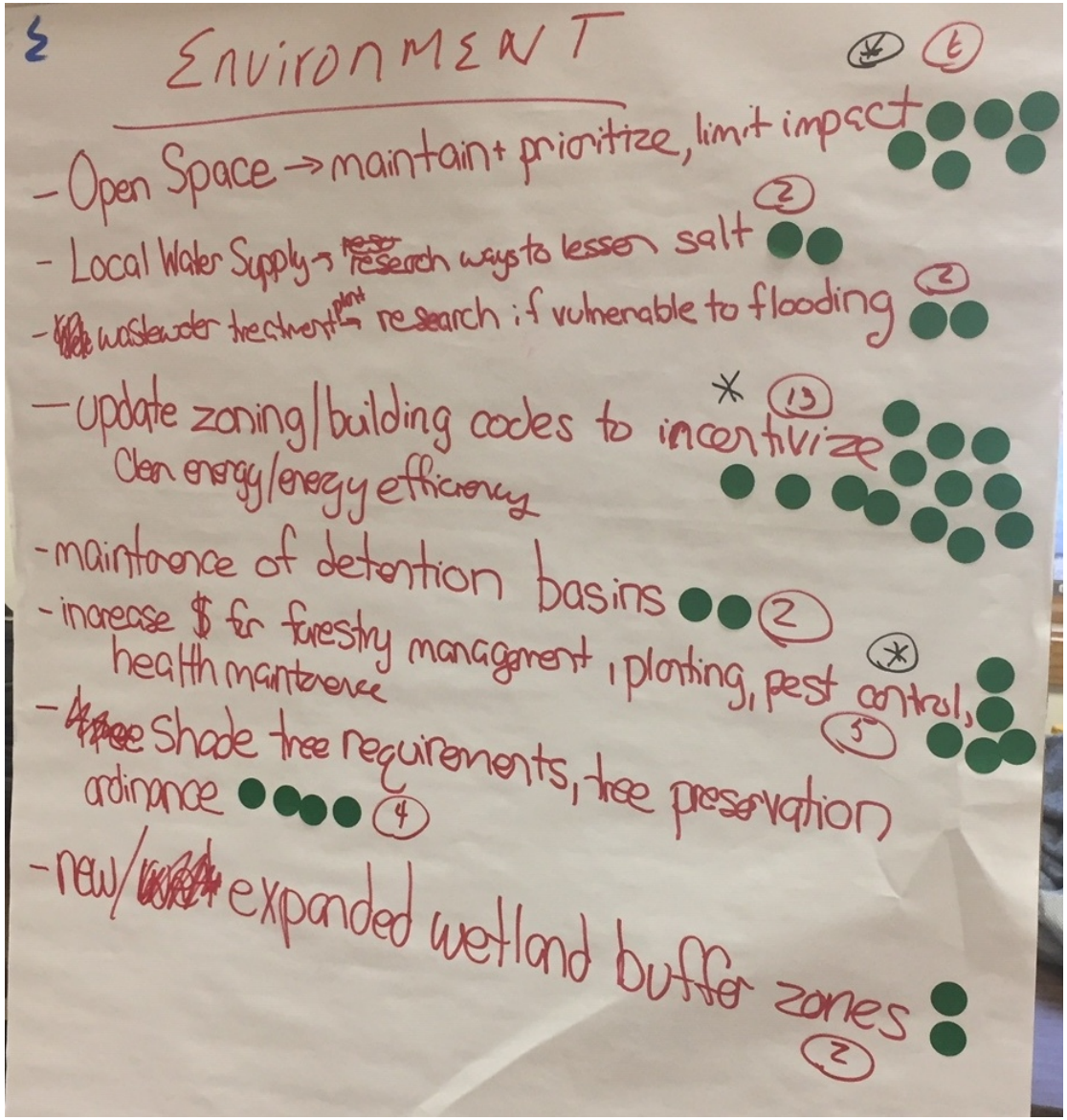
Acknowledgements

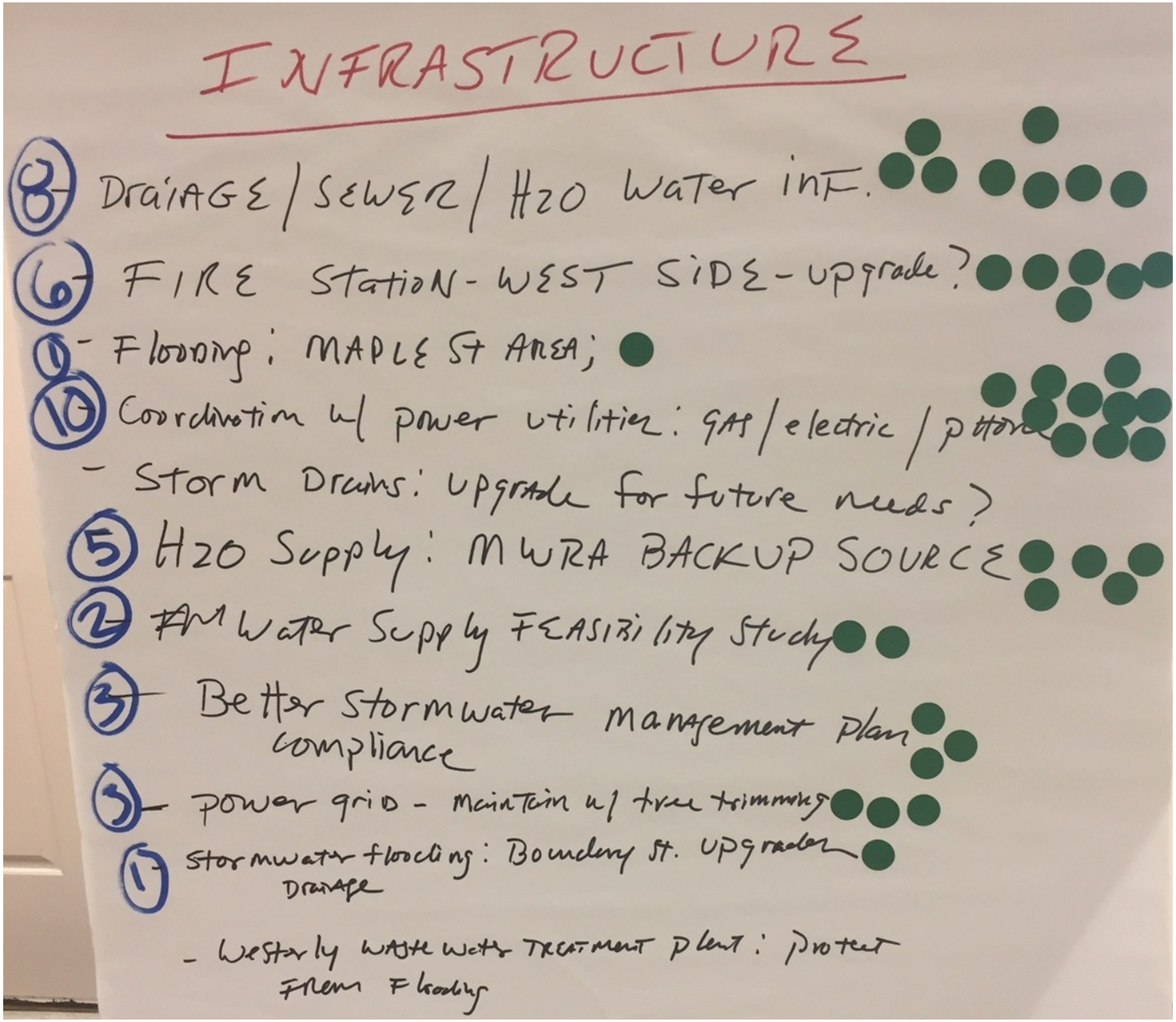
Thanks to the MVP Core Team members, CRB workshop participants, and to Krista Holmi, Tom DiPersio from the Engineering Department who served as local Project Coordinators. Thank you to Tom DiPersio for addressing the workshop. Funding for the CRB Workshop was provided by the Commonwealth of Massachusetts through a grant from the Municipal Vulnerability Preparedness program.

