Appendix D

Presentation from the Listening Session (6/13/2019)

Worcester Community Resilience Listening Session

June 13, 2019

Massachusetts Executive Office of Energy and Environmental Affairs
Municipal Vulnerability Preparedness (MVP) Program
Planning Grant

KLEINFELDER

Agenda

Municipal Vulnerability Preparedness Planning Process (10 mins)

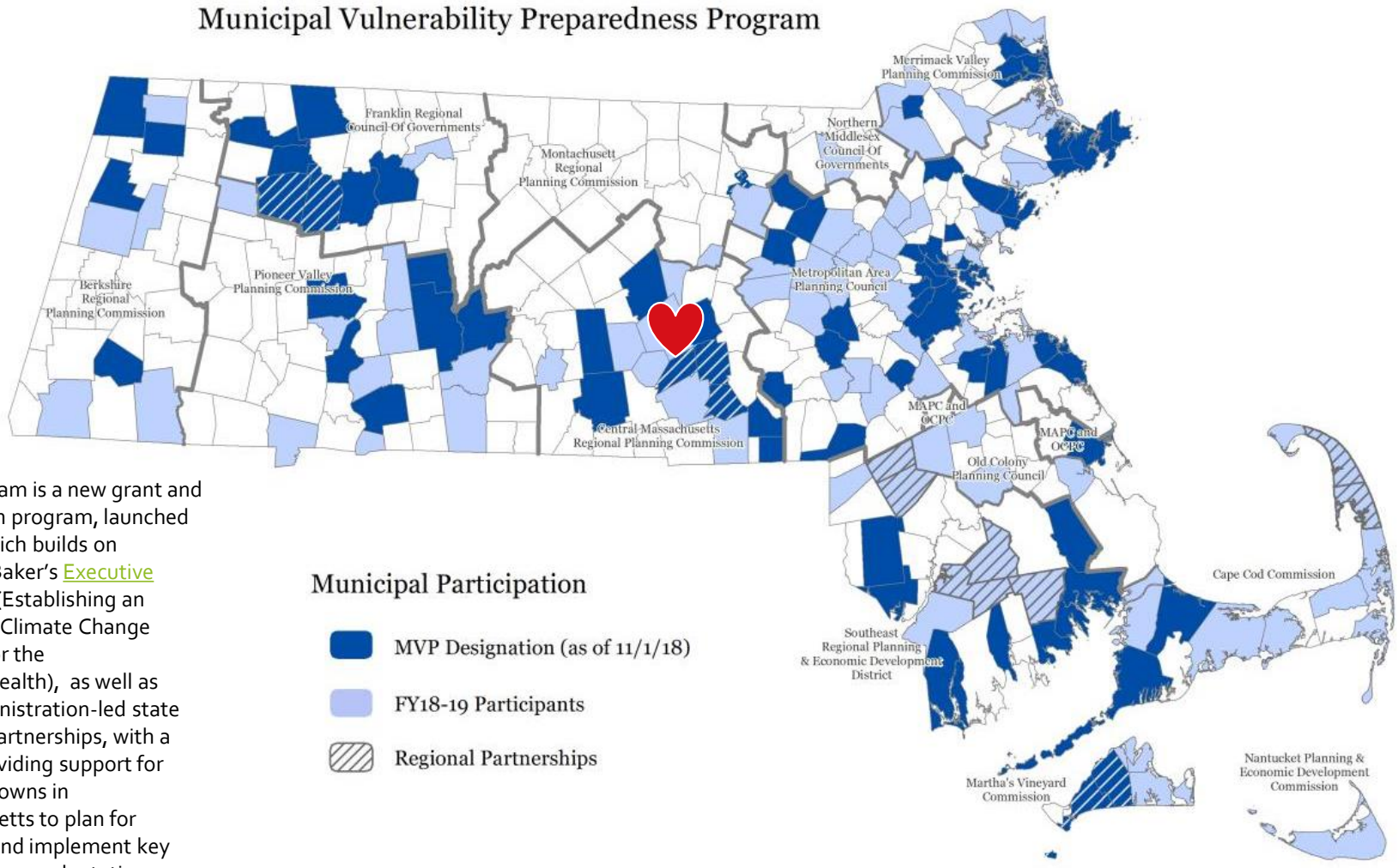
Overview of the Key Findings (30 mins)

- **Identified Hazards and Climate Change Projections**
- **Community Vulnerabilities**
- **Community Strengths**
- **Recommended Priority Actions To Improve Community Resilience**

Questions and Answers (15 mins)

Next Steps and Closing (5 mins)

The MVP Program



MVP program is a new grant and designation program, launched in 2017, which builds on Governor Baker's Executive Order 569 (Establishing an Integrated Climate Change Strategy for the Commonwealth), as well as other administration-led state and local partnerships, with a goal of providing support for cities and towns in Massachusetts to plan for resiliency and implement key climate change adaptation actions.

The Worcester MVP Process

1. **SPRING-FALL 2018:** Applied for the MVP planning grant, formed a Core Group, and selected state-certified MVP consultant (Kleinfelder)

2. **DECEMBER 2018:** Gathered available background information

3. **JANUARY 25 2019:** Held 8-hour workshop

4. **MAY-JUNE 2019:** Performed 5 risk and vulnerability assessments

5. **JUNE 2019:** Finalized workshop outcomes into a report

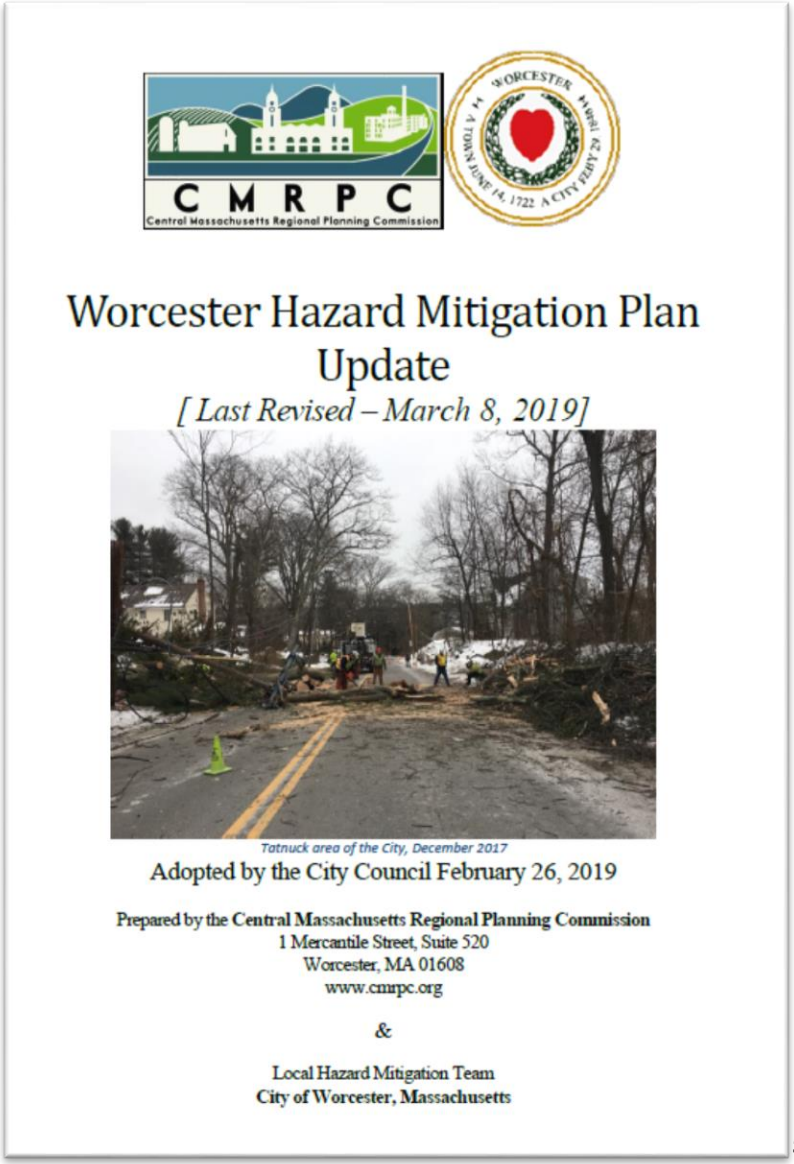
6. **JUNE 13:** Hold public listening session

