# Appendix D: Workshop Material

Overview Slideshow

Climate Change Predictions Slideshow

Brookfield Hazards Slideshow

Workshop Sign-in Sheet

# Municipal Vulnerability Preparedness (MVP)

**Brookfield Workshop**

**April 25, 2019**

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Central Massachusetts Regional Planning Commission

# AGENDA

1. Welcome
2. Introductions – What has drawn you to this meeting? What is your connection?
3. Workshop Overview (Trish Settles)
4. Climate Change Projections, Impacts & Mitigation, Nature Based Solutions Eli Goldman (CMRPC)
5. Profile of Natural Hazards & Critical Infrastructure, Andrew Loew, (CMRPC)
6. Small Team Exercises Part 1

   LUNCH
7. Small Team Exercises Part 2
8. Small Teams Report Back
9. Wrap Up, Next Steps, Closing Remarks

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# Municipal Vulnerability Preparedness

- The Municipal Vulnerability Preparedness grant program (MVP) provides support for cities and towns in Massachusetts to begin the process of planning for climate resiliency. Communities who complete the MVP program become certified as an MVP community and are eligible for follow-up grant funding and other opportunities to assist in implementing strategies
- Based on Community Resilience Building Program as developed by Eli Welchel of the Nature Conservancy and National Oceanic and Atmospheric Administration (NOAA)

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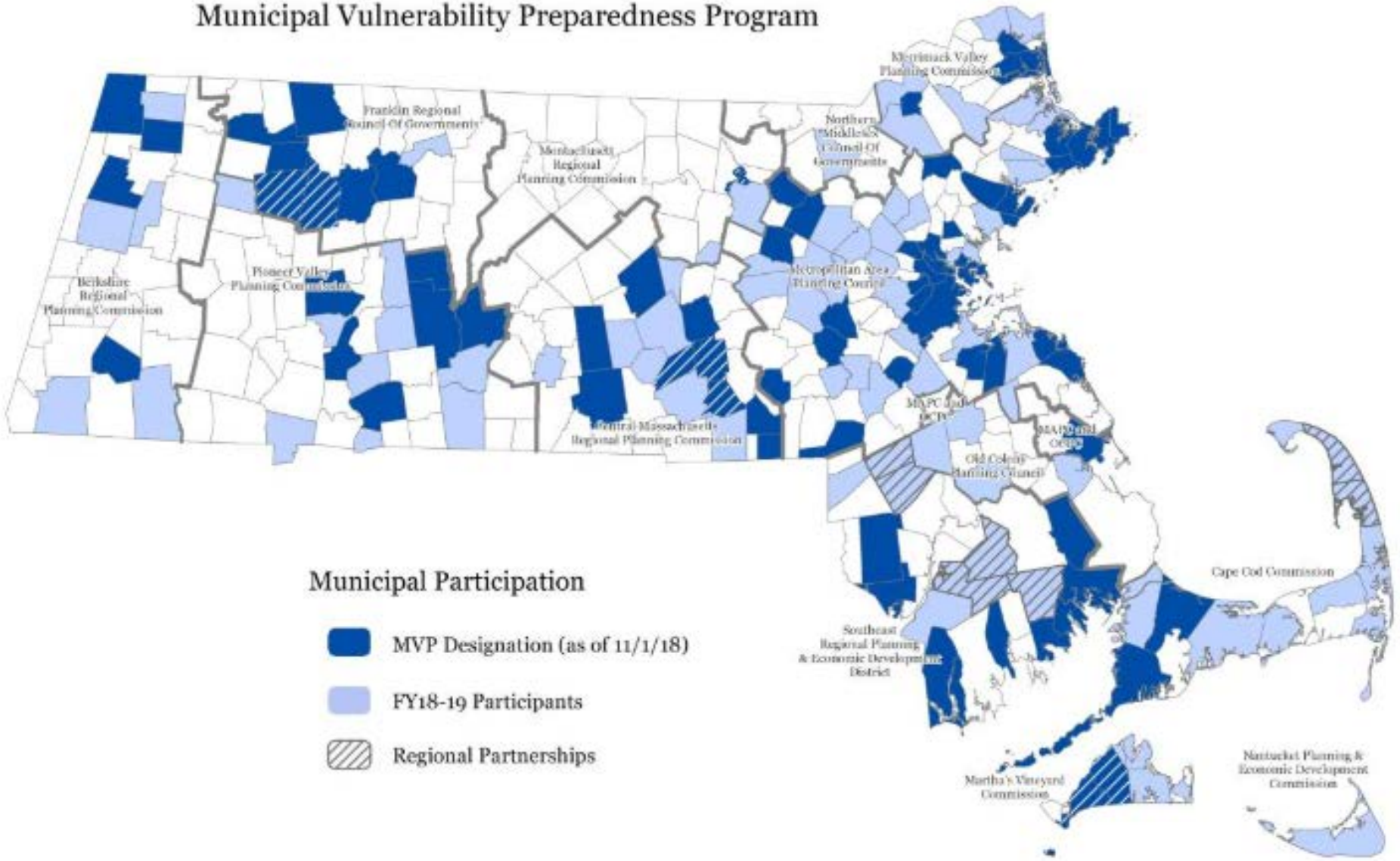


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# Be Prepared, Mitigate the Costs!!

- Climate Preparedness Week –
  - September 24- September 30

- US Natural Disasters in 2017 cost $306 Billion, the most expensive year since NOAA started keeping track in 1980

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# Hazard Mitigation Planning

- Excellent synergy with Hazard Mitigation Planning, but MVP is more focused on climate change in the long term
- Brookfield's Hazard Mitigation was formally accepted by FEMA in September 2018.
- 5-year plans reviewed and approved by MEMA and FEMA with very specific requirements that make municipalities eligible for mitigation grants if and when there is a disaster declaration.

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# Workshop Objectives!

- Review and define extreme weather, natural and climate-related hazards
- Identify existing and future vulnerabilities and strengths
- Develop and prioritize actions for the community and broader stakeholder networks, and
- Identify opportunities for the community to advance actions to reduce risks and build resilience

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# Time to Get to Work!!!

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# First Hazard Identification….

- Winter Storms
- Snow
- Ice
- Flooding
- Tsunami
- Hurricanes
- Wind Events
- Tornadoes
- Drought
- Earthquakes
- Riverine Flooding
- Street Flooding
- Dust Storms
- Wild Fires
- Landslides, Mud Slides
- Coastal Flooding

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# 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, drought, heat wave, etc.)

| Features | Location | Ownership | V or S | Floods | Winter Storms | Droughts & Wildfires | Priority H - M - L | Time Short Long Ongoing |
|---|---|---|---|---|---|---|---|---|
| **Infrastructural** | | | | | | | | |
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| **Societal** | | | | | | | | |
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| **Environmental** | | | | | | | | |
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# The Matrix (no, not the movie)

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# At the Tables…..

- Tables of 6-8 individuals
- We could do table each for
  - Societal,
  - Infrastructure,
  - Environmental and
  - One Mixed (all 3)
- (If we need to balance the tables we may ask you to join another table.)
- Tools and Resources
  - Matrix, Maps, Markers, Dots, & Each Other.

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# Who

- Table Facilitator directs the discussion and keeps the dialogue moving
- Scribes filling in matrix
- CMRPC resource person
- Participants
- ID Table spokesperson for Report Out

# BREAK OUT GROUP Instructions

- Part 1 (Before Lunch)- For each Feature
  - ID category (Environmental, Societal, or Infrastructure)
  - Identify key features – (For Example, Dams, Railroads, Vulnerable Neighborhoods, etc.)
  - Consider ownership

  ---

- Part 2 (After Lunch) – For each Feature
  - Identify and Develop Priority Actions
  - ID Priority and Time

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# The Assignment

- Identify Hazards (For Example - Flooding, Winter Storms and Drought)
- Under sector, decide infrastructure, societal, or environmental,
- Identify location/attribute (nursing home, wetland, airport, public safety building, mill, bridge, communications center)
- Identify ownership (Public or Private or other)
- Assess whether the feature is a vulnerability or a strength.
- Indicate on Base Map
- Focus mainly on town specific major issues
- Develop and prioritize action.

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# Community Resilience Building Workshop Risk Matrix

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

Top 4 Hazards (tornado, floods, wildfire, hurricanes, snow/ice, drought, sea level rise, heat wave, etc.)

| Features | Location | Ownership | V or S | Coastal Flooding SLR/Storm Surge | Inland Flooding and Rain Events | Ice and Snow | Wind | Priority H-M-L | Time Short Long Ongoing |
|---|---|---|---|---|---|---|---|---|---|
| **Societal** | | | | | | | | | |
| Elderly Citizens (facilities) | Multiple | Private | V | Assess and identify vulnerabilities to determine residents needs during emergencies; Coordinate emergency planning efforts; Conduct routine evacuation drills | | | | H | S |
| Neighborhood Cooperation | Town-wide | Private | V | Assist associations in identifying and conducting best practices to reduce risk; Advance a "Neighbor helping Neighbor" Program through Community Center training | | | | H | S |
| Faith-based Organizations | Multiple | Private | V | Coordinate organizations in identifying and conducting best practices amongst members to reduce risk | | | | H | S |
| Municipal & Regional Tabletop Exercise | Town/Region | Town | V | Need to conduct exercises to maximize readiness; Better regional planning/communication plan to discuss vulnerabilities, share ideas, and resources | | | | H | S |
| Homeless Population | Town-wide | Town | V | Extreme weather flyers and communications about available services | | | | M | S |
| Database (locations of vulnerable population) | Town/Region | Town/State | V | Need to improve database to ensure high level responses and safety | | | | M | S |
| Vulnerable Neighborhoods | South side | Town/Private | V | Identify level and location of vulnerable units; Develop longer term plan to reduce vulnerability | | | | M | L |
| Coordinated Evacuation Plan | Town-wide | Town/State | V | Reconfigure evacuation routes; Update signage along critical routes | | | | L | S |

# Report Outs

- Areas of agreement
- Areas of unique perspectives

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# Summary Discussion

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# Next Steps

- Summary Public “Listening” session with Board of Selectmen Presentations
- Report
- Develop resources and Implement actions.

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# Questions or Comments on the Workshop

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# Questions – Contact Us

- Brookfield Board of Selectmen - Clarence Snyder csnyder@brookfieldma.us
- CMRPC – Eli Goldman, egoldman@cmrpc.org
- Executive Office of Energy and Environmental Affairs – Katie Theoharides, kathleen.theoharides@state.ma.us

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# Thank You

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# Municipal Vulnerability Preparedness Program

## Brookfield

## Climate Change Projections

Eli Goldman, CMRPC

# Northeast Climate Science Center UMass Amherst

- Climate Models from the IPCC Fifth Assessment Report
- The Historical Data 1971-2000
- Medium and High Emission Scenarios were Chosen
- Medium Scenario Assumes Emissions Peak at Mid-Century
- High Scenario Assumes a Continuing Emission Trajectory