Appendix A – Action Prioritization, Base Map, and Workshop Materials

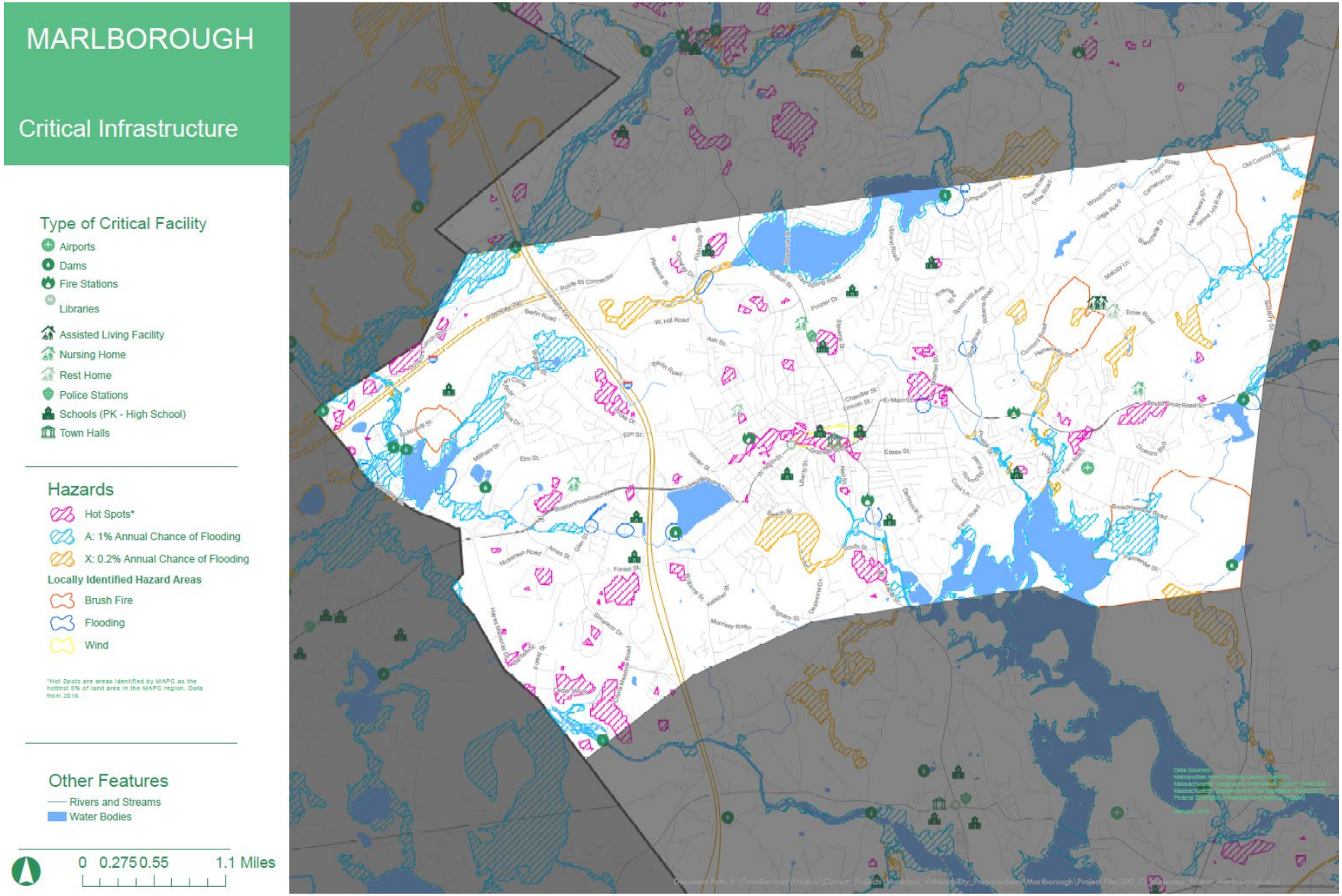
Action Prioritization



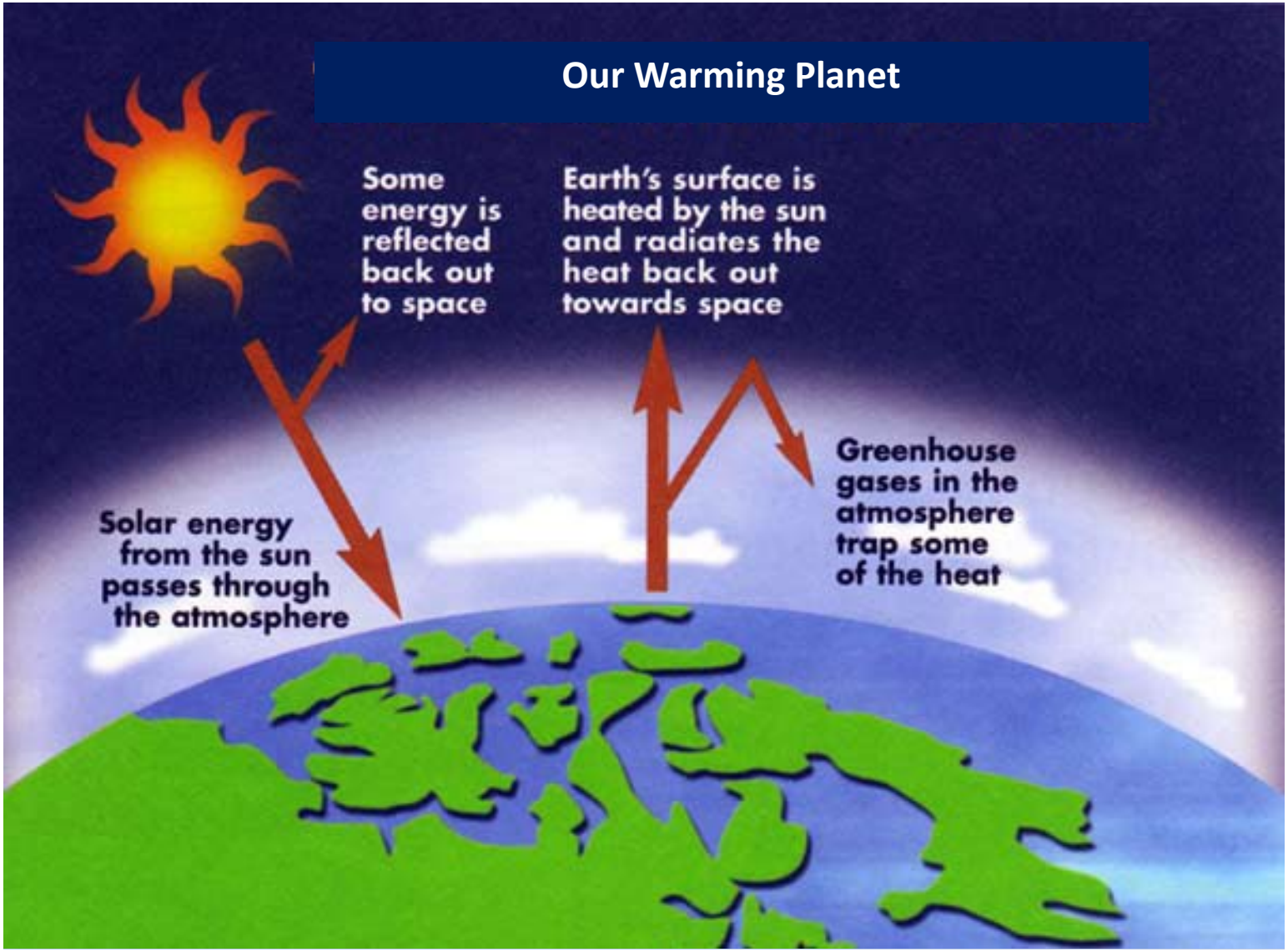

ENVIRONMENT
- Open Space → maintain + prioritize, limit impact
- Local Water Supply → research ways to lessen salt
- wastewater treatment plant research if vulnerable to flooding
- update zoning/building codes to incentivize Clean energy/energy efficiency
- maintenance of detention basins
- increase $ for forestry management, planting, pest control, health maintenance
- Shade tree requirements, tree preservation ordinance
- new/ expanded wetland buffer zones