7. **SUMMER 2019:** Be designated a "Climate Change Municipal Vulnerability Preparedness Community"

8. **FUTURE:** Increased funding opportunities through MVP Action grant program

Other Planning Efforts in Worcester

- Hazard Mitigation Plan (adopted February 2019)
- Integrated Water Resource Management Plan (ongoing)
- Green Worcester Strategic Plan (ongoing)
- Master Plan (forthcoming)



CMRPC
Central Massachusetts Regional Planning Commission

Worcester Hazard Mitigation Plan Update

[Last Revised – March 8, 2019]

Tatnuck area of the City, December 2017

Adopted by the City Council February 26, 2019

Prepared by the Central Massachusetts Regional Planning Commission
1 Mercantile Street, Suite 520
Worcester, MA 01608
www.cmrpc.org

&

Local Hazard Mitigation Team
City of Worcester, Massachusetts

MVP Workshop: January 25, 2019

Objectives:

1. Define local climate-related **hazards**
2. Identify existing community **strengths & vulnerabilities** related to those hazards
3. Identify and prioritize **actions** to improve community **resiliency** to those hazards

Participants (about 60):

- Core Group and City department staff
- Representatives of various committees, residents, non-profit organizations, educational institutions and businesses
- State-certified MVP consultant / group facilitators (Kleinfelder)

NATURAL HAZARDS

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

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

1

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

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

COMMUNITY STRENGTHS AND VULNERABILITIES

COMMUNITY ACTIONS

PRIORITY ACTIONS

Part 1 | Part 2 | Part 3

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

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

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

HEAVY RAINFALL & FLOODING | SNOW/ICE EXTREME COLD | EXTREME HEAT DROUGHT

5

Features	Location	Ownership	V or S	Hazard	Actions	Priority H-M-L	Time Short Long Ongoing
Infrastructural							
WATER DISTRIBUTION SYSTEM	Regional	City	Both		Education: freeze pipes; Redundancy Systems (Drought); Public Education on water use/ Reuse	M / H	L/O / L/O
SCHOOL BUILDINGS	Citywide	City	V	ALL	Adaptive capacity (extreme temps) • Green roofs • HVAC • AIR QUALITY; Schools as neighborhood resilience hub; • BIPPS	H	L
EMERGENCY RESPONSE (FACILITIES + SYSTEMS)	Regional	City +	V	ALL	Multi-lingual communications / messaging (Reverse 911, etc.); Expand CERT to resilient neighbors network	L / H	S / L
UTILITY SYSTEMS	Regional	Private	V	ALL	• Decentralization / Microgrids • Incentives; • Community/Neighborhood scale solutions	H	L
TRANSPORTATION SYSTEMS	Regional	All (mostly City/State)	V	ALL	UMTA Bldg → Flood Risk; DUAL-USE FLOOD STORAGE/INFILTRATION/ • Daylighting Blackstone Canal; • Create benefits Elevation / Conveyance/	H	L
SEWER/STORMWATER SYSTEMS	Citywide (s/w Regional Concerns)	City	V	1/2	• RAIN GARDENS, Permeable pavement; • ON-SITE RETENTION VS. pipe replacing • Stormwater Utility fee + incentives/credits for GI/LID		
Societal					• Regional/Multi-community coordination on future extreme rainfall		
TRANSPORTATION FLEET/MOBILITY	Regional	ALL	Both	ALL	• Use school buses to address mobility limitations during emergencies; • Privatize transit system / Rideshare; Alternative Treatment options	H	L
HEALTH/MEDICAL ACCESS	Regional/State	Regional/State	S	V	Decrease hospital visits/reliability as 1st resort (nurse, onsite, shelter/schools); • Tap into medical reserve corps (underutilized)	M	O
STUDENT POPULATION	Citywide	Public/Private	Both	V	• Emerging resource/problem solvers!! • Require Unique/specific preparedness/response measures (EOP, etc.)	L	O
VULNERABLE POPULATIONS (Seniors, Special Needs, Immigrant, disabled, low/limited income, etc.)	Citywide		V	V	• Property protection / personal preparedness (Education/outreach); • Empower renters / incentivize landlords + property managers (to retrofit, adapt, invest in resilience!!; • BE PART OF THE SOLUTION	H	L
INCLUSIVE / COLLABORATIVE CULTURE	Citywide		S	V	• Build coalitions (resilience hubs) → Connect w/ other social service orgs; • Demonstrate + Replicate	H	L
Environmental					Flooding/Extreme Heat/Snow/Ice; Leverage "Green City Initiative"		
TREE COVER	Citywide	ALL	S/V		• Expand Worcester Tree Initiative (Replace, plant more, preserve); • Incentivize private land owners; • Drought resistant landscaping	H	O
WATERWAYS/WETLANDS	Citywide	V	Both	FLOOD	• Expand/Enhance/Protect existing resources • Lakes + Ponds; • Stormwater improvements	H	O
HILLS	V	V	Both	SNOW/ICE FLOOD	• Power equipment? • LID (Development restrictions); • Snowmelt/stormwater retention? • De-icing / road treatment	L	L
BROWNFIELD SITES	Mostly CBD (but Scattered)	V	V	FLOOD	• Cap/prevent infiltration but fully redeveloped in a resilient		
GREEN/OPEN SPACE	Citywide	V	S	FLOOD			
PARKS + REC	Citywide	City	S	ALL			

Part 1

Part 2

Identified Top Hazards

Worcester's past, current, and future hazards

Flooding from extreme precipitation (heavy rain)

Ice/snowstorms coupled with extreme cold

Extreme Heat / Drought

INFRASTRUCTURE

Critical Infrastructure – provides essential services and serves as the backbone of the city's security and health.

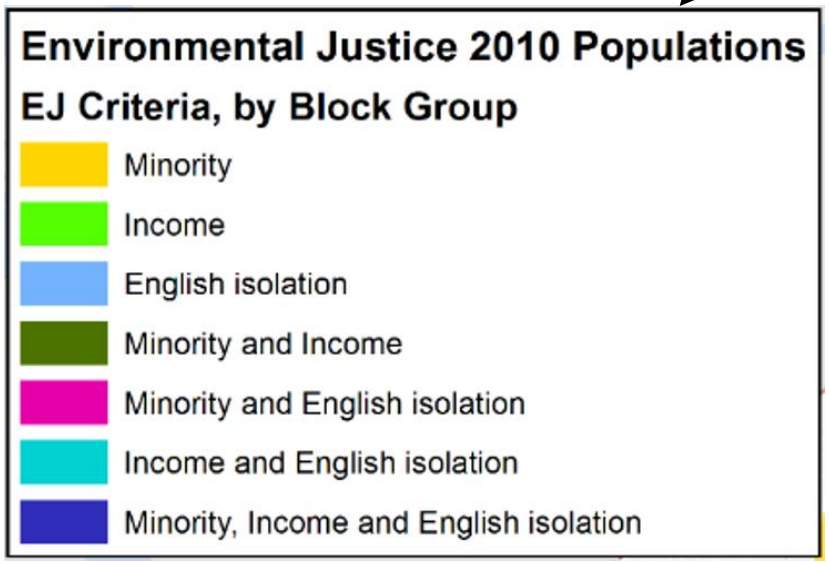
- Vital to the hazard response effort.
- Maintains existing level of protection from hazards for the community.
- Would create a secondary disaster if a hazard were to impact it.
- Facilities and populations to especially protect from a hazard.