NE CASC
Northeast Climate Adaptation Science Center

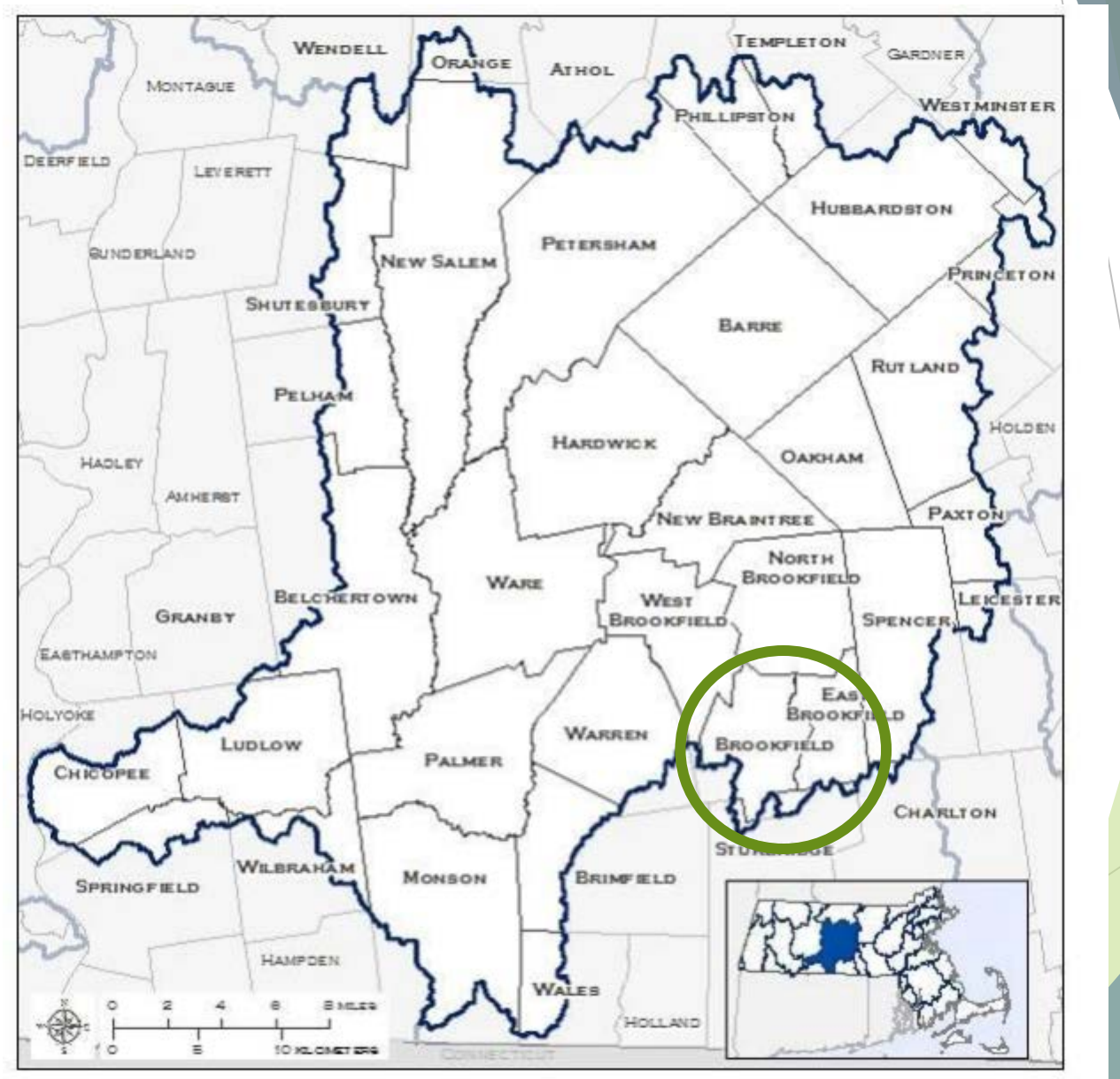
# Our Climate is Already Changing

- Temperature:  2.9°F
  Since 1895
- Growing Season:  11 Days
  Since 1950
- Sea Level Rise:  11 inches
  Since 1922
- Strong Storms:  55%
  Since 1958

# Example Impacts of Climate Change

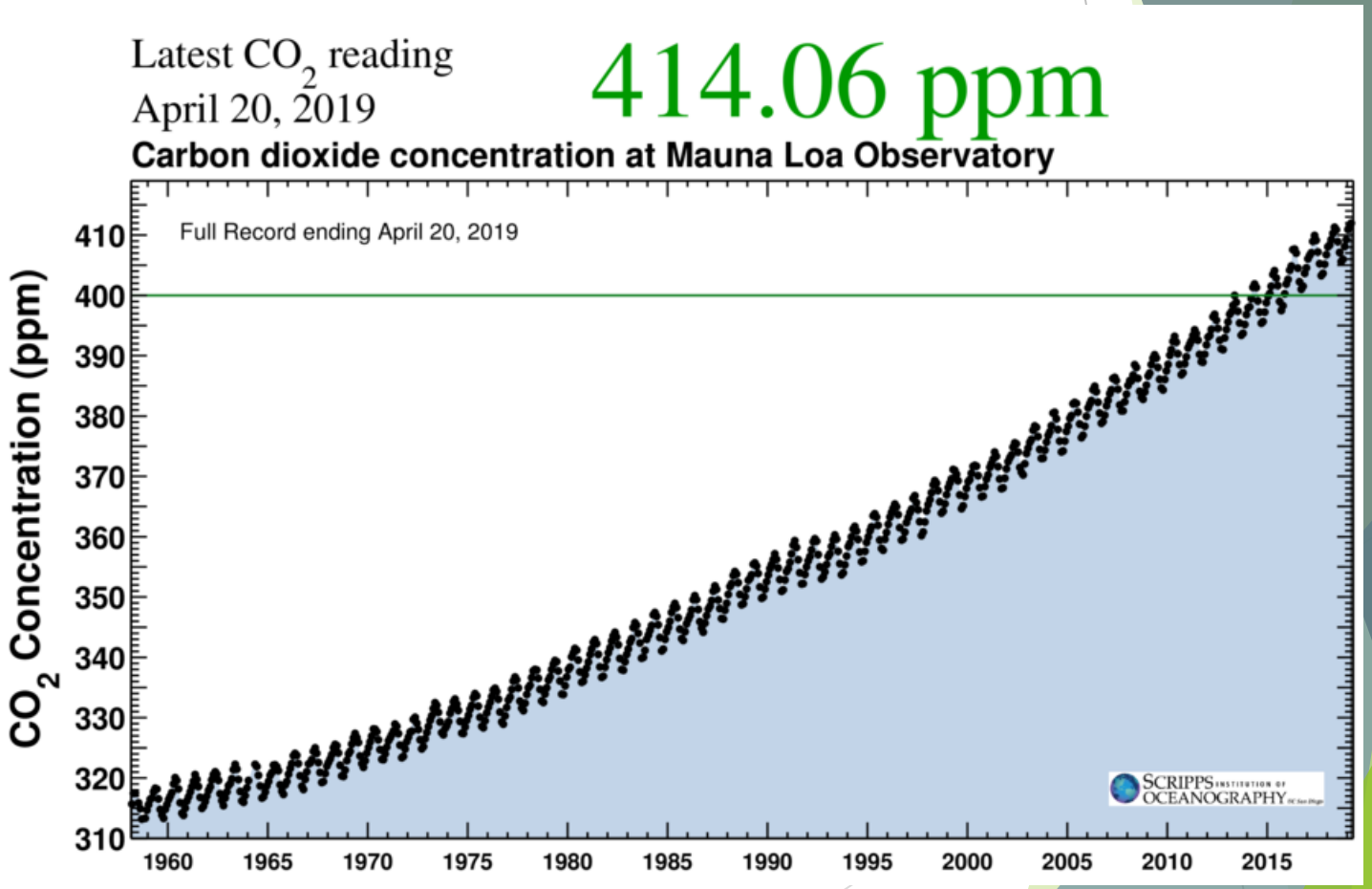
- Agriculture
  - More extreme temperature and precipitation can prevent crops from growing.
- Ecosystems
  - Range shifts can lead to extinction.
- Energy
  - Warming is likely to increase summer peak electricity demand in most regions of the United States.
- Forest
  - Warming temperatures generally increase the length of the growing season. It also shifts the geographic ranges of some tree species.
- Human Health
  - Warmer average temperatures will lead to hotter days and more frequent and longer heat waves. Impacts on vulnerable populations.
- Transportation
  - Heavy rains may result in flooding, which could disrupt traffic, delay construction activities, and weaken or wash out the soil and culverts that support roads, tunnels, and bridges.

# Chicopee River Basin



# Overview of Presentation

- **Hazards**
  - Winter Storms
  - Flooding
  - Wildfire/drought/heat
  - Severe weather (i.e. wind)
- **Climate projections**
  - Precipitation
    - Annual
    - Large events
    - Changes in "___ year storms"
  - Temperature
    - Consecutive dry days

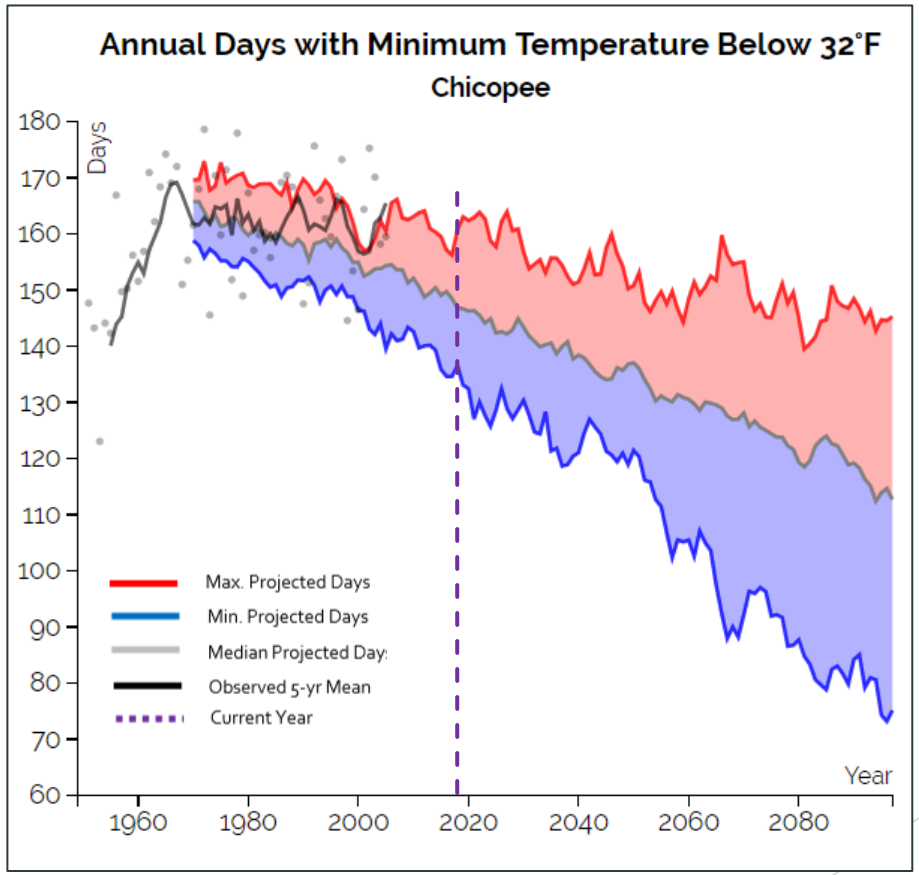


# Winter Storms

- Brookfield is susceptible to large snow and ice storm events
- The local geography plus the way eastern MA protrudes towards the Atlantic Ocean makes Brookfield particularly susceptible to nor'easters and other severe winter storms.

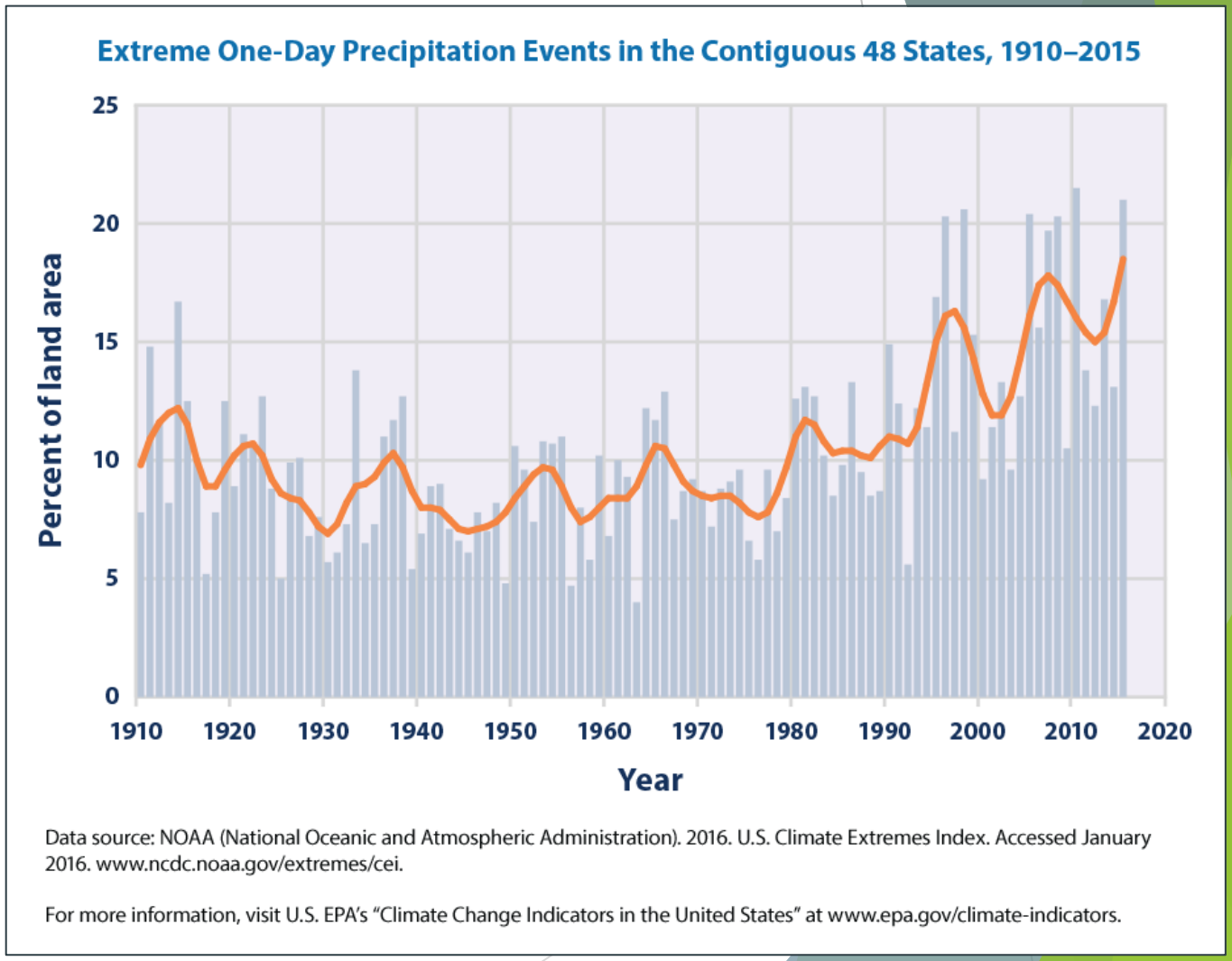
# Winter Storms

- Annual days below freezing is projected to decrease over the next 80 years
- Projected rising temperatures will cause more winter precipitation to fall as rain or freezing rain instead of snow.
- Winter season is expected to see the highest projected increase in precipitation
  - Winter is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and by 0-2 days by the end of century.