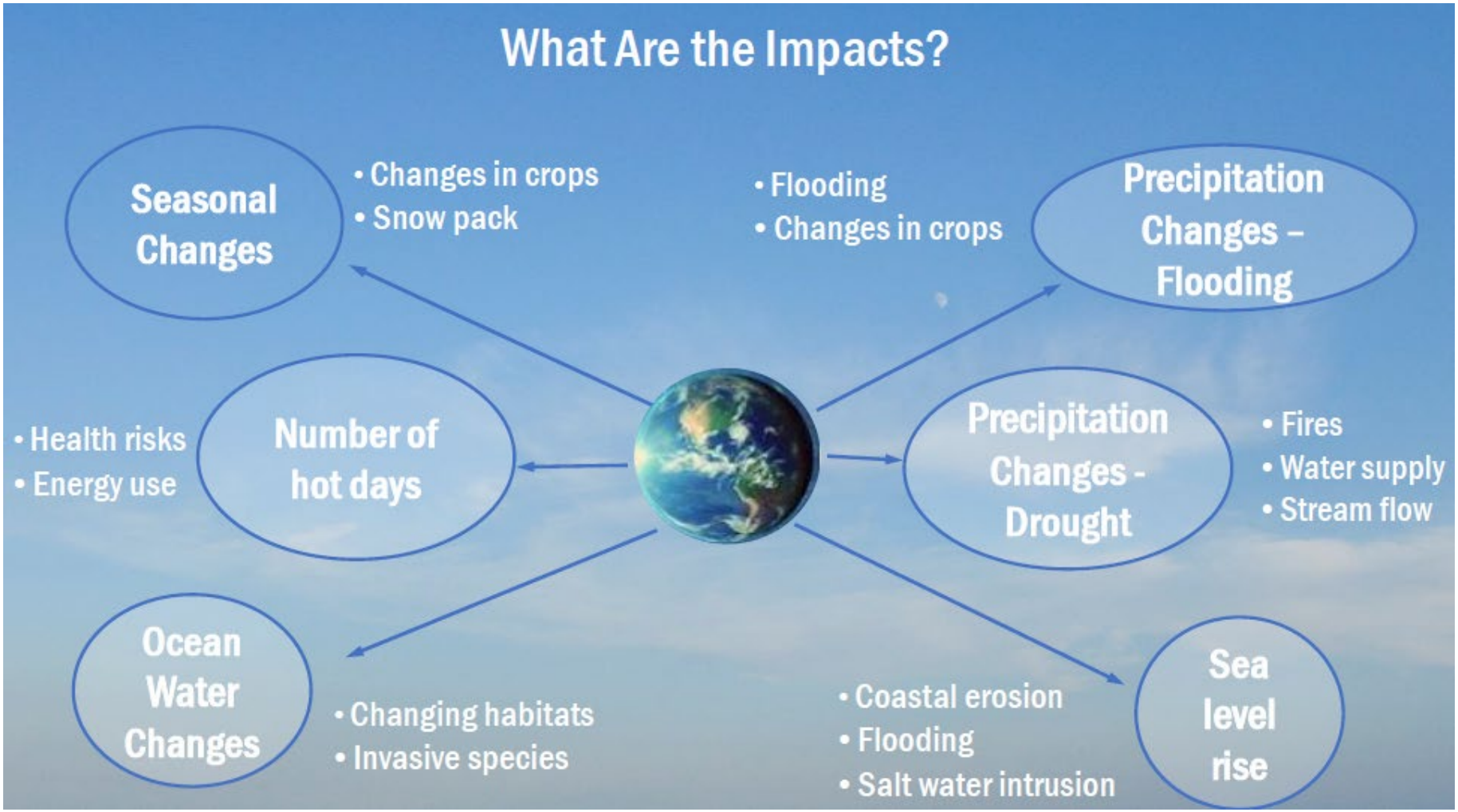

INFRASTRUCTURE
8 Drainage / Sewer / H20 Water inf.
6 Fire Station - West Side - upgrade?
9 - Flooding: Maple St Area;
10 Coordination w/ power utilities: gas / electric / phone
- Storm Drains: upgrade for future needs?
5 H20 Supply: MWRA BACKUP SOURCE
2 ~~AM~~ Water Supply Feasibility Study
3 Better Stormwater management plan compliance
4 power grid - maintain w/ tree trimming
1 Stormwater flooding: Boundary St. upgrades Drainage
- Westerly Waste Water Treatment Plant: protect from Flooding

Base Map

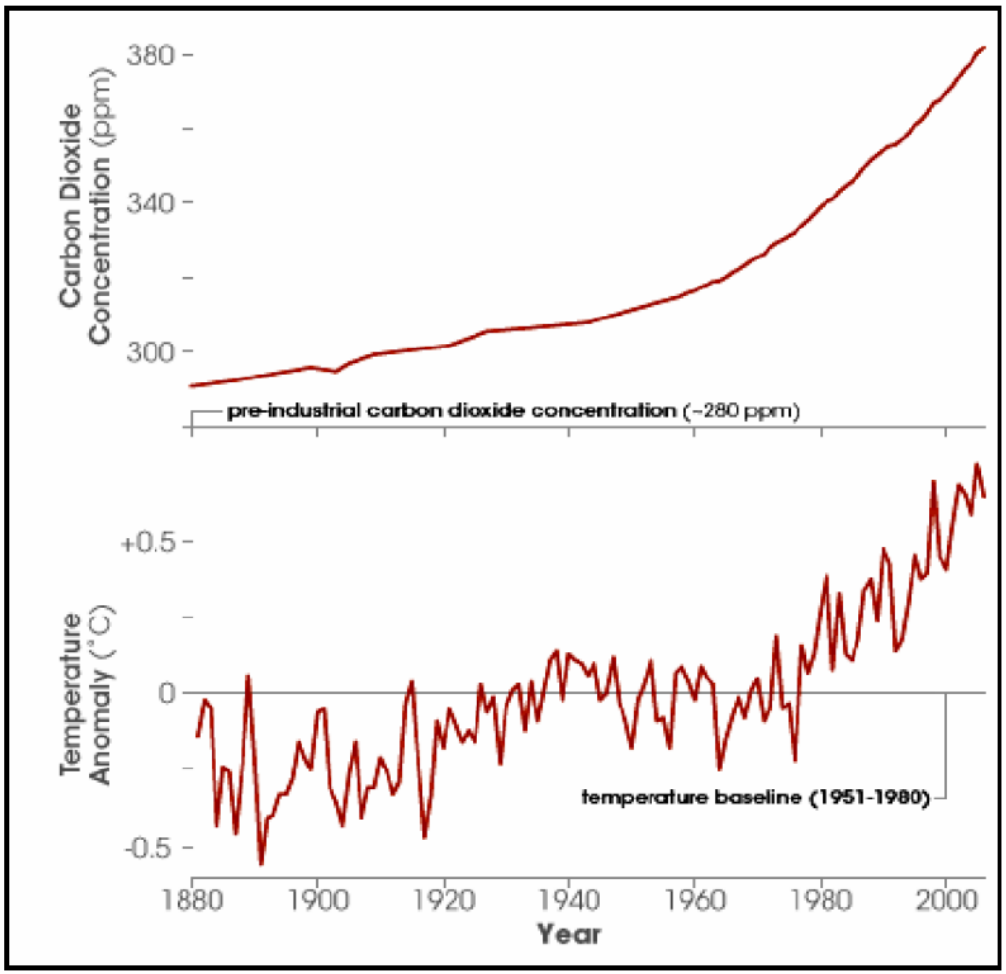

MARLBOROUGH
Critical Infrastructure
Type of Critical Facility
Airports
Dams
Fire Stations
Libraries
Assisted Living Facility
Nursing Home
Rest Home
Police Stations
Schools (PK - High School)
Town Halls
Hazards
Hot Spots*
A: 1% Annual Chance of Flooding
X: 0.2% Annual Chance of Flooding
Locally Identified Hazard Areas
Brush Fire
Flooding
Wind
*Hot Spots are areas identified by MAPC as the hottest 5% of land area in the MAPC region. Data from 2016.
Other Features
Rivers and Streams
Water Bodies
0 0.275 0.55 1.1 Miles

PowerPoint


Our Warming Planet
Some energy is reflected back out to space
Earth's surface is heated by the sun and radiates the heat back out towards space
Greenhouse gases in the atmosphere trap some of the heat
Solar energy from the sun passes through the atmosphere