Examples Include:

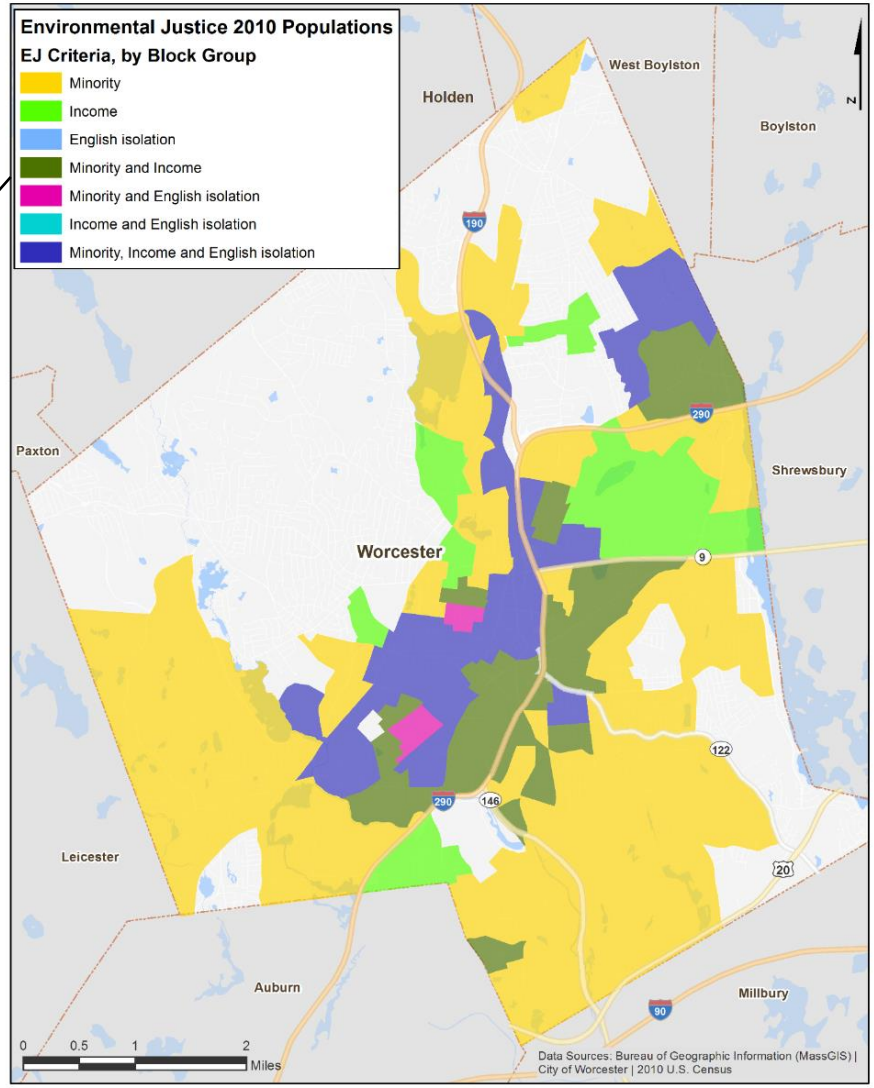
- Bridges, Roads
- Dams, Reservoirs
- Emergency Operations
- Municipal Buildings, Schools, Hospitals
- Utilities, Water and Sewer System
- Commercial Buildings and Businesses
- Historic Sites

Society

Combination of factors and forces that affect the susceptibility of various groups within a community to harm, as well as their ability to respond positively after extreme events.



Environmental Justice Populations Map



Environment

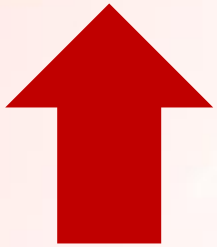
Benefits of natural systems include:

- Flood storage
- Recreation and tourism
- Cooling during heat waves
- Biodiversity conservation
- Water filtration
- Water quality and quantity
- Air quality

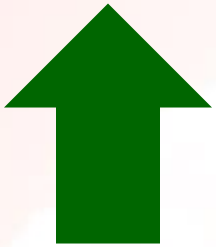
Environmental Challenges:

- Erosion
- Invasive plant material
- Chronic flooding
- Sedimentation
- Ground and surface water pollution
- Impaired water bodies

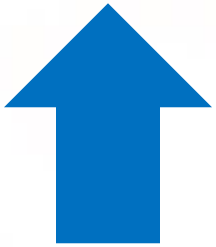
Climate Change: Observed



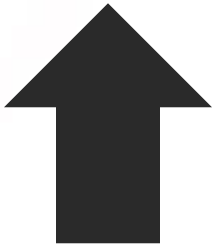
Temperature: **2.9°F** Since 1895



Growing Season: **11 Days** Since 1950



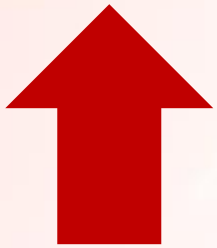
Sea Level Rise: **11 inches** Since 1922

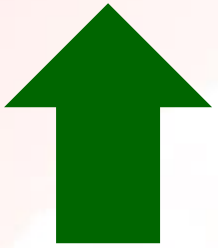


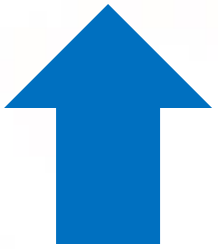
Stronger Storms: **55%** Since 1958

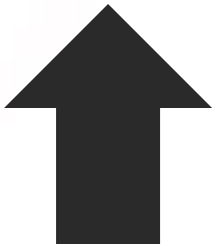
Source: Climate Science Special Report, 2017; NOAA NCEI nClimDiv; NOAA Ocean Service

Climate Change: Predicted

Temperature:  **3 to 11°F** By 2100

Growing Season:  **5 Weeks** By 2100

Sea Level Rise:  **3 to 7'** By 2100

More Storms:  **47%** By 2100

Source: NCICS State Summaries, Fourth National Climate Assessment, and NE CSC

Climate change

Development

increased precipitation

increased temperature

impervious surfaces

stormwater & WQ issues

flooding & infrastructure damage

heat-related illnesses

more cooling shelters

Climate Change in Massachusetts

Total annual precipitation has increased by:

15%

1.2 trillion more gallons **of water or equivalent snow falling on Massachusetts each year.**

~9,700 filled Prudential Towers

Changes are calculated from a linear regression of annual totals from 1895-2015, 1901-2000 reference period.

Source: NOAA

Climate Change and Worcester in 2016

Consider this:

In October, 2016, the City was in the midst of a severe drought (stage III), while also being affected by one of the most severe and damaging rain events in its history…

City Manager Edward Augustus Jr. standing in the Quinepoxet Reservoir after announcing a stage three drought emergency.