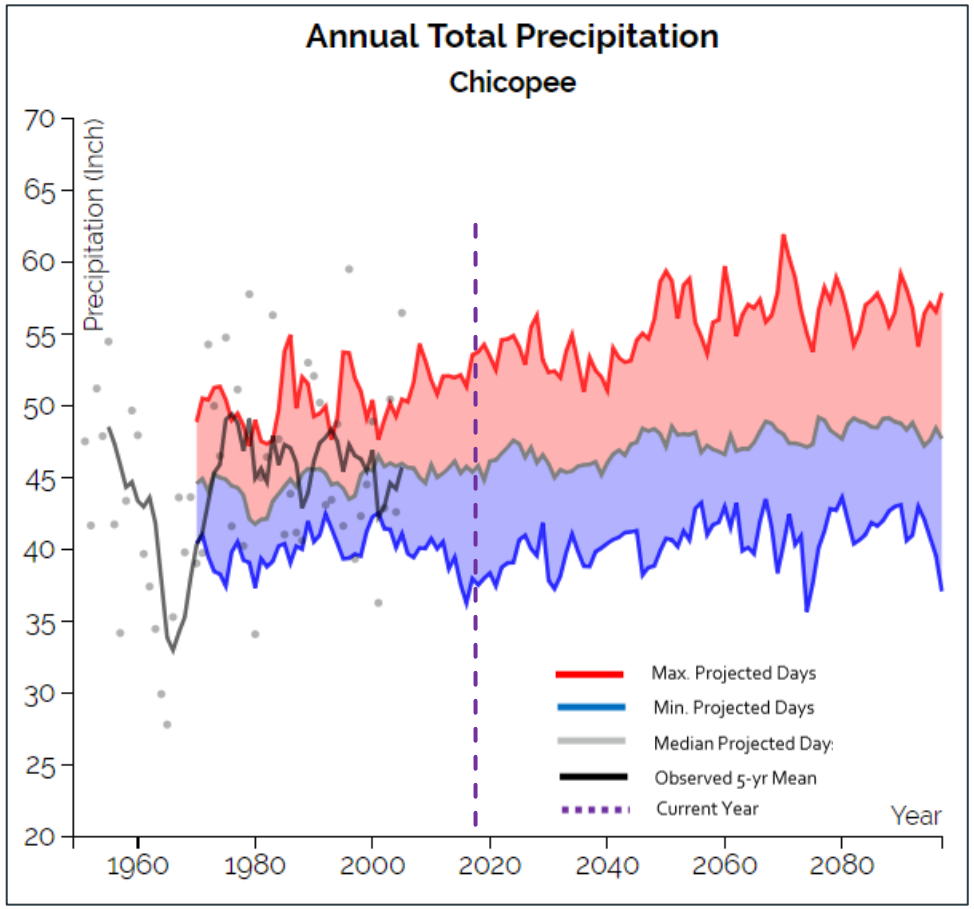


# Heavy Rainfall and Flooding

- Total annual rainfall will increase
- Heavy rainfall events will become more frequent
  - Overbank flooding from rainfall and snowmelt
  - Piped Infrastructure backup and or failure
- Water quality
  - Erosion
  - Nonpoint source pollution

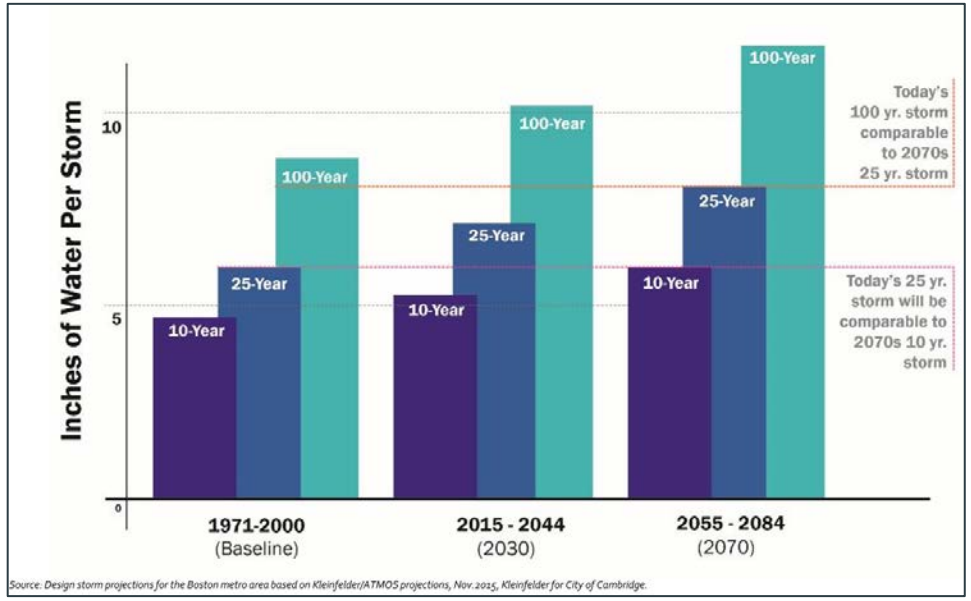


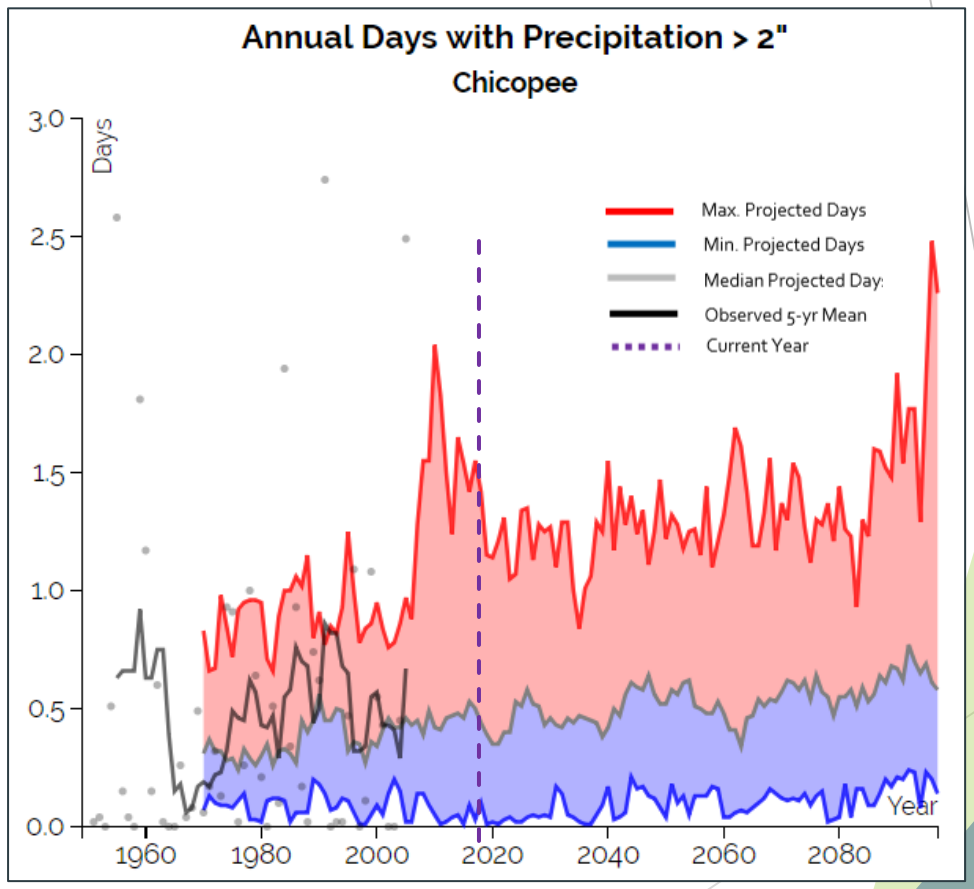
# Heavy Rainfall and Flooding



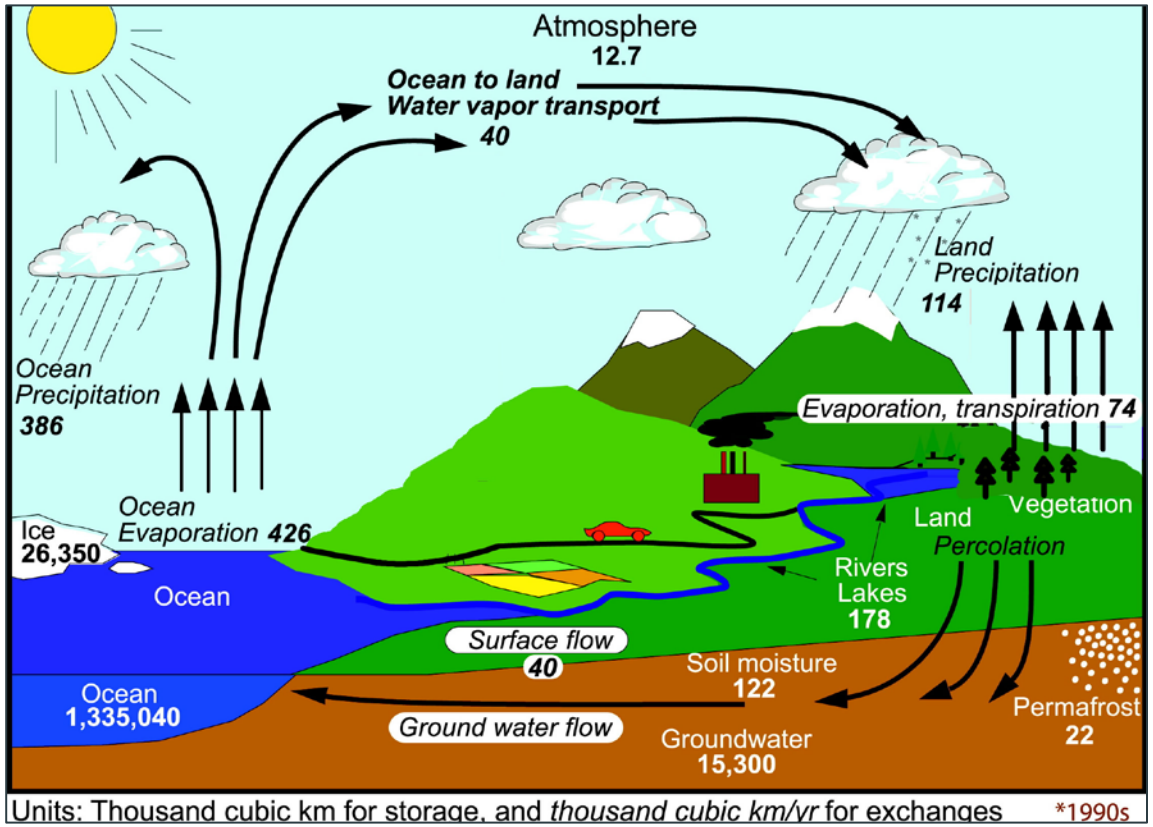

- **Winter** is expected to experience the greatest change with an increase of 0- 23% by mid-century, and of 6-37% by end of century.
- **Summer** could see a decrease of 0.2 to an increase of 2 inches by mid-century (decrease of 2% to increase of 17%), and a decrease of 1.2 to an increase of 2.0 inches by the end of the century (decrease of 10% to increase of 17%).
- **Fall** could see a decrease of 1.2 to an increase of 1.7 inches by mid-century (decrease of 10% to increase of 14%), and a decrease of 1.7 to an increase of 1.5 inches by the end of the century (decrease of 14% to increase of 12%).
- **Spring** is expected to an increase in days with precipitation over one inch of 0-1 days by mid-century, and an increase of 0-1 days by the end of century.