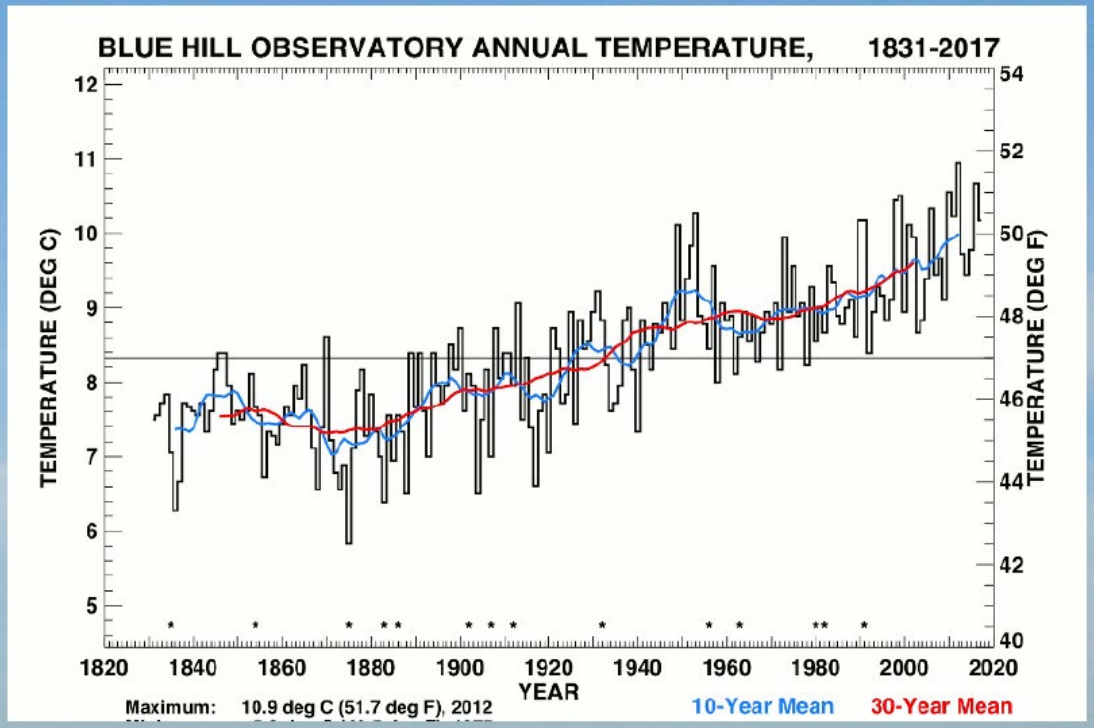

What Are the Impacts?
Seasonal Changes
• Changes in crops
• Snow pack
• Flooding
• Changes in crops
Precipitation Changes – Flooding
• Health risks
• Energy use
Number of hot days
Precipitation Changes - Drought
• Fires
• Water supply
• Stream flow
Ocean Water Changes
• Changing habitats
• Invasive species
• Coastal erosion
• Flooding
• Salt water intrusion
Sea level rise

Global Temperature and CO_2 Trends



Temperature change: observed

For the Northeast United States: temperature increased by almost 2 degrees, between 1895 and 2011 (US National Climate Assessment 2014)

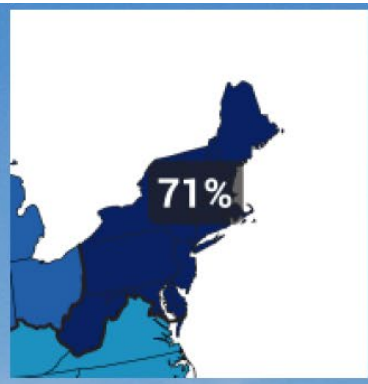


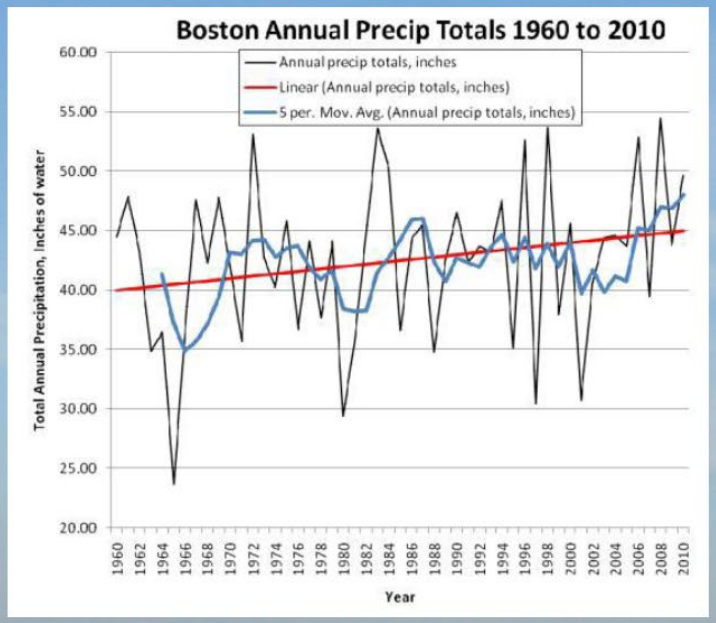
Blue Hill Observatory Annual Temperature, 1831-2017

Precipitation change: observed

For the Northeast United States: 71% increase in the amount of rain that falls in the top 1% events from 1958 – 2012.