Photo by Scott Croteau

https://www.masslive.com/news/worcester/2016/09/five_things_you_need_to_know_a.html

https://www.youtube.com/watch?v=YLvUaPI9Esc

Flooding from extreme precipitation
Community Vulnerabilities

Two types of precipitation flooding:

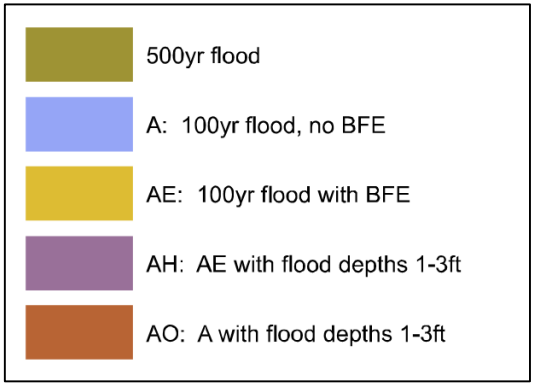
- Overbank flooding from rainfall / snowmelt
- Piped Infrastructure backup / failure (culverts, combined sewer overflow, sanitary sewer overflow)

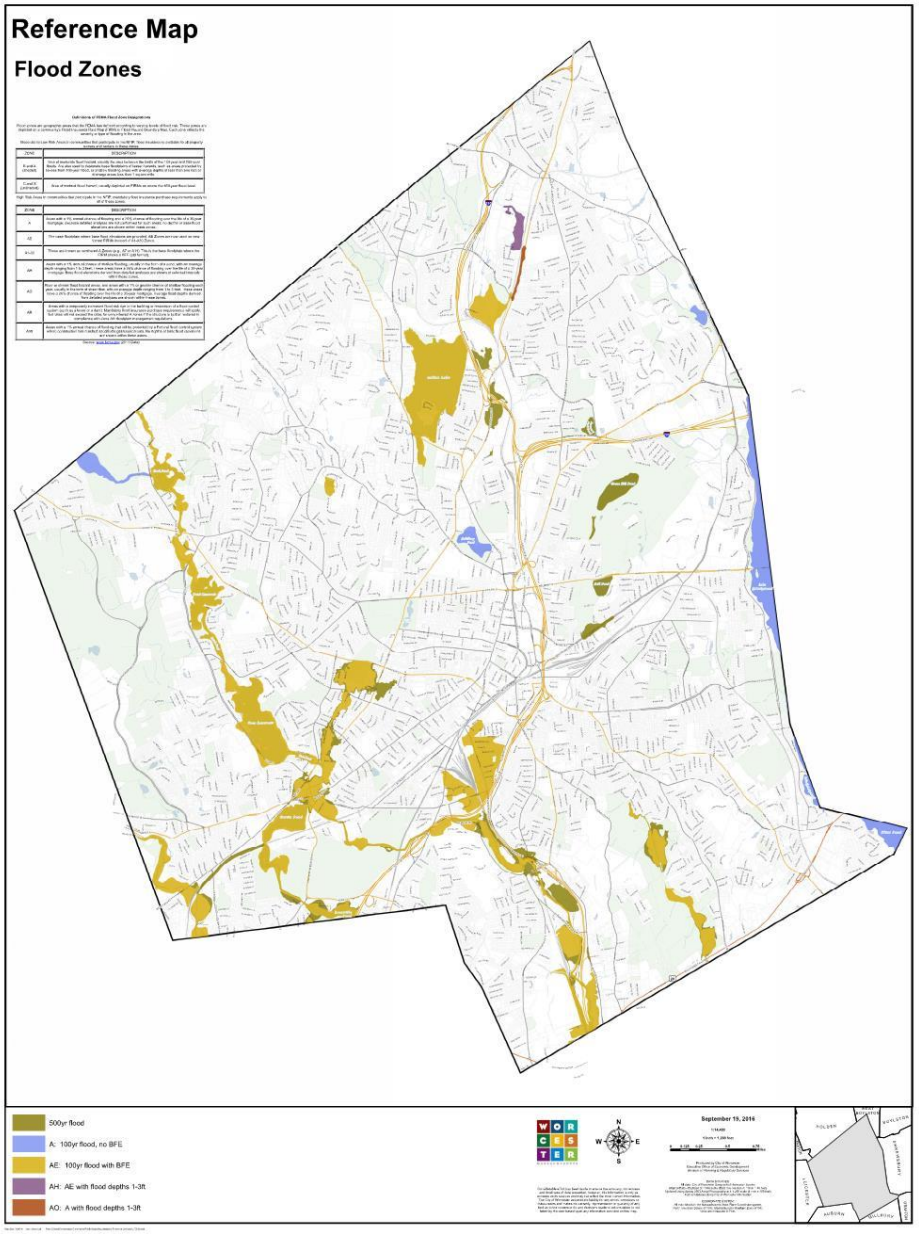
Source: Worcester Integrated Plan [DRAFT], Kleinfelder 2018

FEMA Flood Zones (overbank flooding)

- **Based on historic data** to predict flooding events (doesn't account for climate change)
- **Example**: A 100-year flood is a an event that has a 1% probability of occurring in any given year (500-year flood has 0.2% probability)
- **Used to set requirements** for building code and flood insurance

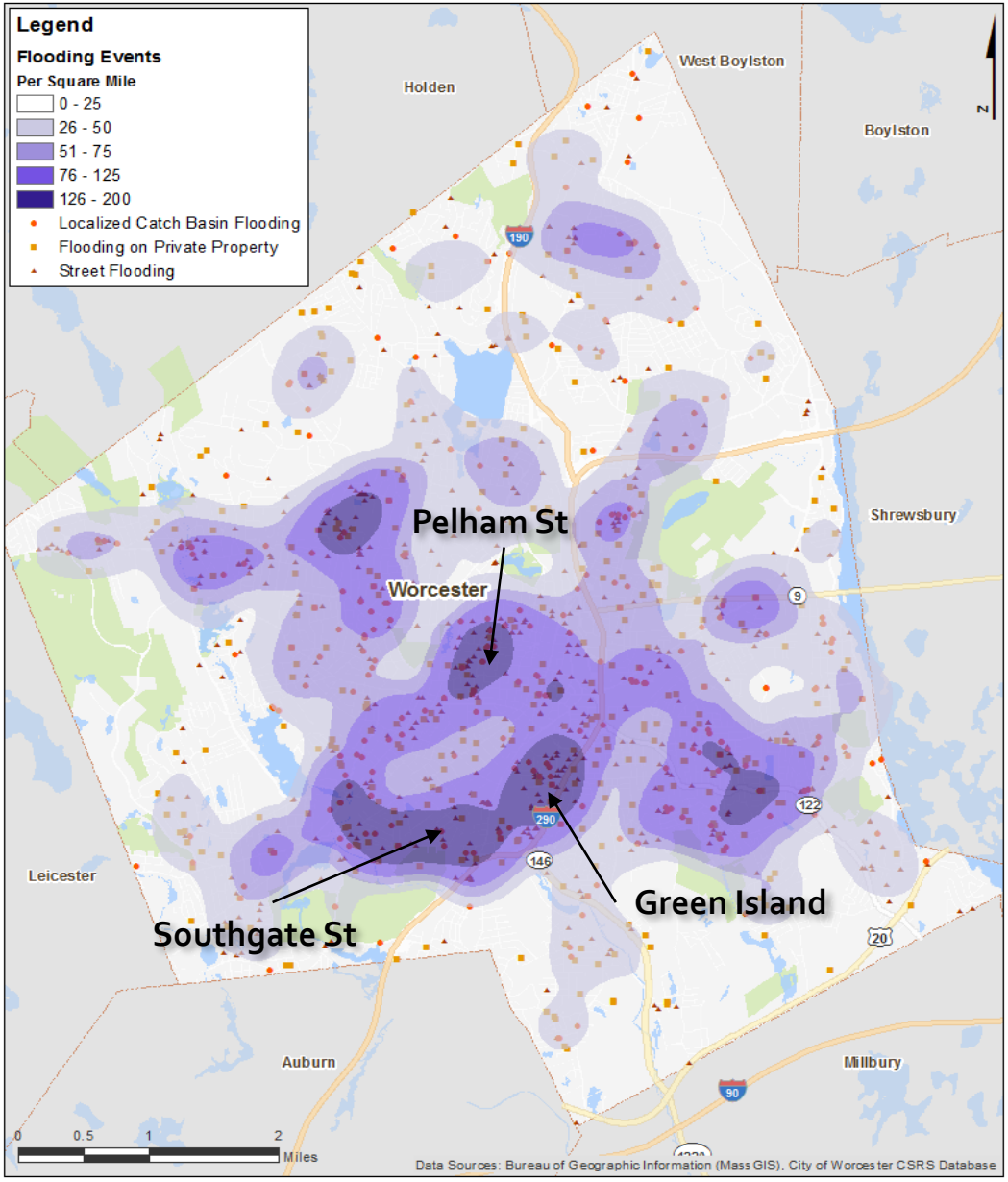
Source: https://www.fema.gov/disaster/updates/fema-flood-maps-and-zones-explained