# Heavy Rainfall and Flooding



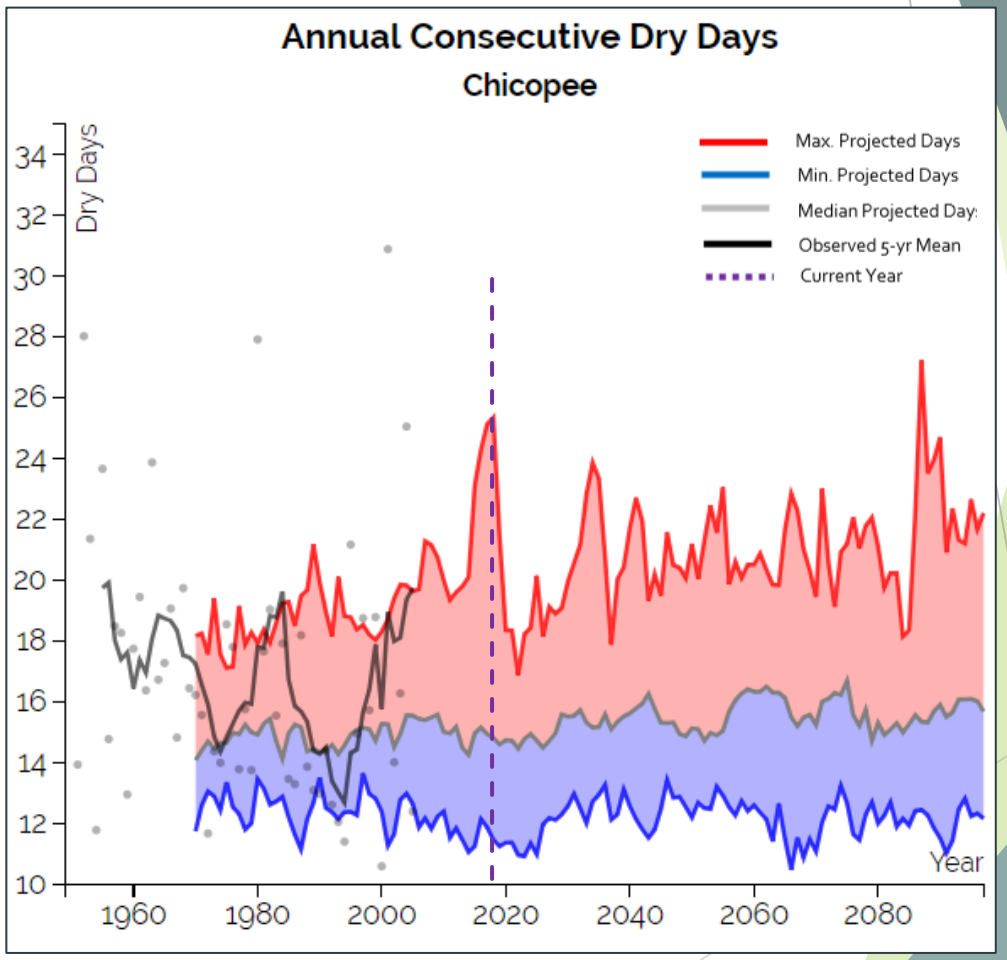
# Effects of Increased Precipitation



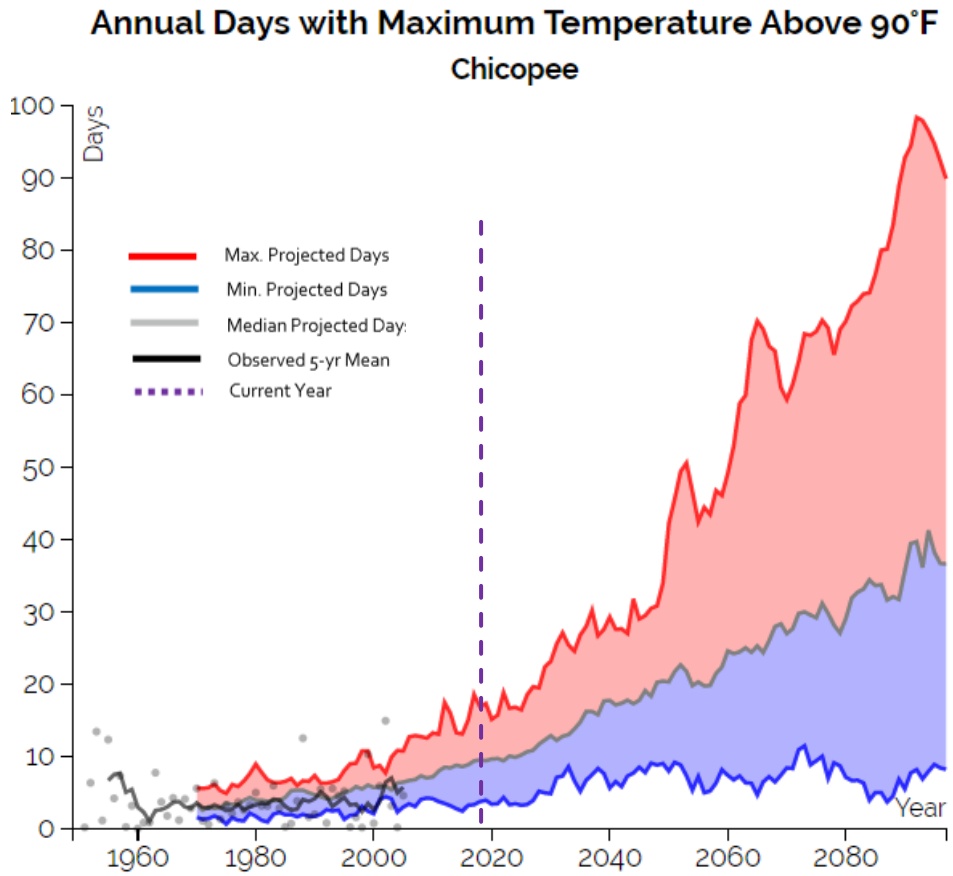

- More Flooding where it already floods
- Increase number of extreme rainfall events
- Drainage and Sewer Systems may not be able handle increased flow
- Ground Saturation

# Drought, Wildfire, Heat

- Annual and seasonal projections for consecutive dry days, or for a given period, the largest number of consecutive days with precipitation less than 1 mm (~0.04 inches), are variable throughout the 21st century.
- Seasonally, the fall and summer seasons are expected to continue to experience the highest number of consecutive dry days.
- The fall season is expected to experience an increase of 0-3 days in consecutive dry days by the end of the century



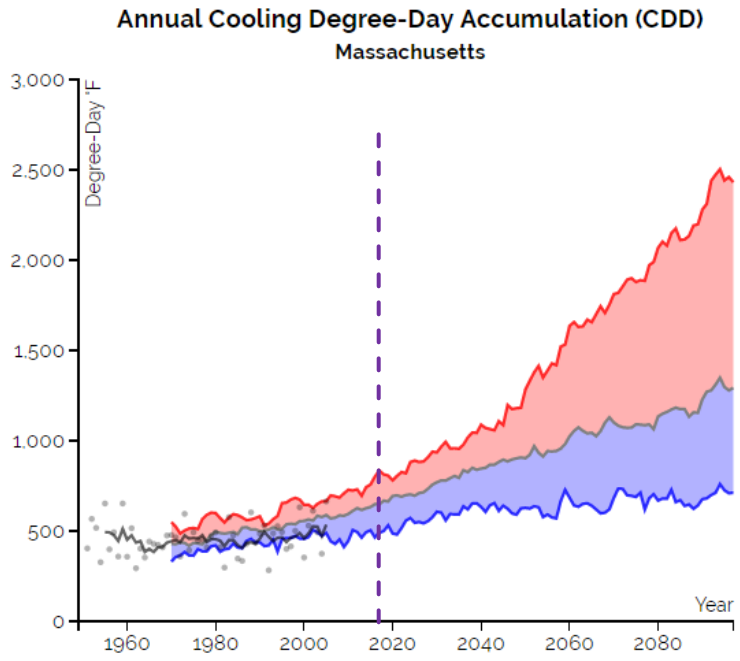
# Drought, Wildfire, Heat

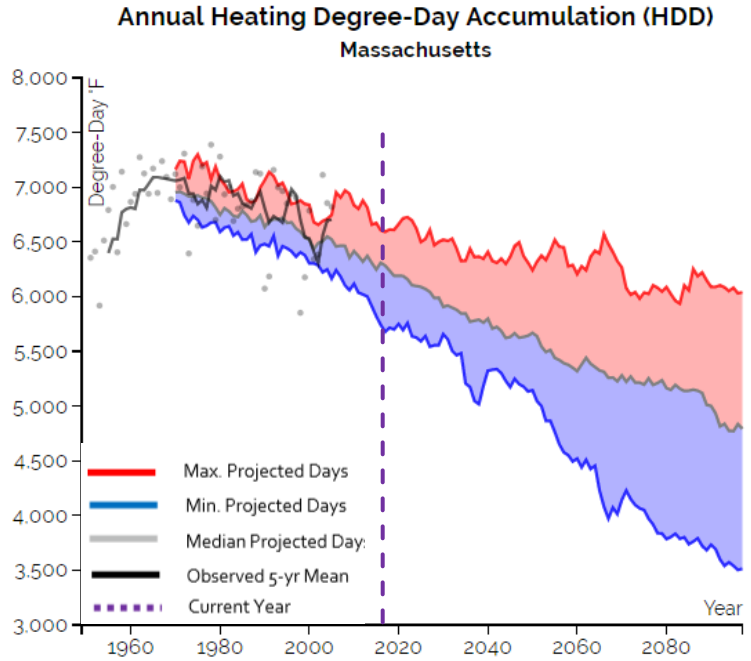



- Annually, the Chicopee basin is expected to see days with daily maximum temperatures over 90 °F increase by 8 to 29 more days by mid-century, and 11 to 69 more days by the end of the century.
- Seasonally, summer is expected to see an increase of 7 to 25 more days with daily maximums over 90 °F by mid-century.

# Drought, Wildfire, Heat

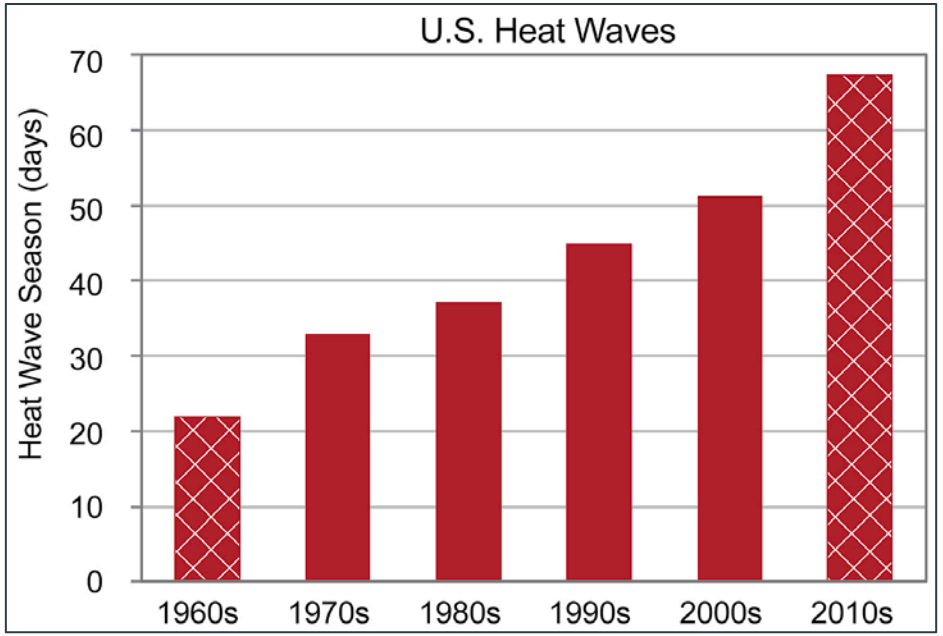
- Degree-days are a sum of the year's high or low temperatures relative to the mean. HDD apply to temps lower than the mean, CDD apply to temps higher than the mean.
- Total heating degree days will be 11-24% lower, but cooling degree days will be 57-150% higher (2050s).