Source: US National Climate Assessment 2014



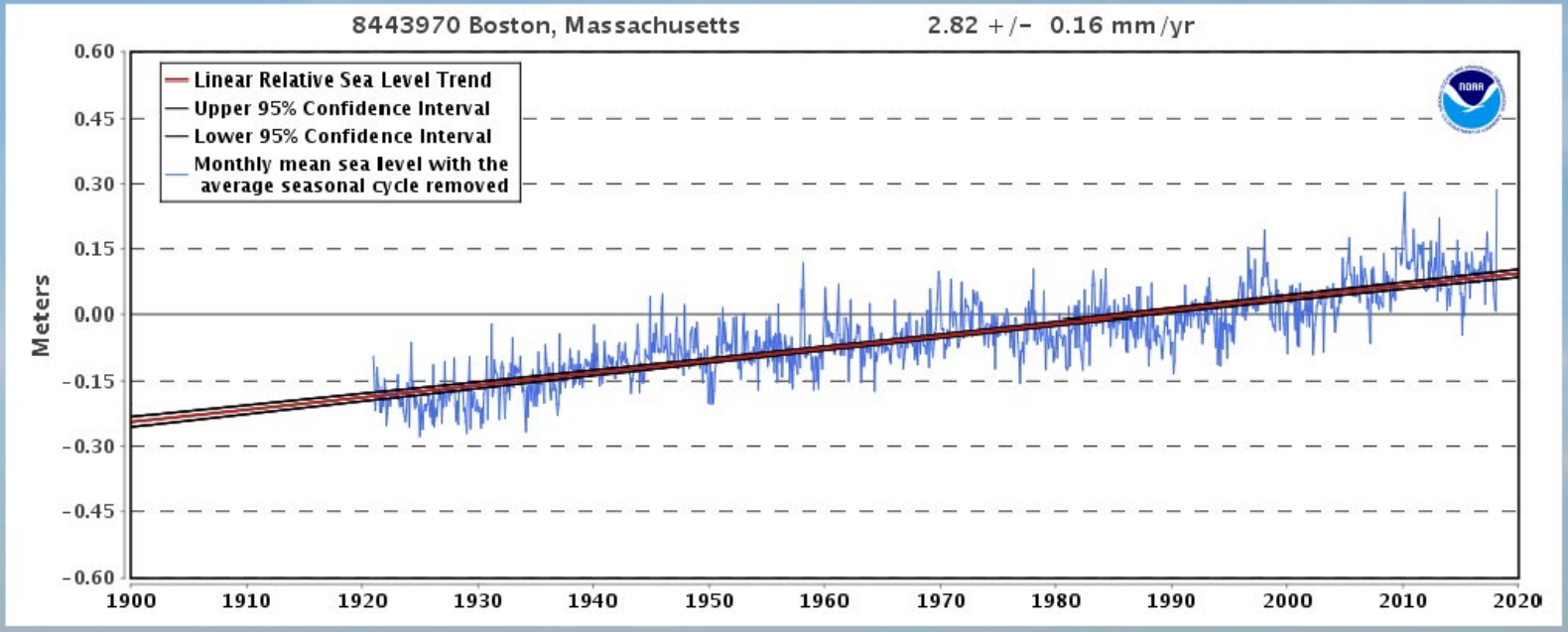


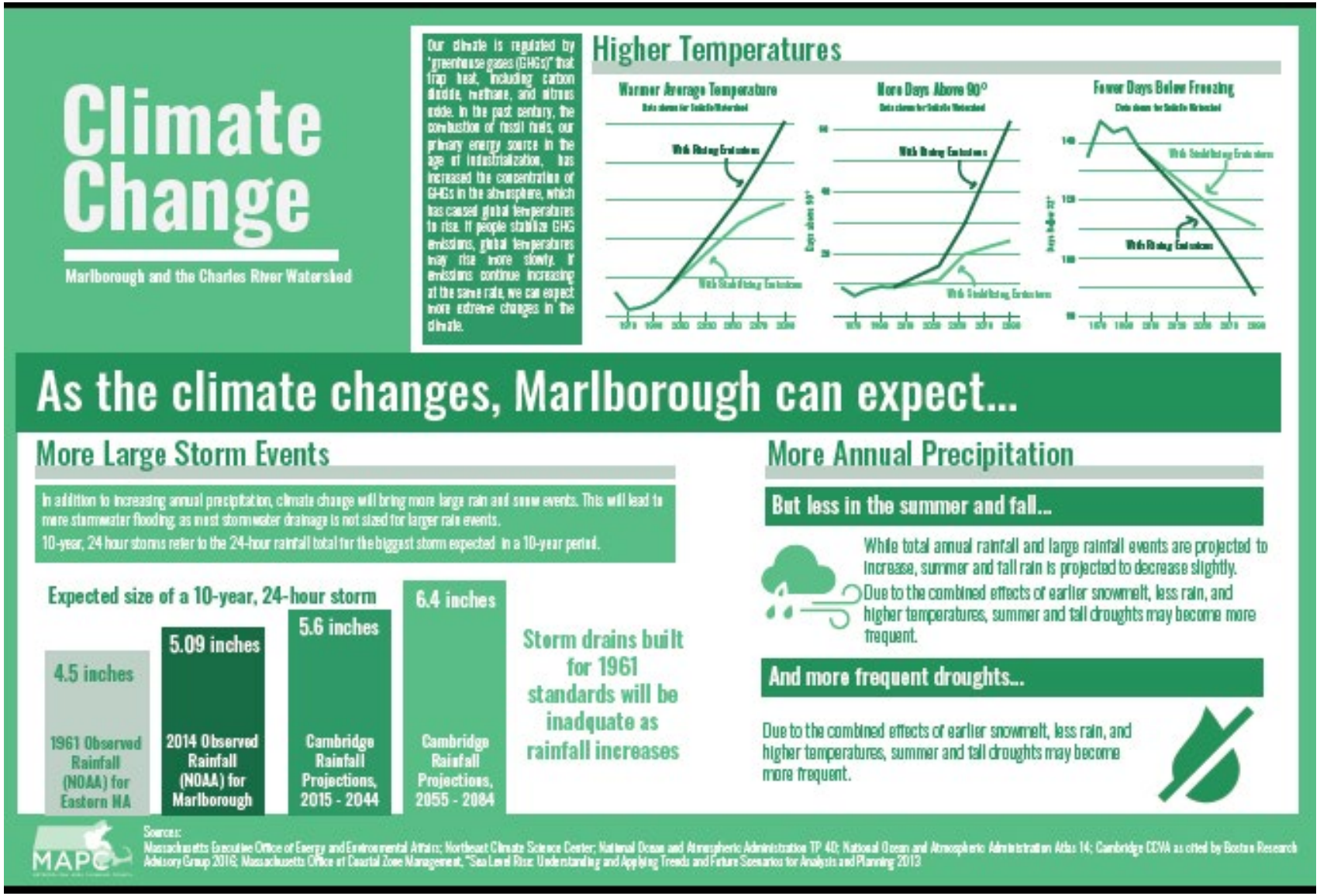
Source: MA Climate Change Adaptation Report 2011

For Boston area: 10% increase over the past 50 years

Sea level rise: observed

- Boston tide station
- Record from 1921-2017
- Equivalent to 11 inches in 100 years




Climate Change
Marlborough and the Charles River 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
Warmer Average Temperature
More Days Above 90°
Fewer Days Below Freezing
As the climate changes, Marlborough can expect...
More Large Storm Events
In addition to increasing annual precipitation, climate change will bring more large rain and snow events. This will lead to more stormwater flooding, as most stormwater drainage is not sized for larger rain events.
10-year, 24 hour storms refer to the 24-hour rainfall total for the biggest storm expected in a 10-year period.
Expected size of a 10-year, 24-hour storm
4.5 inches
1961 Observed Rainfall (NOAA) for Eastern MA
5.09 inches
2014 Observed Rainfall (NOAA) for Marlborough
5.6 inches
Cambridge Rainfall Projections, 2015 - 2044
6.4 inches
Cambridge Rainfall Projections, 2055 - 2084
Storm drains built for 1961 standards will be inadquate as rainfall increases
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.
Due to the combined effects of earlier snowmelt, less rain, and higher temperatures, summer and fall droughts may become more frequent.
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.
MAPC
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

MARLBOROUGH

Vulnerability Inventory

Increasing large rainfall events 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

- School, Child Care, or Special Needs
- Place of Assembly
- Elder Care
- Grocery, Hardware, or Veterinarian
- Emergency Operations Center
- Public Safety
- Medical Facilities
- Municipal
- Water or Sewer Infrastructure
- Communication Tower
- Dam
- Hazardous Material Site
- Gas Distribution
- Power Substation
- Transportation Facility

Hazards

- Hot Spots*
- A: 1% Annual Chance of Flooding
- X: 0.2% Annual Chance of Flooding

Locally Identified Hazard Areas

- Brush Fire
- Flooding
- Snow

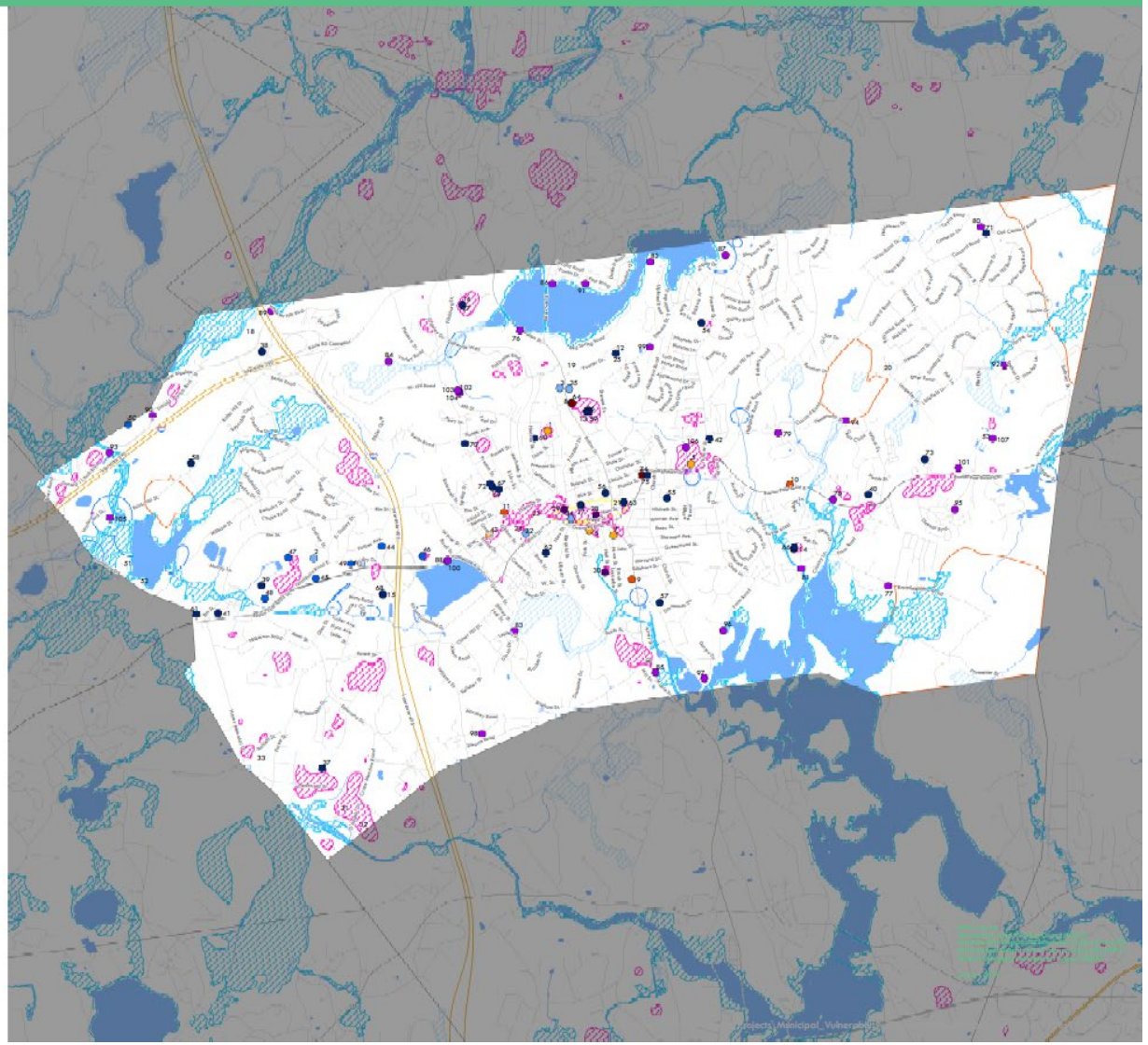
*Hot Spots are areas identified by MAPC as the hottest 5% of land area in the MAPC region. Data from 2016.