Source: http://www.worcesterma.gov/planning-regulatory/boards/conservation-commission

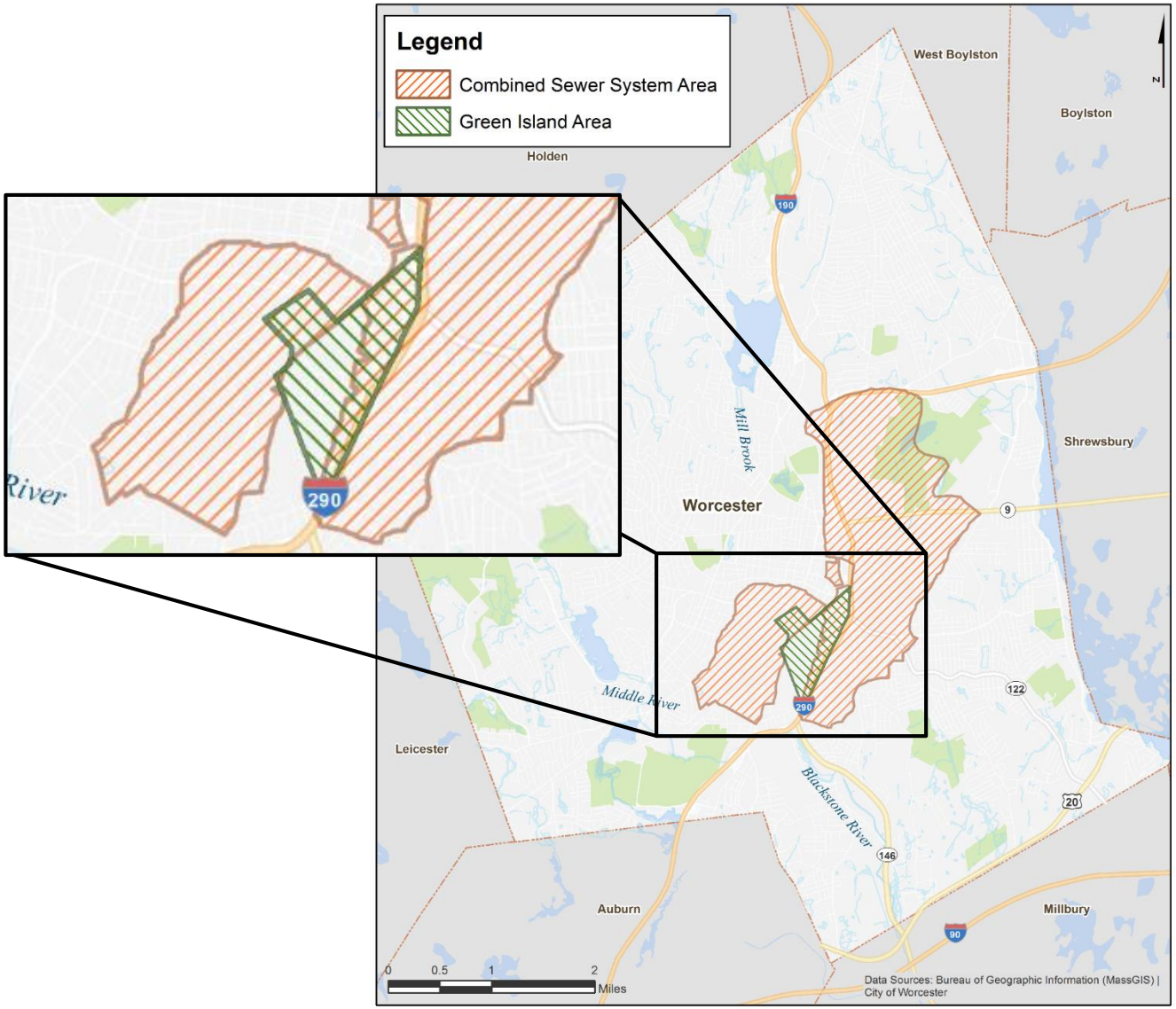
FLOODING DUE TO FINITE STORMWATER DRAINAGE CAPACITY



Concentration of Reported Flooding Events, 2006-2016

Source: Worcester Integrated Plan [DRAFT], Kleinfelder 2018

Combined Sewer Infrastructure



Combined sewer infrastructure map

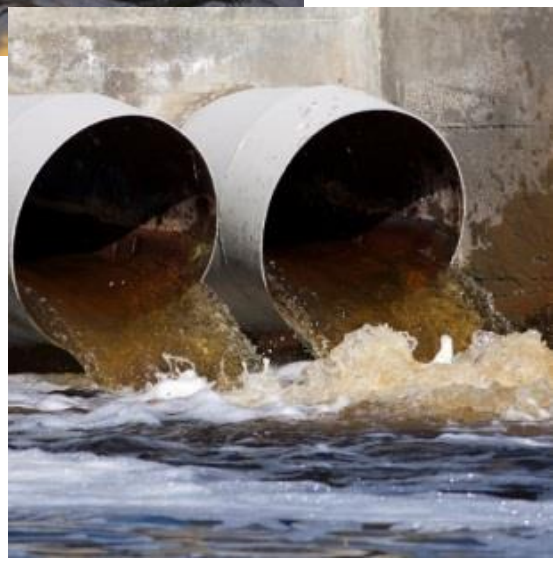
- Combined sewer areas (in brown) are located in the oldest and typically most populated areas of the city.
- Locations are vulnerable to Combined Sewer Overflows (CSOs) during heavy rain events.
- Green Island (in green) area is particularly susceptible given its low-lying topography and location .