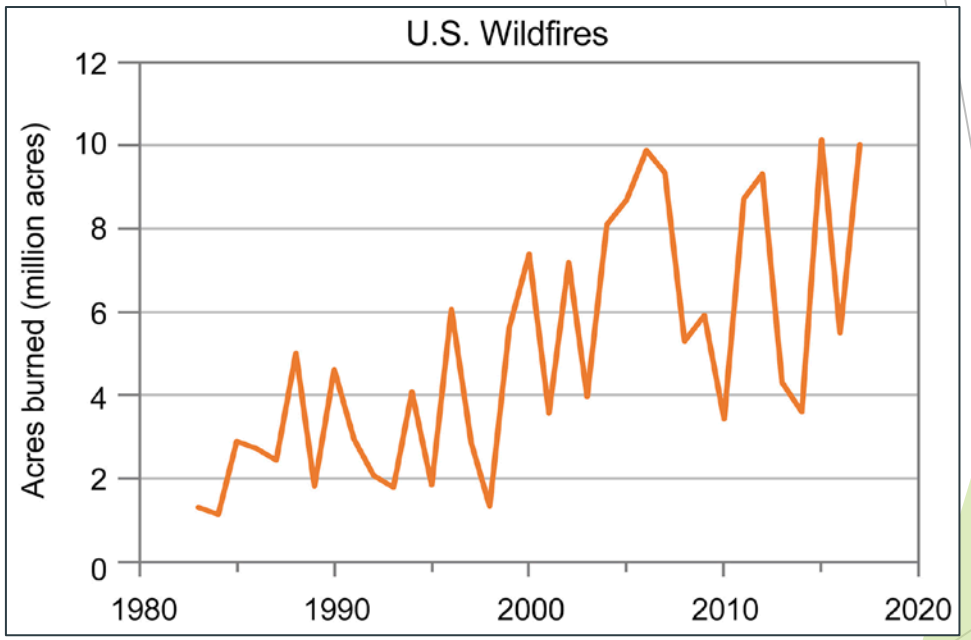


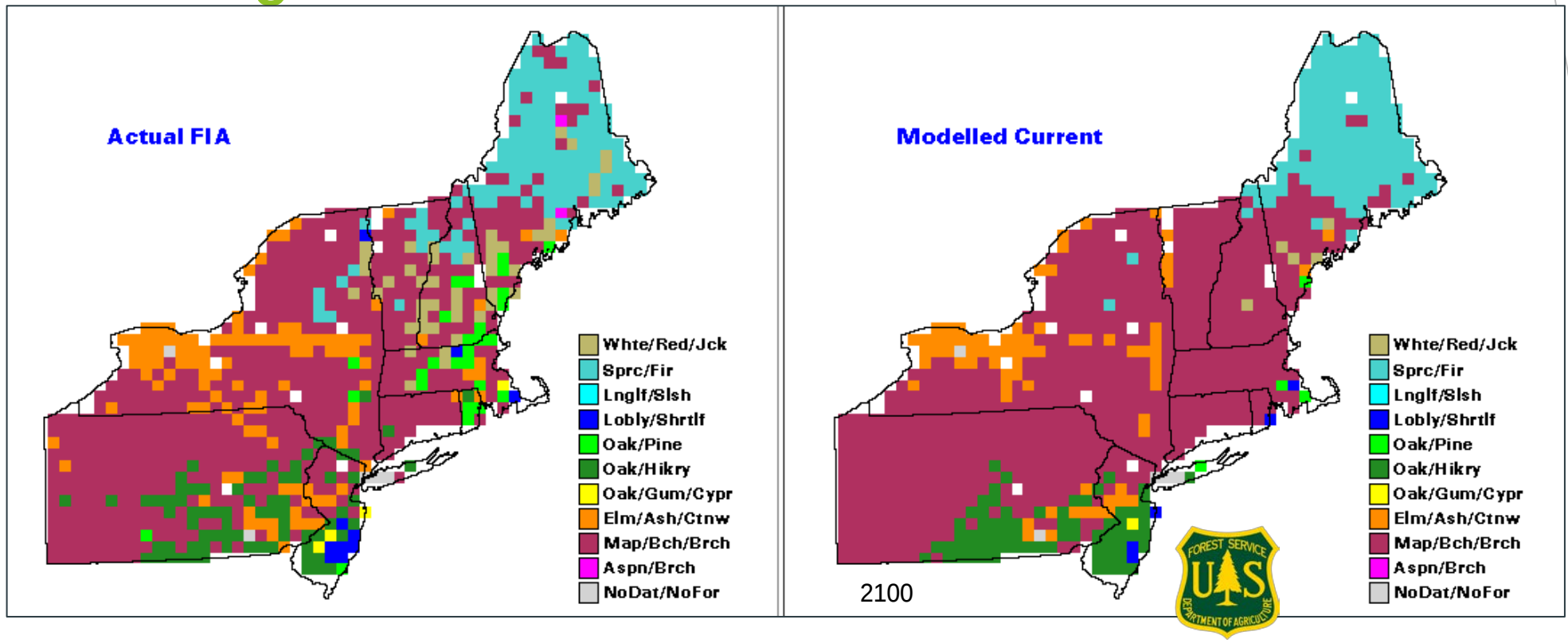
# Drought, Wildfire, Heat

## Nation-Wide Data



# Change in Forest Cover




Warming temperatures generally increase the length of the growing season. It also shifts the geographic ranges of some tree species. Habitats of some types of trees are likely to move north or to higher altitudes. Other species will be at risk locally or regionally if conditions in their current geographic ranges are no longer suitable.

# The Effects of Hotter Weather

- Drought conditions will be more likely
- Increased risk for wildfires
- Heat related illnesses
- Higher costs related to cooling
- Increased water temperature, impact native species – ex. trout

# Nature Based Solutions

Natural systems, mimic natural processes, or work in tandem with traditional approaches

Integrate low impact development (LID) designs into new development at neighborhood scales

Mass Audubon

Shaping the Future of Your Community

# Return on Investment Studies in MA

## Dept. Ecological Restoration

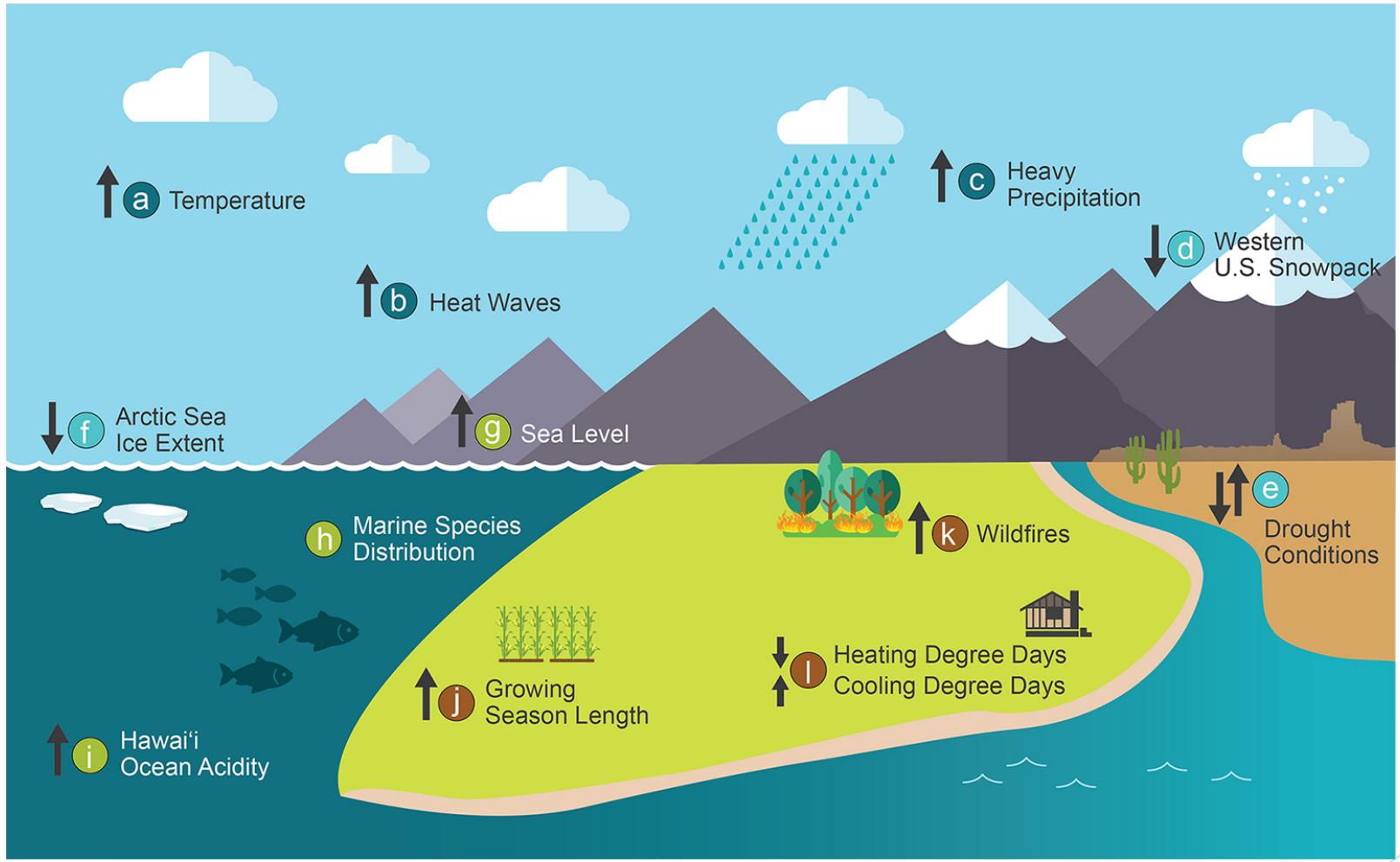
Traditional Culvert

Nature Based Culvert

Mass Audubon

Shaping the Future of Your Community

# Questions?




Eli Goldman
egoldman@cmrpc.org

# Brookfield: Natural Hazards, Critical Infrastructure and Facilities, and Vulnerable Populations

- Natural hazards
- (Critical infrastructure and facilities)
- Vulnerable populations

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# Natural Hazards

- Flooding (all types)
- Droughts and wildfires
- Winter storms
- Severe thunderstorms/hurricanes/wind/tornadoes

- Extreme temperatures
- Landslides
- Earthquakes

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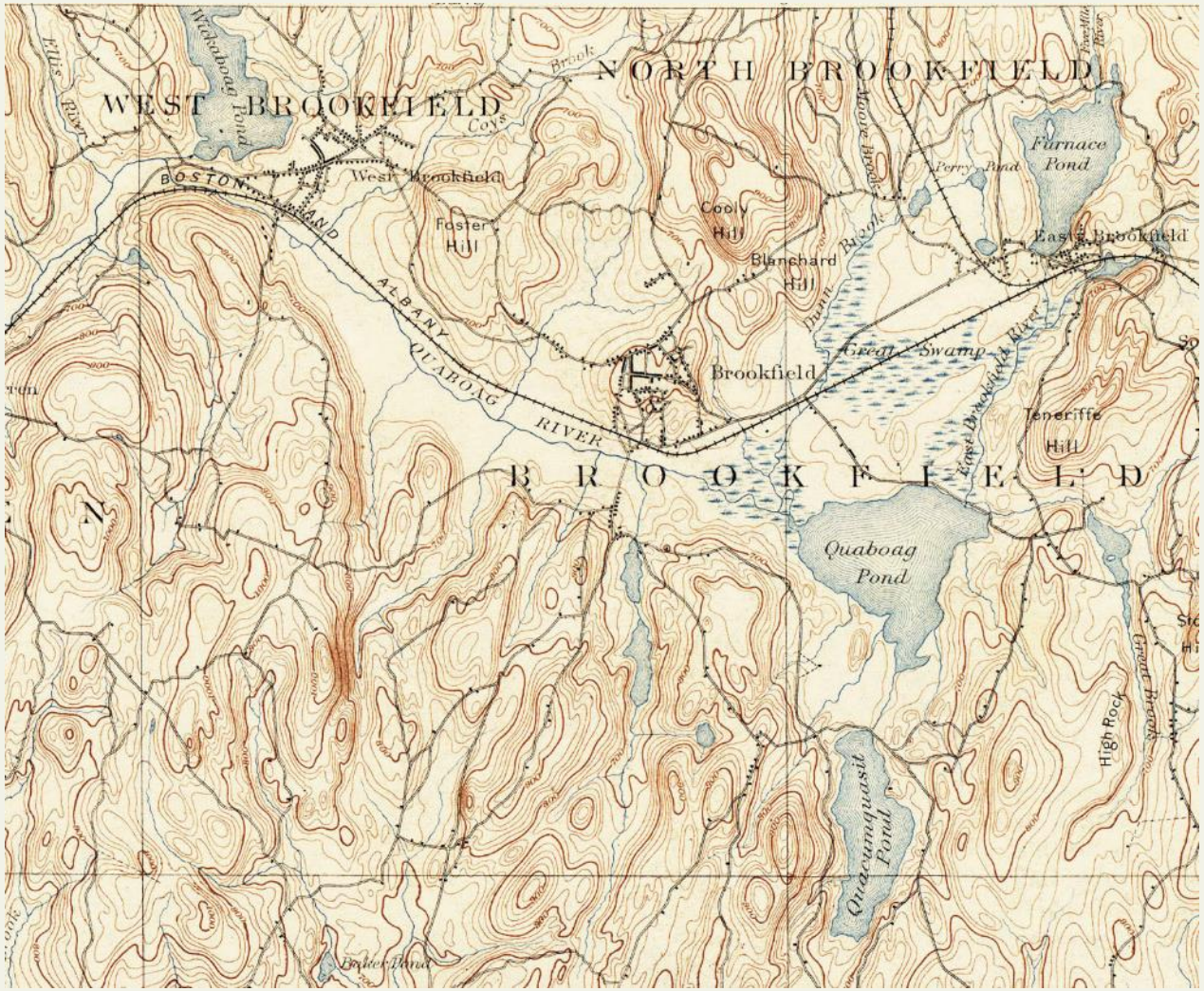
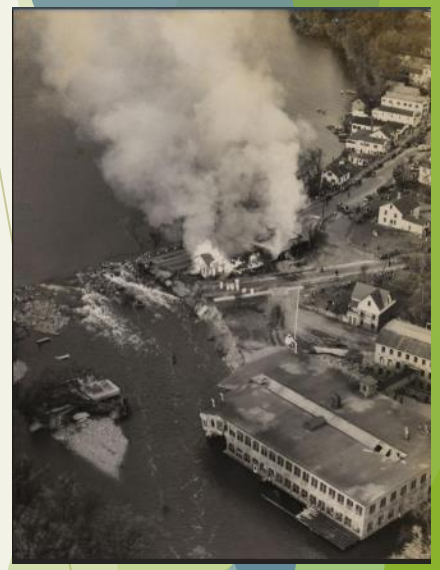
# Natural Hazards: Flood Risks