Other Features

- Rivers and Streams
- Water Bodies

Critical Infrastructure I	NAME
1	UMASS/Marlborough Hospital
2	Marlborough Hills Nursing Home
3	Bolton Manor Nursing Home
4	Marlborough Animal Hospital
5	CVS Pharmacy
6	Walgreens
7	Brooks Pharmacy
8	Police Department
9	Central Fire Station
10	Fire Station III
11	Pleasant Street Fire Station II
12	Marlborough High School
13	Marlborough Middle School
14	Kane Elementary School
15	Richer Elementary School
16	Assabet Valley Regional High School
17	Immaculate Conception School
18	New England Sports Center (Temporary
19	Nowin Rink
20	New Horizons
21	John Rowe Funeral Home
22	Short Funeral Home
23	Sullivan/Collins Funeral Home
24	Slattery Funeral Home
25	EDS/Marlborough High School
26	EDS/Marlborough Middle School
27	EDS/Assabet Valley Regional
28	City Hall
29	Walker Building
30	Department of Public Works Facilities
31	Ken's Foods
32	Comet
33	Seastar Seafood
34	Council on Aging
35	Elder Housing
36	Elder Housing
37	Next Generation Day Care
38	Bright Horizons Day Care
39	Bright Horizons Day Care
40	Kinder Care Learning Center
41	Our Future Learning Ctr.
42	Children's World Learning Center
43	Bowler Pharmacy
44	Marriott Courtyard Hotel
45	Embassy Suites Hotel
46	Holiday Inn Hotel
47	Royal Plaza/Best Western
48	Hampton Inn Hotel
49	Homestead Studio Suites Hotels
50	Solomon Pond Mall
51	Westerly Waste Water Treatment
52	Water Treatment Plant
53	Easterly Waste Water Treatment
54	Jaworek School
55	Assabet Valley Collaborative
56	Early Childhood Center
57	Gleathaven Academy - JRI
58	Hillside School
59	Intermediate Elementary
60	The Cottage Children's Center
61	The Little Flower Learning Center
62	New Covenant Christian
63	AMST Charter School
64	Marlborough Police Station
65	Marlborough Fire Headquarters
66	Adventure Club-Kane School
67	Discovery Club-Boys&Girls Club
68	Discovery Club-Richer School
69	Happy Hours Preschool
70	Kids' Quarters
71	Meadowbrook Child Garden Pre-Sch
72	Our Lady Preschool of Learning Center
73	Saint Anne-Montessori School
74	SMOC Family Child Care
75	Marlborough Child Care and Head Star
76	PS017-1
77	PS085-2
78	PS073-3
79	PS046-4
80	PS010-5
81	PS084-6
82	PS006-7
83	PS092-8
84	PS028-9
85	PS104-10
86	PS017-12
87	PS007-13
88	PS080-14
89	PS014-17
90	PS038-18
91	PS018-19
92	PS036-20
93	PS081-21
94	PS047-22
95	PS074-23
96	PS094-24
97	PS105-25
98	PS113-26
99	PS031-27
100	PS080-37
101	PS088-40
102	PS042-41
103	PS042-42
104	PS042-43
105	PS063-44
106	PS058-45
107	PS049-46

0 0.3 0.6 1.2 Miles



Marlborough

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.

Low Income Households

43% ±4% of households in Marlborough are low-income

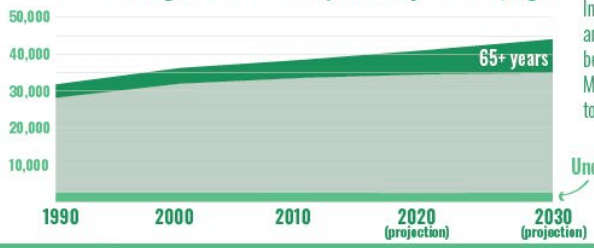
7.5% ±1.6% of households in Marlborough are below poverty level

*A four-person household earning less than $78,150 is considered low-income; a four-person household earning less than $24,563 is below poverty level

Older Adults and Young Children

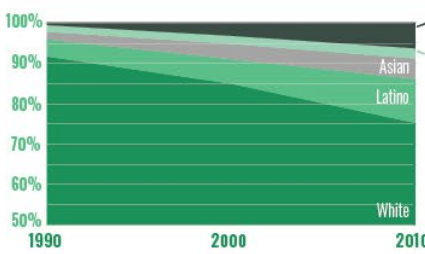
Adults over 65 and children under 5 are more likely to develop health problems on very hot days or during heat waves. Older adults are also more likely to have disabilities or mobility constraints and may need additional assistance during emergencies. They are also more likely to live alone than younger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

Marlborough Recent and Projected Population by Age



In 2030, seniors are projected to be about 20% of Marlborough's total population.

Communities of Color



Marlborough is becoming more diverse... but the two biggest minority groups have comparatively high poverty rates.

14.6% of Latino households in Marlborough are below poverty level

14% of Asian households in Marlborough are below poverty level

Latino Populations in Marlborough

People Living Alone

As of 2010, about 30% of Marlborough households consisted of someone living alone.

About one-third of people living alone were over 65.

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.

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

Marlborough

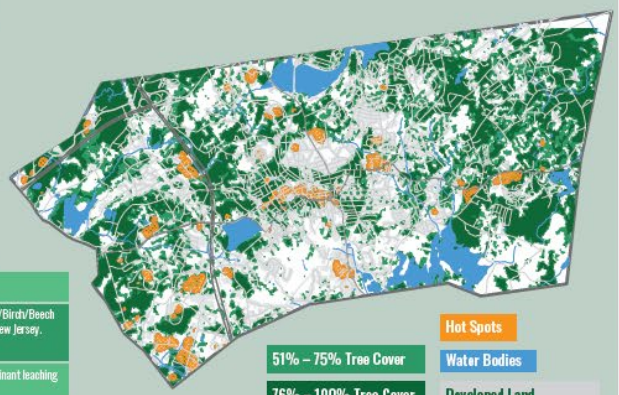
Natural Resources

Natural Resources lessen climate impacts by absorbing and storing carbon dioxide and by serving vital protective functions. Forests, open space, wetlands, rivers, and streams protect drinking water quality and quantity, provide flood control, and give relief from extreme heat. Healthy ecosystems are more resistant to stresses from a changing climate and better able to protect against heat and flooding.