Source: Worcester Integrated Plan [DRAFT], Kleinfelder 2018

Flooding from extreme precipitation
Community Vulnerabilities

Some of the concerns included:

- inadequate conveyance capacity
- clogged catch basins
- undersized culverts
- poor surface water quality
- disrupted emergency communications
- transient and immigrant population with lack of local knowledge on resources and service providers
- degrading water quality
- lack of enforcement on other pollution prevention measures
- managing risk for groundwater contamination and pollution of waterways from industrial sites



Source: Worcester Integrated Plan [DRAFT], Kleinfelder 2018

Flooding from extreme precipitation

Climate Change Projections

Climate Indicator		Observed Value 1971-2000 Average	Mid-Century Projected Change in 2050s	End of Century Projected Change in 2090s
Days with Precipitation > 1"	Annual	7 days	Increase by 10-42% 8-10 more days per year	Increase by 15-55% 8-11 more days per year
	Winter	2 days	Increase by 10-69% 2-3 more days per year	Increase by 25-109% 2-3 more days per year
	Spring	2 days	Increase by 2-46% 2 more days per year	Increase by 11-82% 2-3 more days per year
Total Precipitation	Annual	47 inches	Increase by 2-13% Increase of 1 - 6 inches	Increase by 3-16% Increase of 1.2 - 7.3 inches
	Winter	11.2 inches	Increase by 1-21% Increase of 0.1 - 2.4 inches	Increase by 4-35% Increase of 0.4 - 3.9 inches
Consecutive Dry Days	Summer	12 days	Variable (-1 - +2 days)	Variable (-1 - +3 days)
	Fall	12 days	Increase by 0 - 3 days	Increase by 0 - 3 days

Source: http://resilientma.org/changes/changes-in-precipitation

Snow/Ice Storms
Community Vulnerabilities

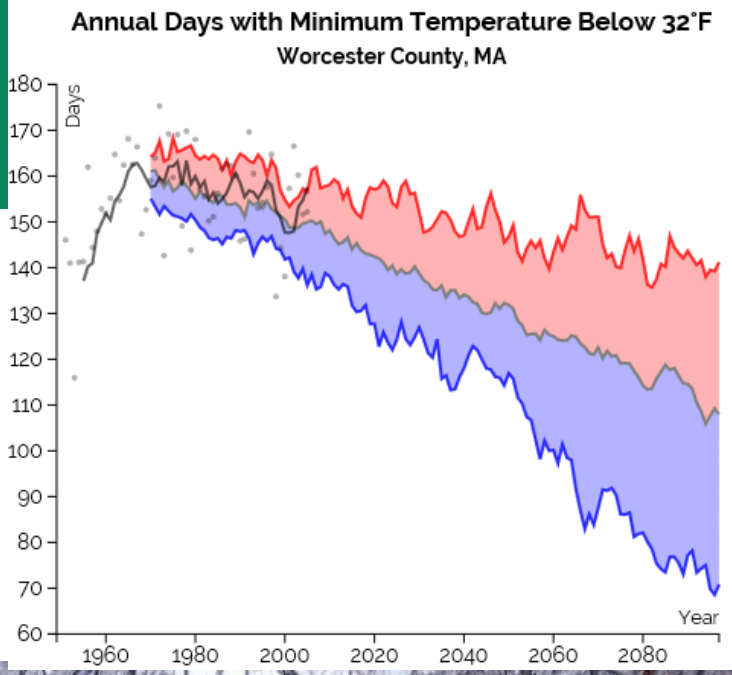
Worcester is susceptible to large snow and ice storm events.

Some of the concerns included:

- Obstructed emergency access/evacuation
- Managing frozen water pipes
- Obstructed access to emergency shelters
- Property damage
- Negative impact on economic business opportunities
- Inadequate capacity for sheltering vulnerable populations

Snow/Ice Storms
Climate Change Projections

- Annual precipitation volume in winter is projected to ***increase*** 30% due to climate change.
- Annual days below freezing is projected to ***decrease*** over the next 80 years due to climate change.
- This will cause **more winter precipitation to fall as rain or freezing rain** instead of snow.



Extreme Heat Community Vulnerabilities

Yes, heat is a problem in New England!

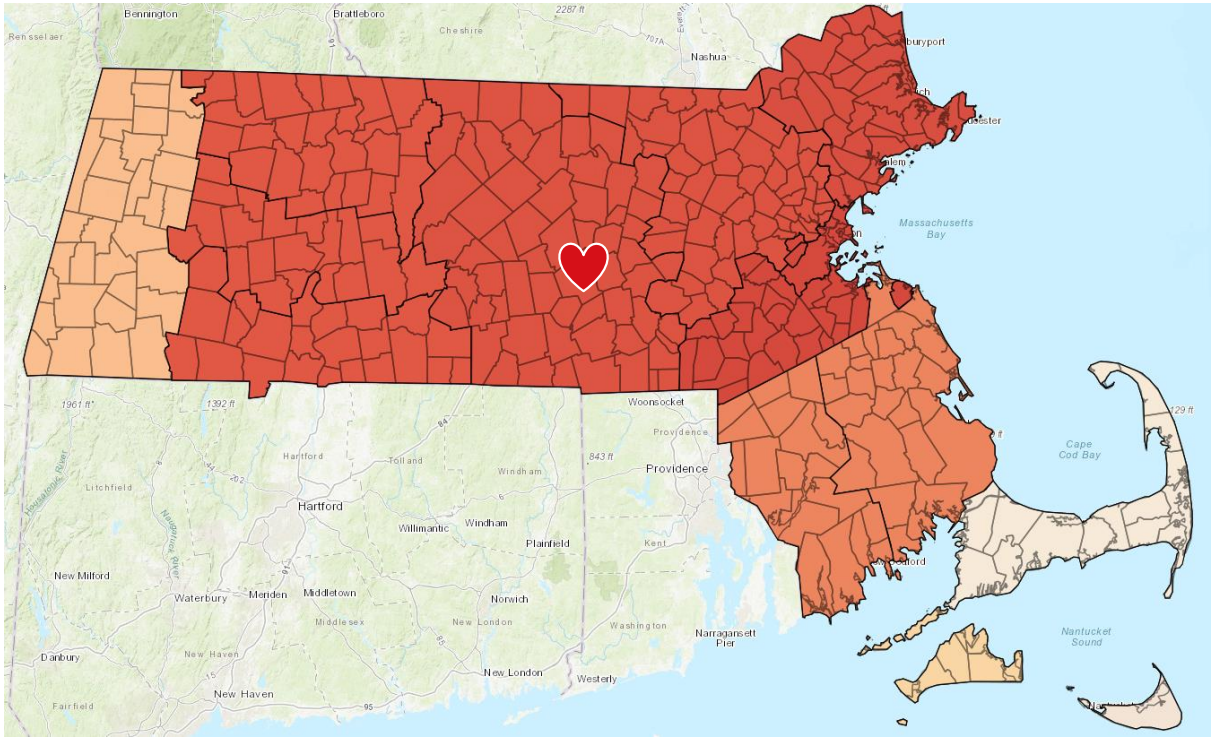
- Heat effect exacerbated in impervious surface areas known as "**heat islands**"

Some of the concerns included:

- power outages (brownouts) and service interruptions.
- inadequate energy efficiency of buildings
- inadequate capacity for sheltering vulnerable populations
- overstressed healthcare providers
- combatting invasive species