Map courtesy USGS 1887

East Brookfield, 1938, Worcester T&G

West Brookfield, 1938, Worcester T&G



State Ave, Monson, 1938
Monson Historical Soc

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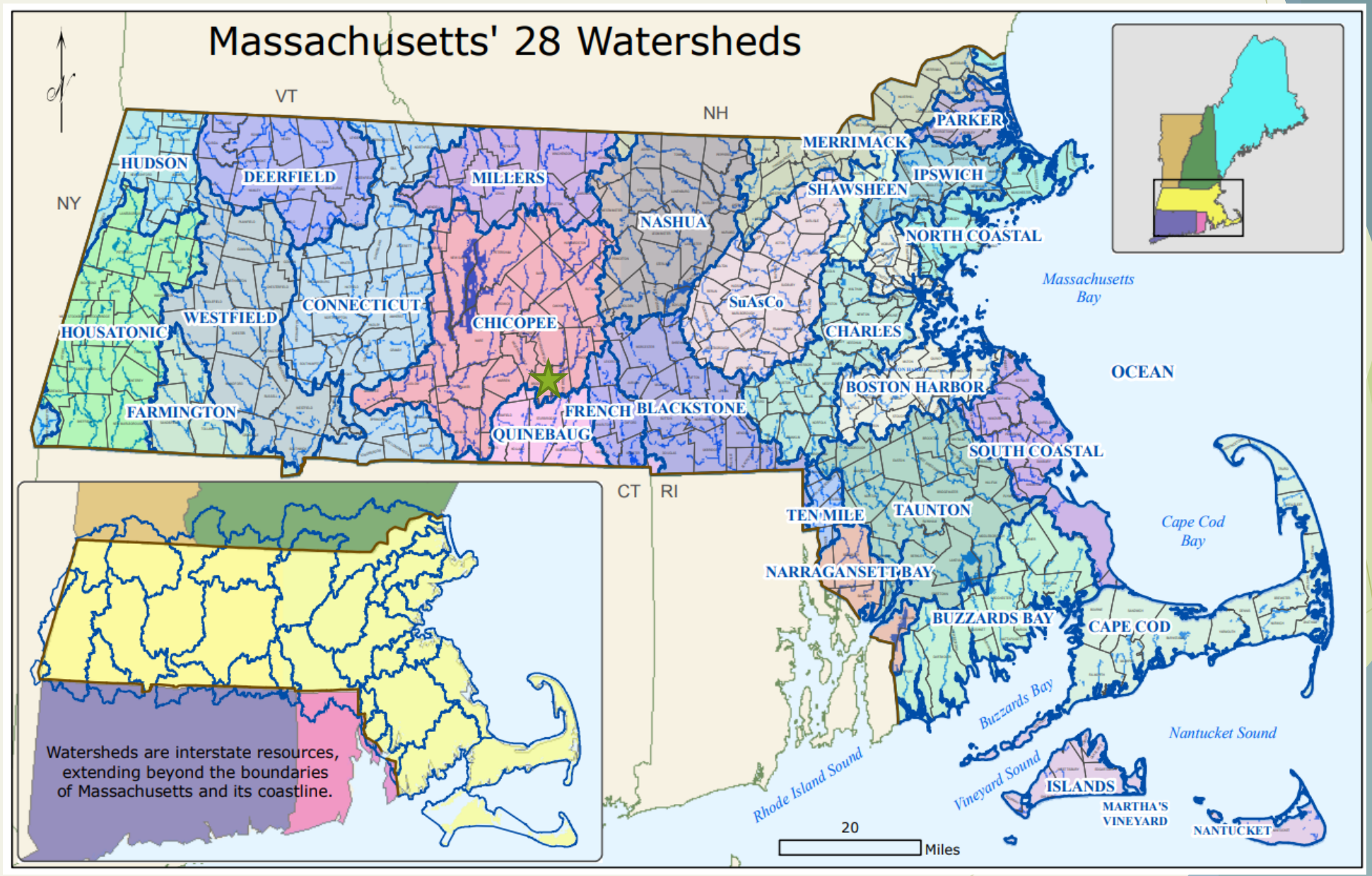
# Natural Hazards: Flood Risks

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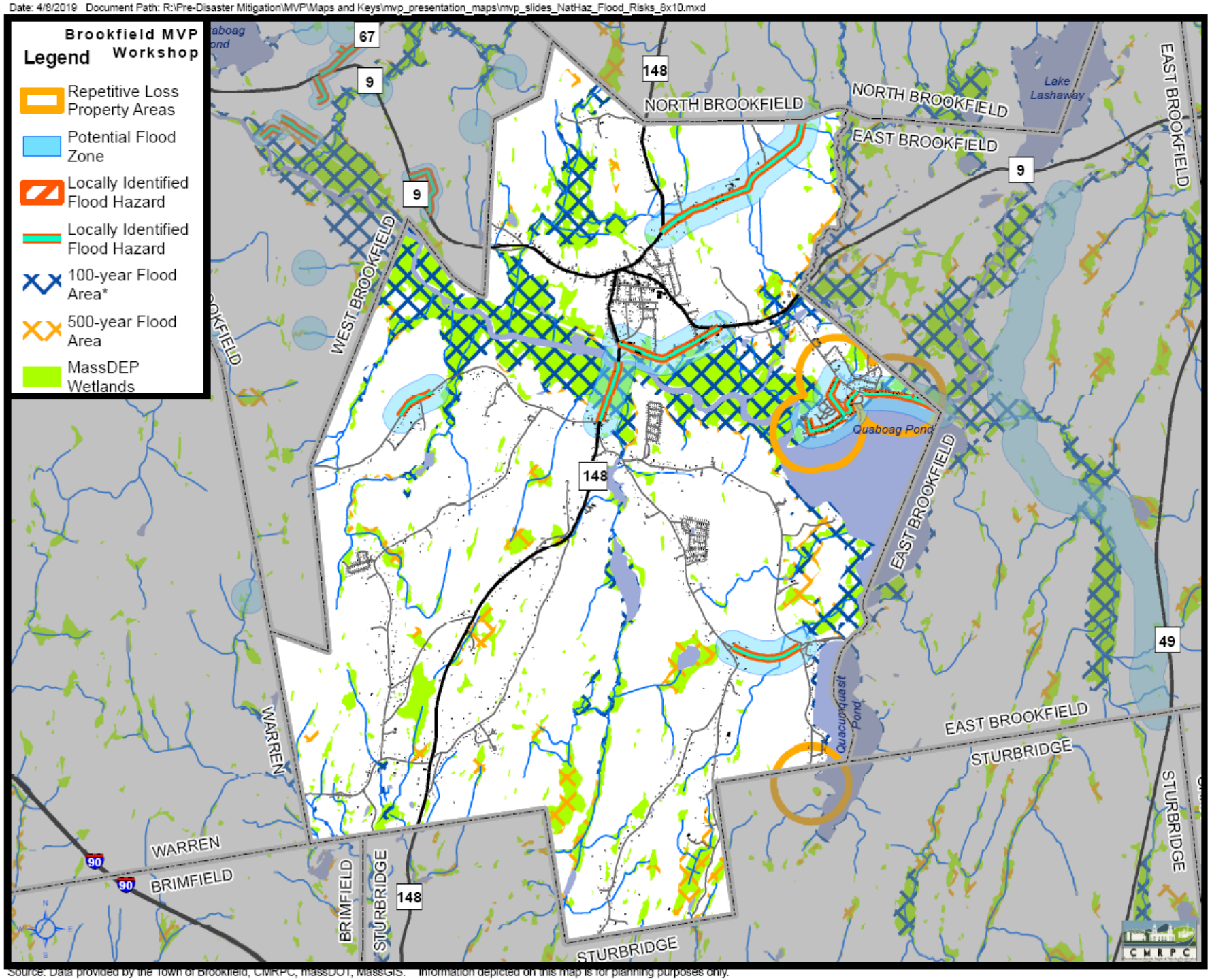
# Natural Hazards: Flood Risks

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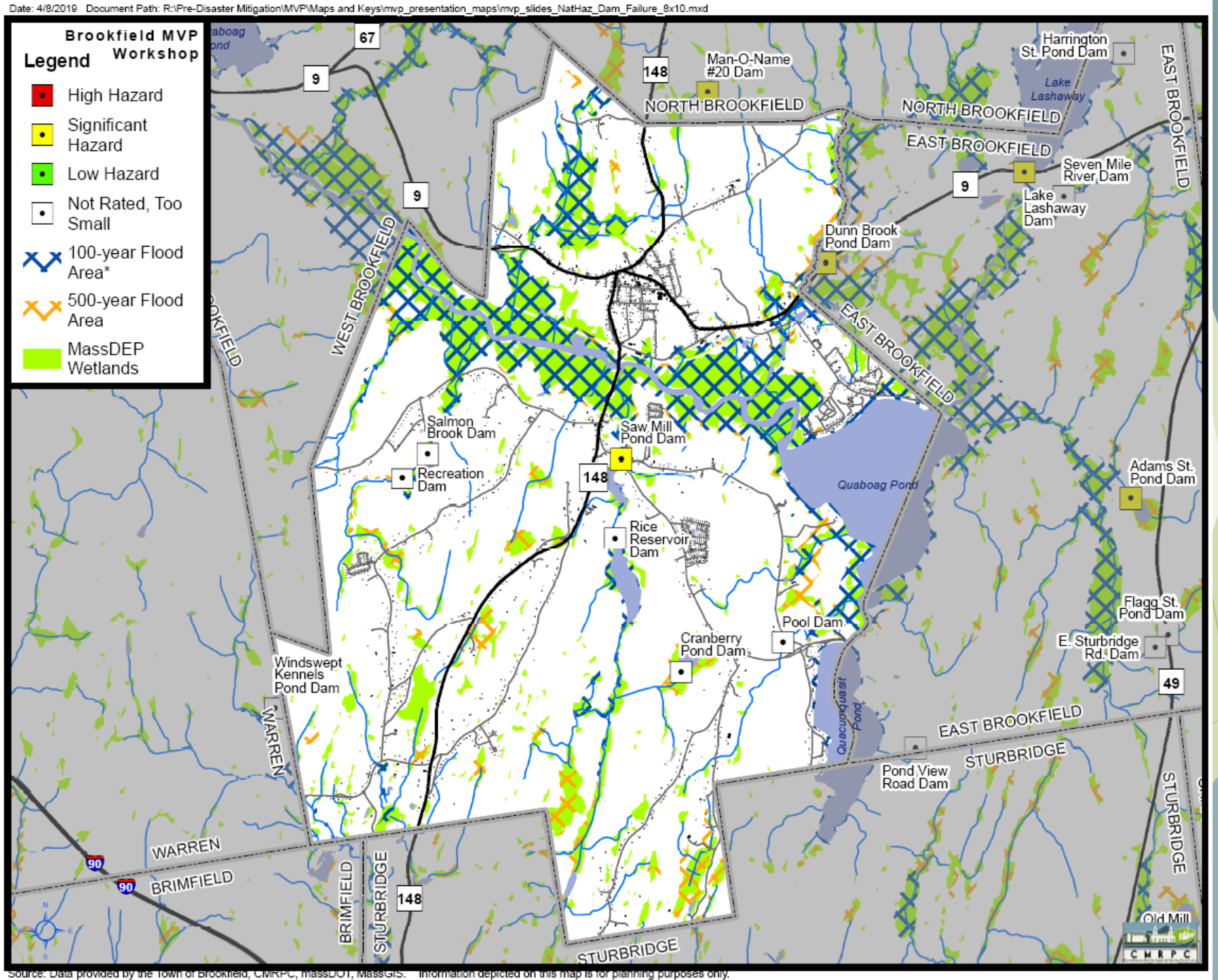
# Natural Hazards: Dam Failure Risk