Trees

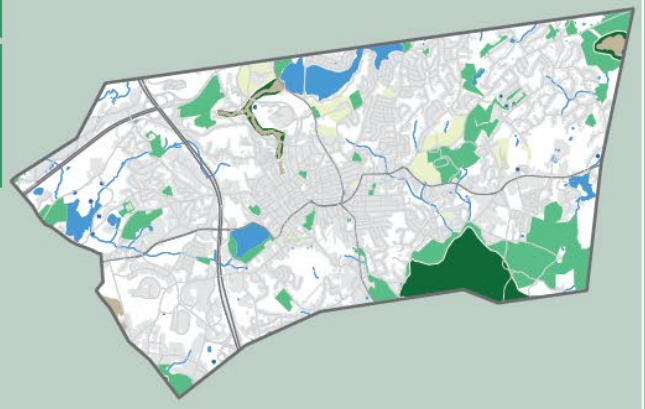
Trees are important in mitigating the impact of heat waves. According to the EPA, suburban areas with mature trees are 4-6 degrees cooler than new suburbs without trees. Shaded surfaces can be 25-40 degrees cooler than the peak temperatures of unshaded surfaces. Trees also absorb remarkable quantities of precipitation. Research has shown that a typical medium-sized tree can intercept as much as 2,380 gallons of rain per year (USDA Forest Service).

Risk	Impact
Warming	Expected to shift forest type from Maple/Birch/Beech forest to Oak/Hickory forest similar to New Jersey. New pests and diseases
Flooding, Drought, Wildfire, Ice Storms	Impaired waters, toxic exposure, contaminant leaching



Critical Habitat

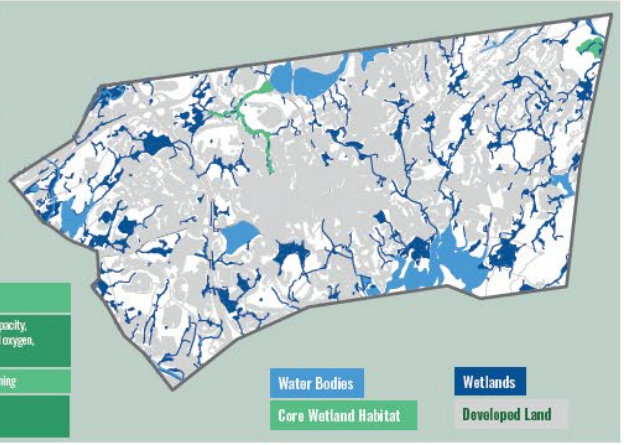
Core Habitat and Critical Natural Landscapes are state-identified intact landscapes, or exemplary natural communities, that are better able to withstand climate stresses, and support the long-term survival of rare species and natural habitats.



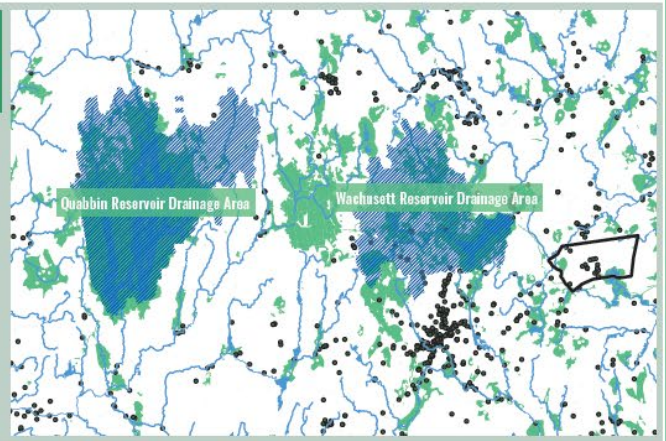
Freshwater Resources

Marlborough contains, healthy, intact freshwater systems that sustain critical ecosystem functions in climate change. These ecological assets protect drinking water quality and quantity, provide flood control, and maintain overall ecosystem health for climate resilience.

Risk	Impact
Drought/ Warming	Seasonal no-flow/ low-flow, reduced absorption capacity, diminished fish habitat, algal blooms, low dissolved oxygen, reduced drinking water supply
Flooding	Impaired waters, toxic exposure, contaminant leaching
Extreme Precipitation	Scouring, impaired waters, sewer overflows



Drinking Water Resources



MAPC

Sources:
MassGIS (Bureau of Geographic Information); BioMap2: Conserving the Biodiversity of Massachusetts in a Changing World; MassGIS (Bureau of Georgraphic Information); National Land Cover Database (NLCD); Massachusetts Department of Fish and Game; Massachusetts Department of Environmental Protection; Massachusetts Department of Transportation (MassDOT); Federal Emergency Management Agency (FEMA); Metropolitan Area Planning Council

APPENDIX B – TABLE MATRIX RESULTS

Participants were divided into small groups identified as Yellows, Blue, Green, or Red. Concerns were categorized as Environmental, Infrastructure, or Societal. Participants identified climate-related strengths and vulnerabilities for Marlborough. Solutions were proposed for the vulnerabilities. Solutions were then prioritized as High, Medium, or Low. Each table was asked to identify their top three priorities. The information was recorded in a matrix for each table and is reproduced in the chart below.

Yellow Table

Category	Features	Location	Ownership: public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
Infrastructure	Water supply – local source offline, 100% MWRA, one pump station	#1	Public	V	Redundancy everywhere, esp. MWRA pumping station. Analysis of electricity usage in the city, education about reducing peak usage		
Infrastructure	Electric grid – support in peak demand, older infrastructure	#2	Private	V – multiple sources S – good service	More robust design for emergency electric supply – different fuel sources? For critical facilities. Study feasibility of using as backup water supply		
Infrastructure	Travel grid/evacuation route		Public	S	Evacuation signage + communications		
Infrastructure	Treatment plant (multiple pumps, backups old)	On map	Public	S/V	Upgrade pump stations		
Infrastructure	Drainage infrastructure – many areas don't have	#4	Public	V	Analysis of where pressure points are: incentivize people to improve drainage; green infrastructure; ordinance		

Yellow Table

Category	Features	Location	Ownership: public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
					incentive storm water update in redevelopment		
Infrastructure	Strong inventory of [actual] facilities – emergency planning, collaboration. Up to date		NA	S			
Infrastructure	Dams – old, regular inspections, ownership cloudy		both	V, reg. inspection	Inventory for future		
Infrastructure	Transportation – new buses, good fleet		-	S	Make sure its port of emergency response plan. Inventory/keep track, agreement in place with owners. Update zoning + building codes to incentivize clean energy, efficiency even more		
Infrastructure	Some underground electric infrastructure – less vulnerable to trees, more to flooding, freezing		National Grid	V/S	Continue maintenance of trees around electric lines		
Society	Emergency file of vulnerable seniors, but dependent on sign up, check ins		-	S/V			

Yellow Table

Category	Features	Location	Ownership: public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
Society	MANY assisted living, senior housing, manufactured homes		Private	V			
Society	Heat – seniors and young children vulnerable and cold		-	V	Storm kit/resources for emergencies: maintained + used; broader/more comprehensive		
Society	Communication with no power about seniors, centers		-	V	Establish emergency education/communications to public		
Society	Language barrier with non-English: more modern		-	V	Radio, social, emergency broadcasts, encourage communication among neighbors. Map of emergency places/resources?		
Society	Hospital in town, no high ground, multiple clinics good	#5	P	S	Wide distribution of emergency plan + communications strategy to public/nonprofit/ school/community leadership		
Society	Spread out daycare centers, schools			V	Designed alerts that people know about. Easier city website/web portal that's easy to find for city emergency plan/documents etc.		

Yellow Table

Category	Features	Location	Ownership: public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
Society	Neighborhoods of vulnerable populations			V	[French] Hill – Anglican Church outreach inner city.		
Society	Faith-based organizations with good outreach, good list			S	Emergency planning curriculum for public/in schools		
Society	City services, new equipment, police, fire, DPW			S	Emergency prep newsletter/mailing		
Environment	Rail system, rail rails		Public	S	Continue to maintain, volunteers, information		
Environment	Old water treatment plant – chemicals			V	Study feasibility of using as backup water supply		
Environment	Beach-cooling, in wading pools + splash park		Public	S	Continue upkeep, [baking] for cooling opportunities		
Environment	[tributaries] + wetlands	Ex: [Milton] Brook		S	Incentive rain barrel usage + water conservation. Increase wetland buffers + signage. Maintain existing detention basins		
Environment	Solar/wind opportunity? Existing res. Solar, 37 comm. projects – only one [oea] allows [ground-manted] solar			?	Update zoning + building codes to incentivize clean energy, efficiency even more		
Environment	Storm water management plan			S	Continue to maintain, fully fund forestry management,		