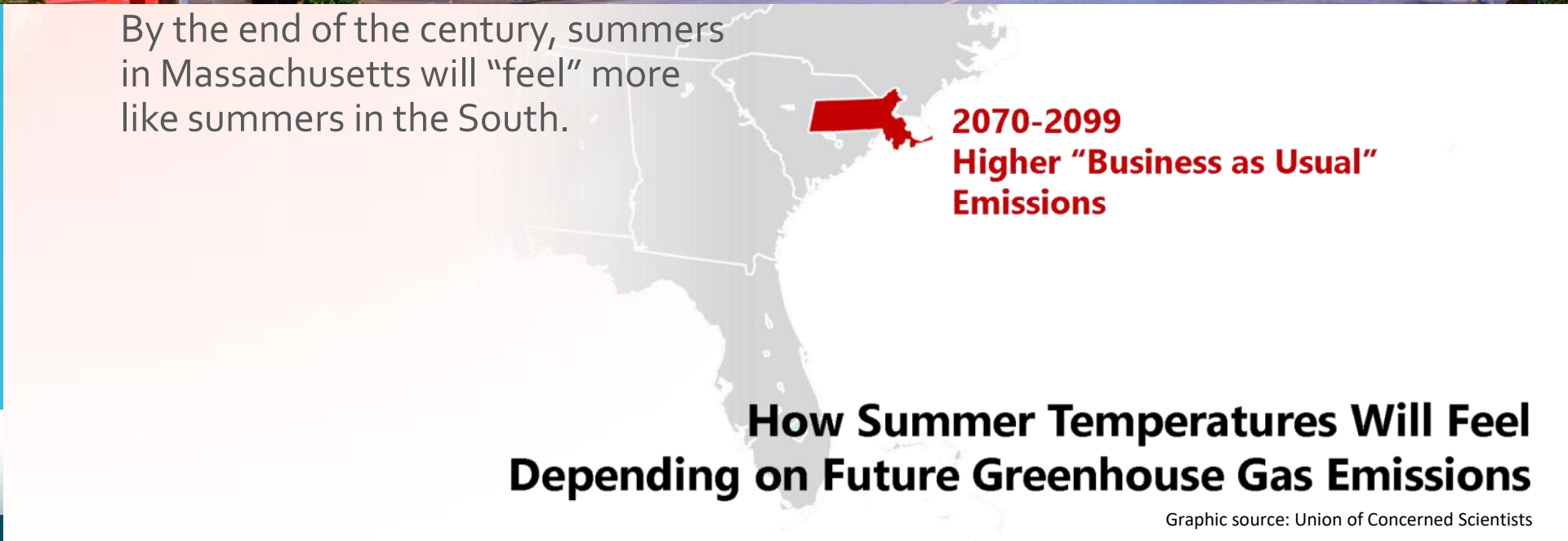
Extreme Heat
Climate Change Projections

2070 projection: 25 ***more*** days over 90°



Extreme Heat
Climate Change Projections

By the end of the century, summers in Massachusetts will "feel" more like summers in the South.

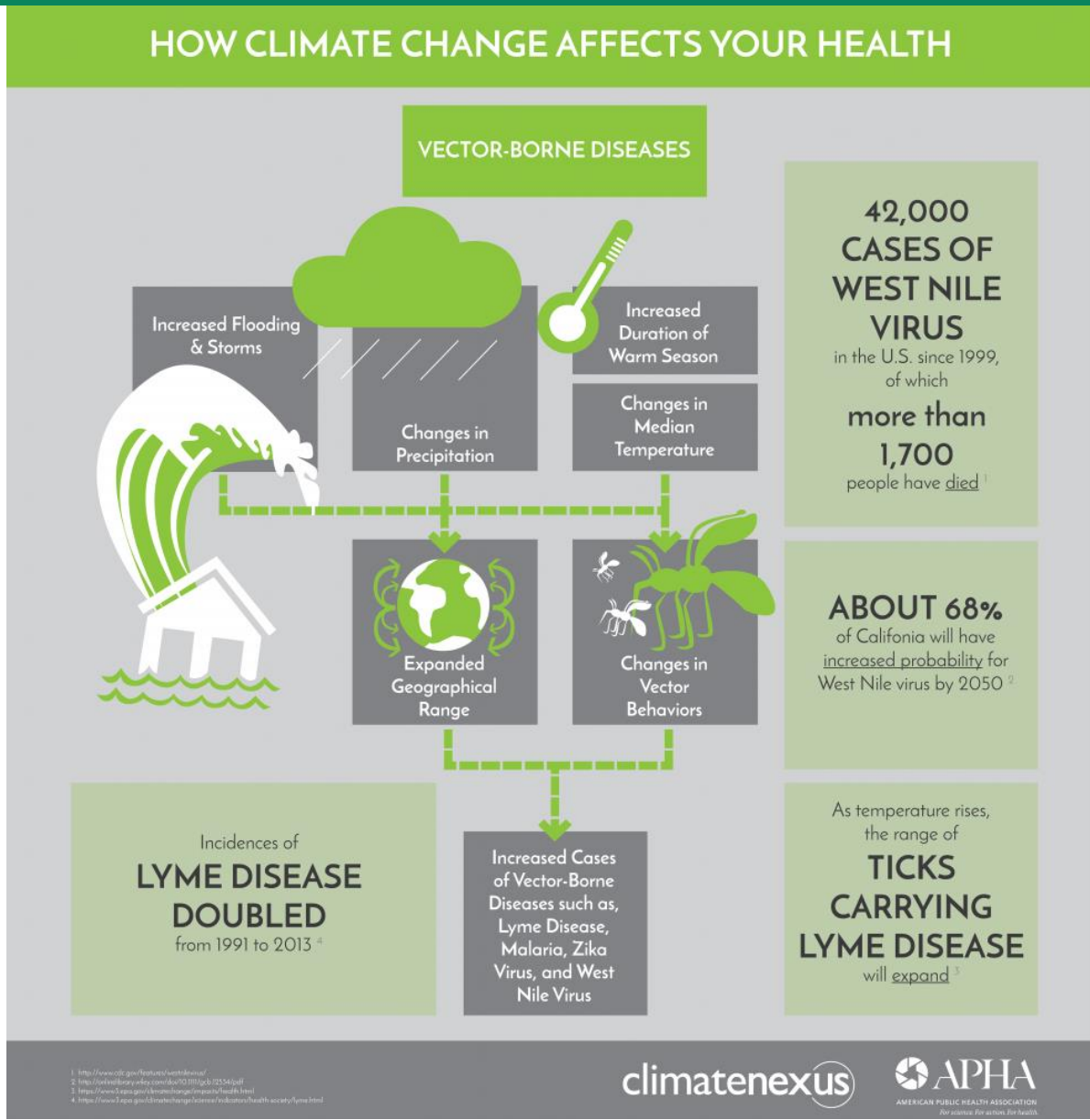


Graphic source: Union of Concerned Scientists

Extreme Heat
Climate Change Projections

Human health issues:

- Heat-related illness and mortality
- Air quality, asthma
- Vector-borne diseases



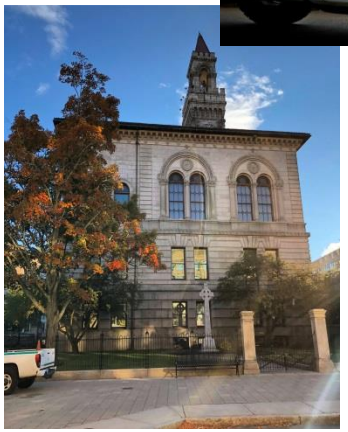
Drought Community Vulnerabilities

- Reduces surface water storage & recharge of groundwater supplies
- Exacerbates the impacts of flood events on water quality (less vegetation, drier soils lose capacity to hold water)
- Weaken tree root systems, making them more susceptible to toppling during high wind events.

Worcester City Manager Edward Augustus Jr. standing inside a portion of the Quinapoxet Reservoir during the drought in September 2016.