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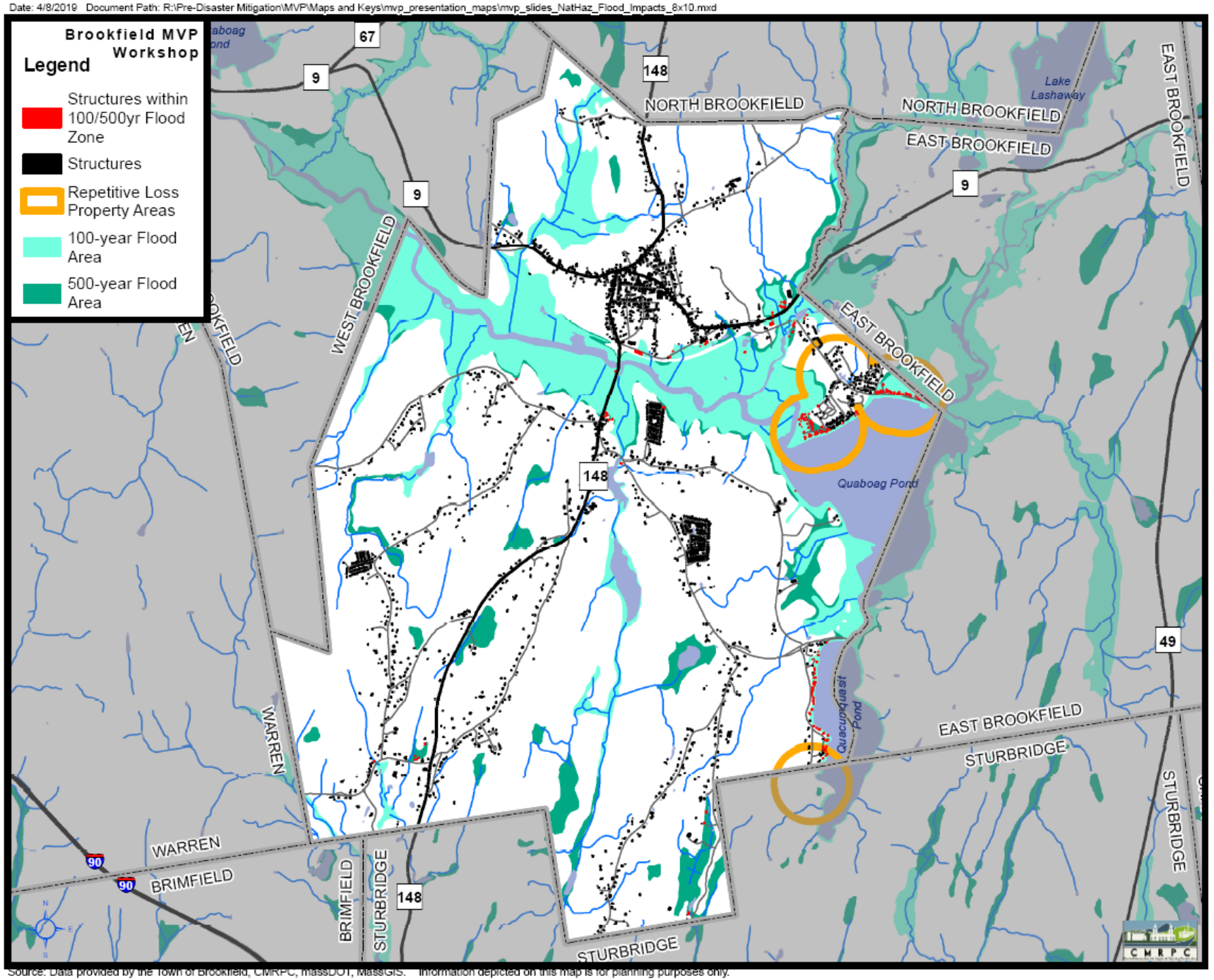
# Natural Hazards: Flood Impacts

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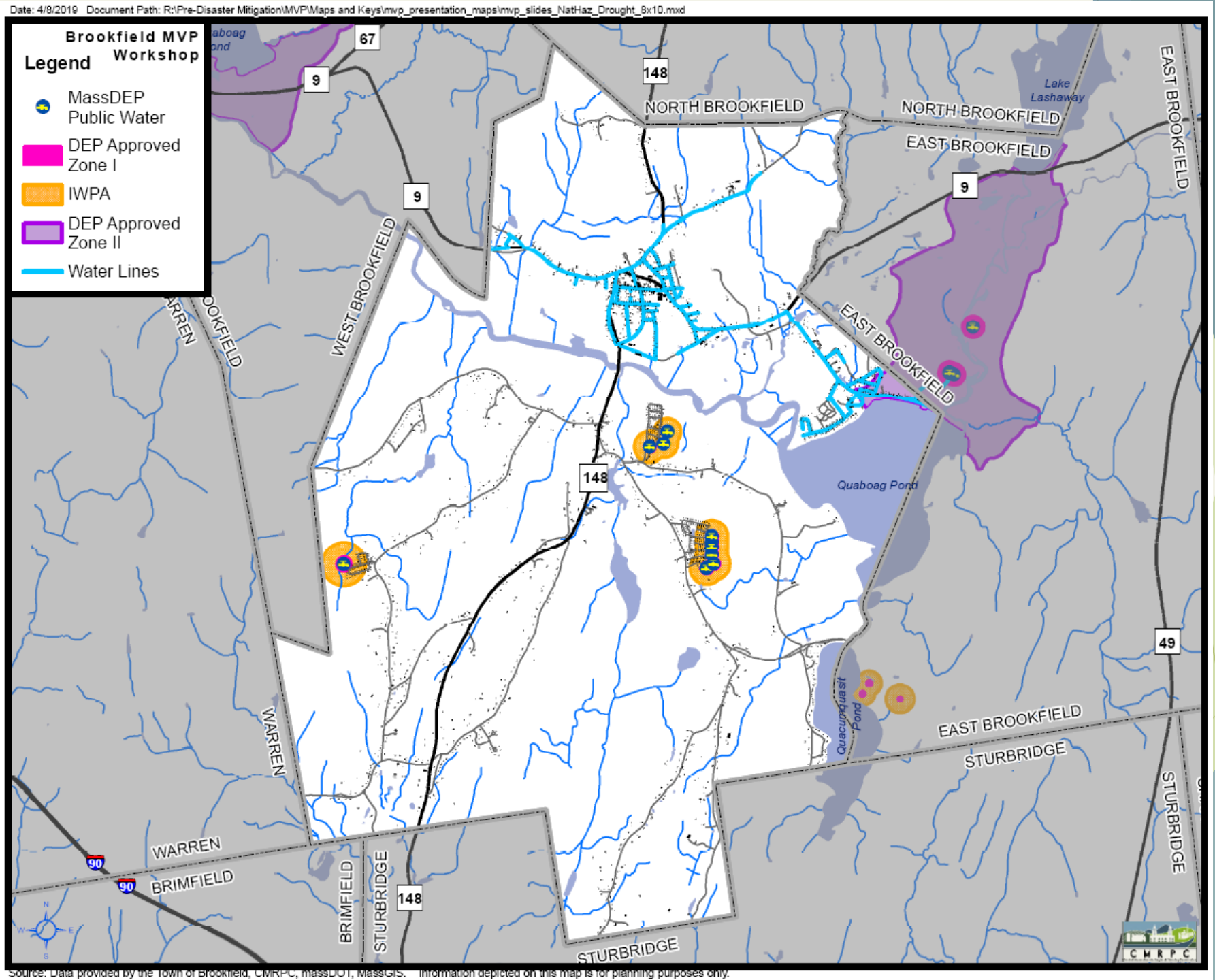
# Natural Hazards: Droughts & Water Systems

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# Natural Hazards: South Side Water Survey

## TOWN OF BROOKFIELD – SOUTH AREA WATER SURVEY

December 2018

Dear Southern Brookfield Resident or Business Operator:

With support from a state Municipal Vulnerability Preparedness (or MVP) grant and the Central Massachusetts Regional Planning Commission, the **Town of Brookfield** is exploring the long-term possibility of extending municipal water service to serve all or some neighborhoods south of the Quaboag River that currently rely on private well water. As an early step in its research, the Town asks that all households and businesses in that portion of the community **complete the attached survey** to tell us more about your existing well service, water usage, and thoughts about possible expansion of the Town's water system. Please respond no later than **January 4, 2019**.

Municipal water service can provide a number of benefits not available through private wells:

- Access to clean water sourced from an aquifer that is relatively resilient to drought
- Water that's available even when the power goes out, without the need for your own generator
- Professional management of your water supply, including regular testing and treatment in compliance with federal and state standards
- A backup connection to the water supply in another community (West Brookfield) in case of drought or other emergency
- Water for fire hydrants that can protect your family and property and help reduce your homeowners' or renters' insurance rates
- No need to monitor your own water chemistry, maintain/replace your own pump or generator, or drill new wells (or deepen existing ones) in time of drought
- Shared costs with other users of the water system
- Superior water service at long-run costs that are roughly comparable to maintaining your own well

The average Brookfield residential water customer currently pays about $20 per month for Town water service while lighter users pay less than $10 per month. If the municipal system is expanded, one-time hookup costs for new residential water users in are expected to be around $1,500, and a special assessment ("betterment") charge to residential property owners receiving new service from the system expansion can be expected to range from around $10 to $60 per month for 20 to 30 years, depending on the system size and property-specific factors. In comparison, costs for installation or total replacement of a residential well system typically range from $5,000 to $7,000, while operations, maintenance and occasional replacement of well components such as pumps are estimated at $20 to $40 per month for most users in the long term, depending on various factors. Residents of mobile home parks generally pay for water service as part of their rental fee – consult your park's management for details.

Completed survey responses should be returned to the Brookfield **Town Hall** or the **Merrick Public Library**, or they can be mailed to Brookfield Water Survey, c/o Central Massachusetts Regional Planning Commission, 1 Mercantile St. Suite 520, Worcester, MA 01608. Surveys may alternatively be **completed online** at www.surveymonkey.com/r/BrookfieldSouthWater (please submit **only ONE total survey per household/business**). Individual survey responses are confidential.

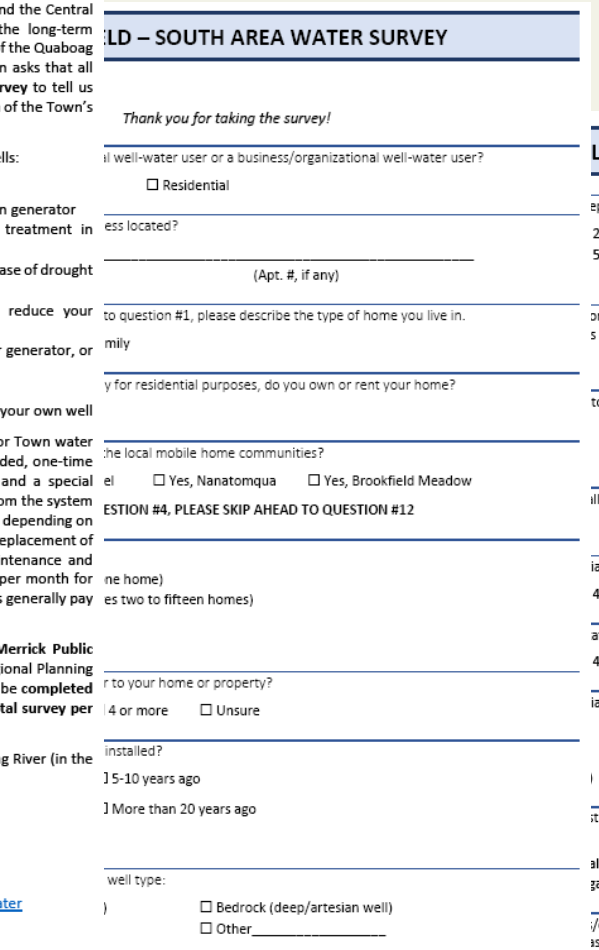
PO Box holders receiving this survey for homes or businesses located **north** of the Quaboag River (in the Town Center, Route 9 or vicinity) are asked **NOT to complete or submit it**.

Sincerely,

**Brookfield Water Commission**

Donald Taft  Robert R. Barnes  Al Jones

This survey is available online at www.surveymonkey.com/r/BrookfieldSouthWater



LD – SOUTH AREA WATER SURVEY

*Thank you for taking the survey!*

l well-water user or a business/organizational well-water user?

☐ Residential

ess located?

_____

(Apt. #, if any)

to question #1, please describe the type of home you live in.

mily

y for residential purposes, do you own or rent your home?

he local mobile home communities?

el  ☐ Yes, Nanatomqua  ☐ Yes, Brookfield Meadow

ESTION #4, PLEASE SKIP AHEAD TO QUESTION #12

ne home)

es two to fifteen homes)

r to your home or property?

4 or more  ☐ Unsure

installed?