Yellow Table

Category	Features	Location	Ownership: public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought) including plan/resources to prevent invasive species	Priority	Time
Environment	Trees forestry department, planning for transport of process			S			
Environment	Insects, beetles, invasive species			V			
Environment	Using [ran] + natural water more			S	Opportunity to invest more		
Environment	Strength: new ways to treat roads in winter: bring solutionary beet juice						

Blue Table

Category	Features	Location	Ownership: public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
Infrastructure	11: Gleen St – water hacks up		Both	V	Redesign of intersextoin; alt traffic patterns in emergency – both same actions	High	Short-term
Infrastructure	Localize flooding near registry		Public	V			
Infrastructure	Hospital -on the hill		Private	S			

Blue Table

Category	Features	Location	Ownership : public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
Infrastructure	W./Water treatment plant near flood zone		Public	V	Investigate vulnerability. Harden the facility	High	Short-term
Infrastructure	Fire and Police are in good spot (flooding)		Public	S			
Infrastructure	Heat spots need to be on easy-to-find map		Private	V	Mapping it, sharing it, have round table conversation among leadership about it.	Medium	Long-term
Infrastructure	MWRA near flooding area		Public	V	Research vulnerability and plan	High	Short-term
Infrastructure	3I: Energy Powerlines/Natural Gas/[action] data need to be checked		Private	V	Research the vulnerability and sharing data with city leadership and private business owner	High	Short-term
Infrastructure	Maple street flooding (evacuation)		Public	V	Redesign and come up with back up. See first row		
Infrastructure	Local building codes are they taking extreme temp into consideration? (Question are they?)		Public	V	Research to see how big of an issue and implementation if its costs effective to benefits	Low	Ongoing
Infrastructure	Is the trade center used as emergency space?		Private	S			

Blue Table

Category	Features	Location	Ownership : public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
Infrastructure	Check with the schools in area what kind of support can they offer the city in an emergency?		Private	S			
Infrastructure	What is the metal aid plan? Public + private)		Both	V	Research and make public aware of it	Medium	Ongoing
Infrastructure	Back up for town information technology (?)		Public	V	Confirm the plan	Medium	Ongoing
Society	Elderly housing is away from flooding area		Public	S			
Society	Good number of vulberable population that needs gov't support		Both	V	Some needs to be in charge of coordination with state and other partners		
Society	Homeless pop has shelter in the town		Both	S		Medium	Short-term (+plus long term implementation)
Society	3S: Education about salt use in winter needed	Everywhere	Both	V	Education on website/pamphlets. Connect with private sector in changing what they are doing	High	Short-term

Blue Table

Category	Features	Location	Ownership : public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
Society	Radio rebroadcasting station (back-up?). LEPC plan (need to contain certification)		Both	V/S	Know what is the plan. Is there a need for another option	Medium	Short-term
Society	1S: Confirm backup powers at city buildings	Everywhere	Public	V	Research. Upgrade if needed	High	Short-term
Society	Does the hospital have a plan for backup power? Ambulance and emergency services		Both	V	Research. Create one if not	Medium	Short-term
Society	Who is main person/contact for emergency management?		Public	V/S	Make the public aware	Low	Short-term
Society	More public education for emergency moments		Public	V	Make public aware of it	Low	Short-term
Society	Does public transportation have an emergency plan?		Private	V	Confirm the plan	High	Short-term
Society	Who is the go-to person managing this?		Private	V	Confirm the person	High	Short-term
Society	Strong town leadership (fire, police and others)		Public	S			
Society	Dept heads in town are meeting		Public	S			
Society	MWRA has many emergency resources for the town		Both	S			
Society	2S: How much does the town grow during the work day? What is the plan for them?			V	Find the data and find out what is being done for	High	Short-term

Blue Table

Category	Features	Location	Ownership : public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
					those workers during an emergency moment		
Society	Understanding more of public health impact of climate change locally			V	Education, research and share info with public. Find state and private data	Medium	Ongoing
Environment	Proscribed burn [dome]		Public	S		High	Short-term
Environment	Lots of salt used during winter		Private	V	See above		
Environment	City is using new Bryn salting system – 25% salt, 75% water		Public	S			
Environment	Less salt = stronger wetlands		Both	V/S		High	Short-term
Environment	1E: Local water supply has lots of salt → [emacting] pipes		Both	V	Research and implementation of solution		
Environment	Back up water supply		Both	V	“”		
Environment	Lots of wetlands that are protected		Both	S			
Environment	Tree maintenance needs to keep up		Both	S	Keep it up and coordinate more! More coordination!	Low	Ongoing
Environment	LEPC plan (need to contain certification)		Both	S			
Environment	Strong relationship with city and state			S	City needs to take action		

Blue Table

Category	Features	Location	Ownership: public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
Environment	3I: New fire station is needed			V	Communication plan, connect with partners like churches to help with these populations	High	Short-term
Environment	More translation/multi-[lang secrets]/needed			V	Where is the city data?	Medium	Ongoing
Environment	Data center for town			V	As we replace stuff city needs to track and expand	Medium	Short-term
Environment	2I: Older town/infrastructure			V	See first sheet	High	Ongoing
Environment	Cable and FIOS need to maintain trees			V	research	Medium	Ongoing
Environment	2E: Waste water treatment vulnerability?			V		High	Long-term

Red Table

Category	Features	Location	Ownership: public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
Infrastructure	Power grid – outages	Citywide	N Grid	V	More proactive/targeted tree trimming	H	O

Red Table

Category	Features	Location	Ownership: public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
Infrastructure	Backup gen., sewer, PS, NW TP, water, MWRA	City Hall	City/MWRA	S	Building upgrades to reduce electric loads (future conditions)	m	L
Infrastructure	Roadway flooding – storm		City	V	Drainage assessment of vulnerable roadways	H	S
Infrastructure	Boundary St. bridge area Assabet – raised	Map	City	S	New development to use updated precip. data – local regs.	H	S
Infrastructure	Water tanks (2)	Map	City	S			
Infrastructure	Retention ponds on developments	Citywide	Private	S/V	ID opp's to maximize recharge retrofits	M	L
Infrastructure	MWRA back-up water	Citywide	MWRA	S			
Infrastructure	Western MRWP – in flood zone	MWRP	City	V	Assessment of food risk, future conditions	H	S
Infrastructure	Public transit – MWRA		MWRTA	S/V			
Infrastructure	Road closures – fallen trees (ice/wind)	Citywide		V	Maintain tree trimming (city/utility)	H	O

Red Table

Category	Features	Location	Ownership: public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
Infrastructure	Gas line + distribution plant	Map (green)	Tennessee gas	V			
Society	Senior center – backup generator – shelter	Map	City	S	Communication with seniors (non-computer). "Buddies" volunteers	M	S
Society	Schools – shelters/backup gen		City	S	Transportation to shelters	M	O
Society	New Horizons Asst. Living	Map	Private	S/V			
Society	Senior housing	Map	MCDA + private	V	Evaluate back up generation needs	H	S
Society	Nursing homes	Map	Private	V	Evaluate back up generation needs	H	S
Society	Marlborough Hospital	Map	Private	S	Evaluate back up generation needs	H	S
Society	Brazilian population/churches	Citywide		V	Targeted outreach/comm. – "buddies"	H	S
Society	Social media outreach	Citywide		S	Add multilingual outreach	M	O
Society	Reverse 911 (by neighborhood/citywide)	Citywide	City	S	Outreach to sign up cellphone #s	M	O
Society	Senior shuttle		MWRTA	S			
Environment	Ft. Meadow res (recreation) – WQ	MAD	Hudson/ Marl	S/V	Watershed protection/manage storm water	M	L

Red Table

Category	Features	Location	Ownership: public or private	V and/ or S	Actions: list below (flooding, heat waves, severe storms, drought)	Priority	Time
Environment	Tree cover/loss in 495 corridor	Citywide	City/private	S/V	Shake tree requirement for new development	H	O
Environment	Hot stops – heat islands		Citywide	V	Tree preservation ordinance	H	O
Environment	Thermal pollution – runoff from pavement	Citywide		V	Evaluate dam removal/storm water retention	H	S
Environment	Wetlands – protect buffer zones	Citywide	Private	S	Review buffer zones to reflect future hybrid corridors	H	O
Environment	Cold water fisheries – NE [Maul. Hop BK Tributary]	NE Marlboro	State forest	S			
Environment	Wildfire potential – Millham Res.	Map (WF)	City	V	Forest management	M	O