- In Worcester, there have been 7 major droughts since 1930 (3-8 years each)

COMMUNITY STRENGTHS



Recommended Priority Actions To Improve Community Resilience

RECOMMENDATIONS - INFRASTRUCTURE

- **Develop a public outreach and education initiative**
- **Stormwater management**
  - System-wide hydrologic/hydraulic drainage evaluation and model
  - Investigate a stormwater enterprise fund/stormwater utility fee
  - Prioritize green infrastructure projects to mitigate urban heat island and reduce flooding
- **Buildings**
  - Implement adaptation/resiliency strategies to harden critical city-owned buildings
- **Transportation**
  - Advocate and assist in creating a resilient transportation network
- **Drinking Water**
  - Assess the vulnerability of drinking water supply to future drought conditions

Recommendations – Societal Features

- **Initiate an education program/campaign**
  - Be inclusive, multi-lingual, make info accessible
  - Help people know when and how to shelter
- **Improve the City's emergency planning to incorporate climate change**
  - Increase collaboration
  - Increase communication during emergency to most vulnerable populations
- **Empower renters and property owners to prepare**
  - Update old building stock to improve resilience

RECOMMENDATIONS - ENVIRONMENT

- **Protect open space and water resources**
  - Continue Blue Spaces program
  - LID requirements in regulations to manage stormwater
- **Improve waste collection practices**
  - Composting
  - Recycling
- **Increase urban tree canopy**
  - ID locations, create inventory
  - Replacement programs, regulations, & maintenance

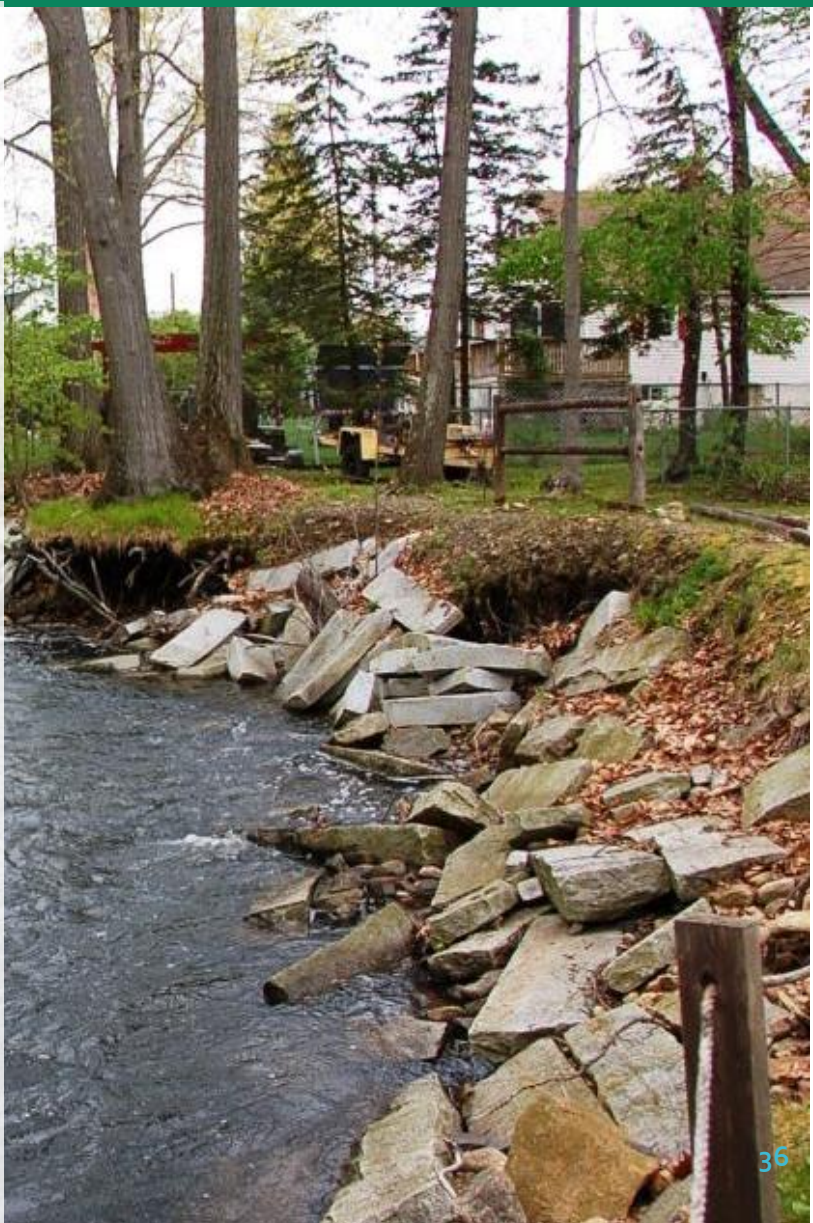
Questions & Answers

1. What surprised you or was inconsistent with your perception of Worcester?

2. What concerns you? Where are opportunities?

3. Where would you like to see more information? What's missing?

4. Which recommendations are the highest priority?



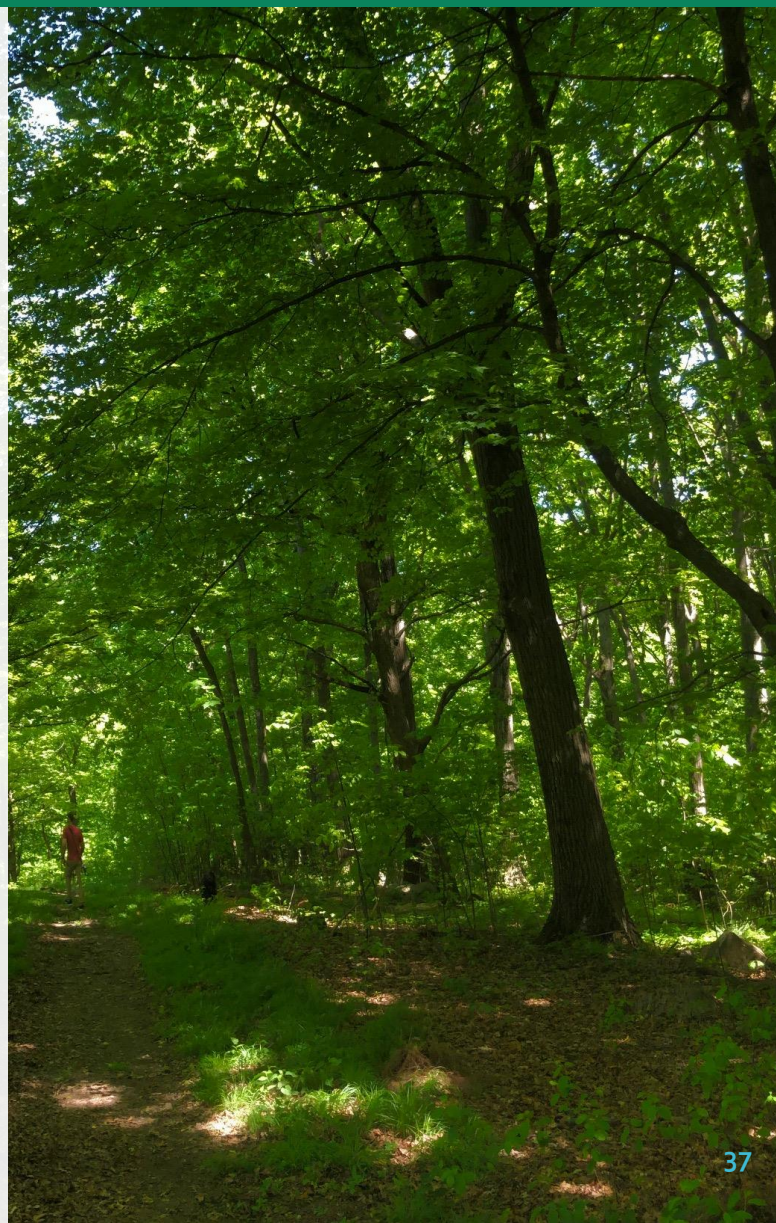
Questions & Answers

Next Steps

- Finalize report
- Be designated an MVP Community
- MVP Action Grant

Where to get more information

- **Current -** http://www.worcesterenergy.org/leading-by-example/resilient-worcester
- **Upcoming –** www.worcesterma.gov/Resilience



COMMENTS

Submit comments on the Report by June 25th, 2019
to

WorcesterEnergy@worcesterma.gov

Thank You !!!

The Kleinfelder Team

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Stefanie Covino

Michelle Smith

James Bedard

Matthew Labovites