] 5-10 years ago

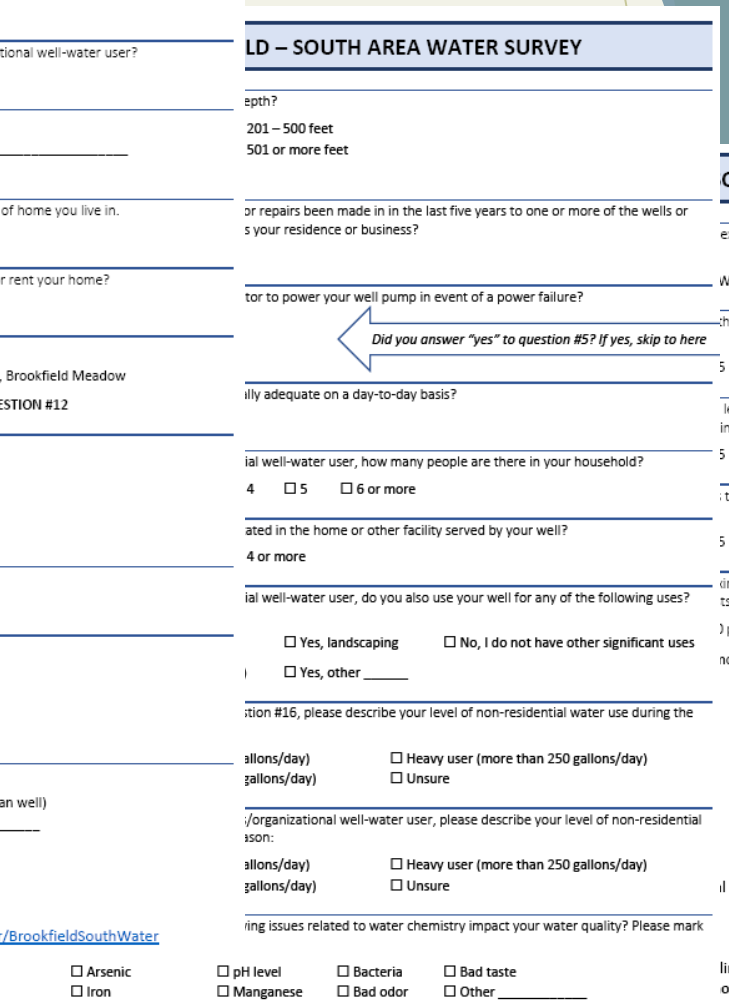
] More than 20 years ago

well type:

)  ☐ Bedrock (deep/artesian well)

☐ Unsure  ☐ Other_____

This survey is available online at www.surveymonkey.com/r/BrookfieldSouthWater



LD – SOUTH AREA WATER SURVEY

epth?

201 – 500 feet

501 or more feet

or repairs been made in in the last five years to one or more of the wells or
s your residence or business?

tor to power your well pump in event of a power failure?

*Did you answer "yes" to question #5? If yes, skip to here*

lly adequate on a day-to-day basis?

ial well-water user, how many people are there in your household?

4  ☐ 5  ☐ 6 or more

ated in the home or other facility served by your well?

4 or more

ial well-water user, do you also use your well for any of the following uses?

☐ Yes, landscaping  ☐ No, I do not have other significant uses

☐ Yes, other _____

tion #16, please describe your level of non-residential water use during the

allons/day)  ☐ Heavy user (more than 250 gallons/day)

gallons/day)  ☐ Unsure

/organizational well-water user, please describe your level of non-residential
ason:

allons/day)  ☐ Heavy user (more than 250 gallons/day)

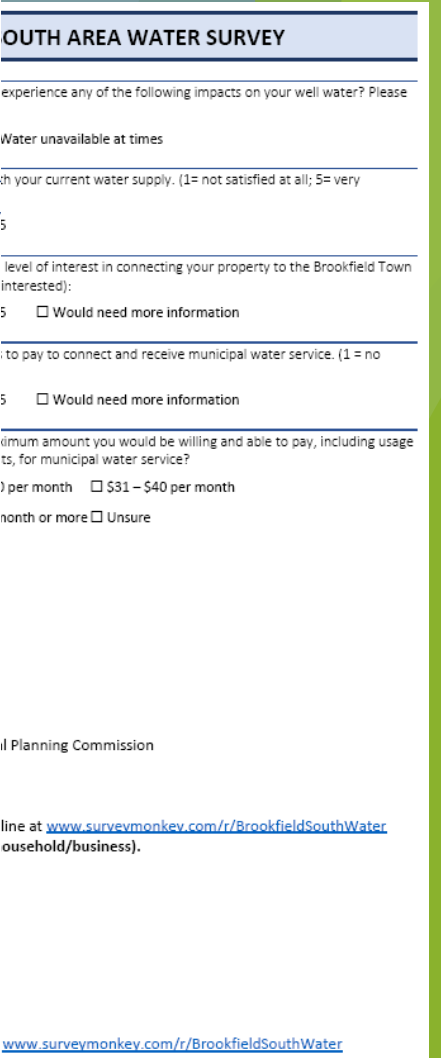
gallons/day)  ☐ Unsure

ing issues related to water chemistry impact your water quality? Please mark

☐ Arsenic  ☐ pH level  ☐ Bacteria  ☐ Bad taste

☐ Iron  ☐ Manganese  ☐ Bad odor  ☐ Other _____

This survey is available online at www.surveymonkey.com/r/BrookfieldSouthWater



OUTH AREA WATER SURVEY

experience any of the following impacts on your well water? Please

Water unavailable at times

h your current water supply. (1= not satisfied at all; 5= very

5

level of interest in connecting your property to the Brookfield Town
interested):

5  ☐ Would need more information

to pay to connect and receive municipal water service. (1 = no

5  ☐ Would need more information

imum amount you would be willing and able to pay, including usage
ts, for municipal water service?

) per month  ☐ $31 – $40 per month

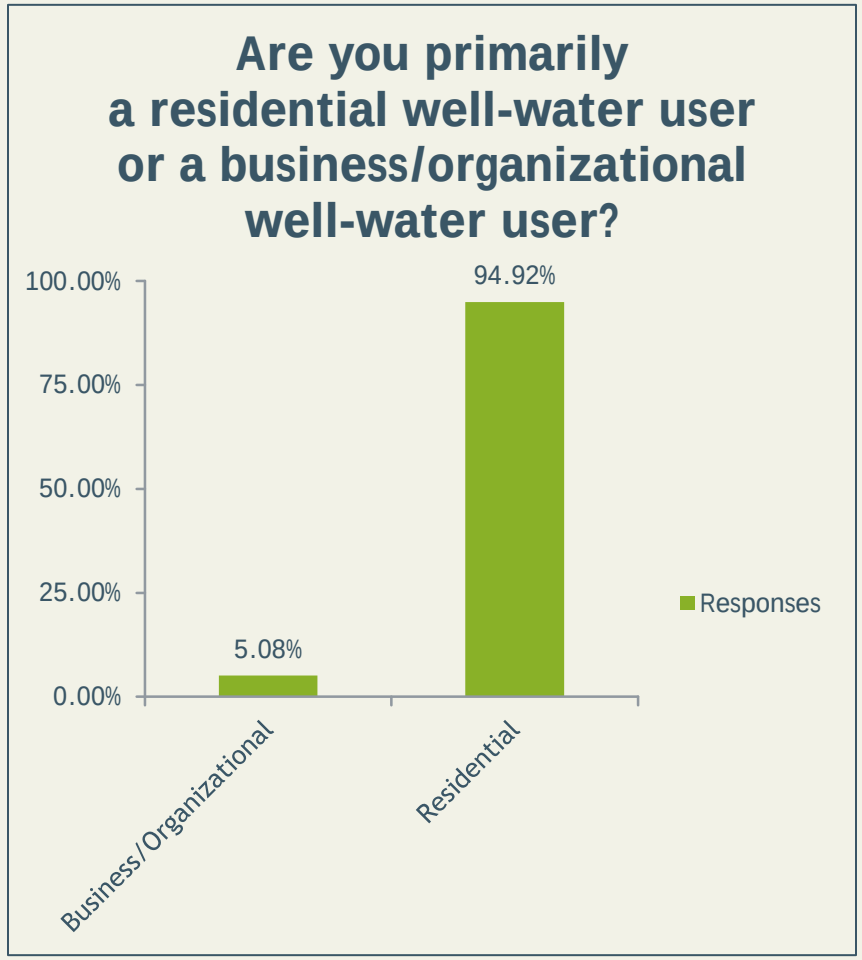
nonth or more ☐ Unsure

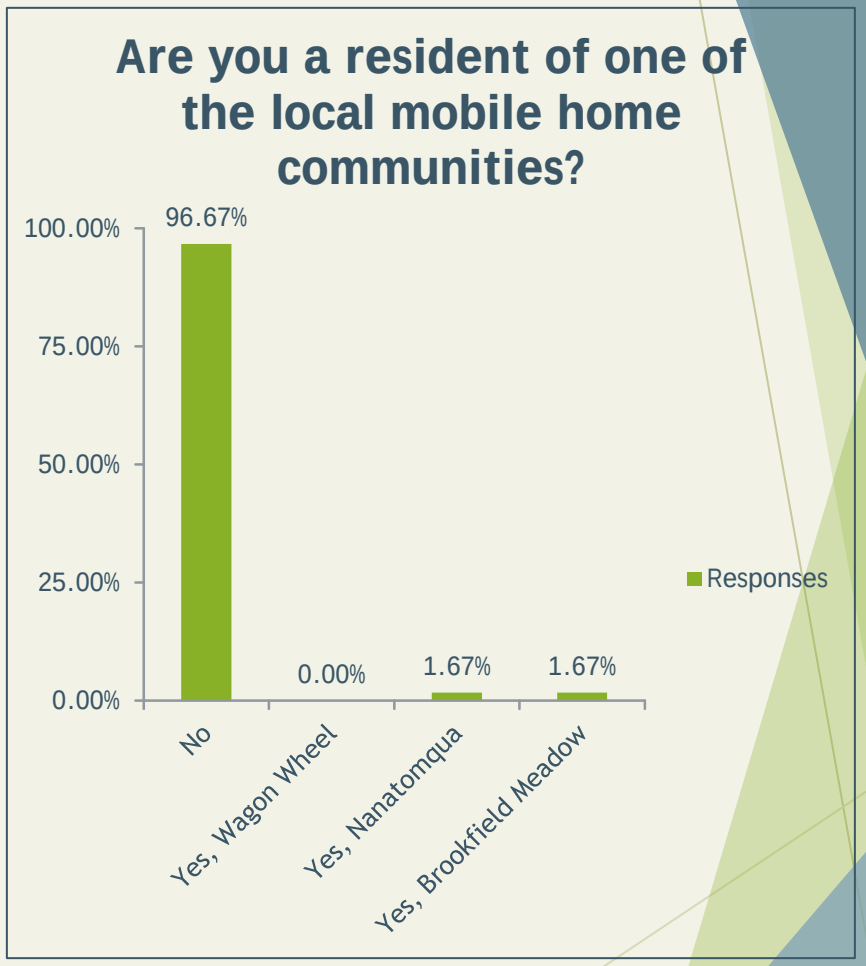
l Planning Commission

line at www.surveymonkey.com/r/BrookfieldSouthWater
ousehold/business).

This survey is available online at www.surveymonkey.com/r/BrookfieldSouthWater

# Natural Hazards: South Side Water Survey

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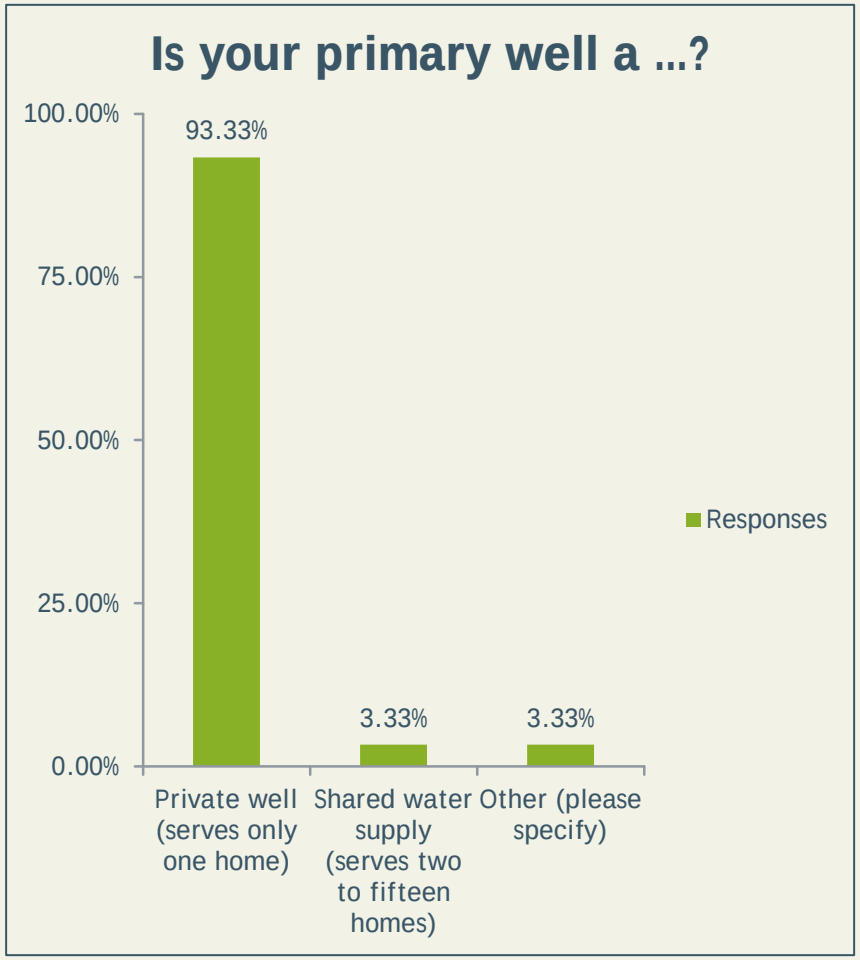
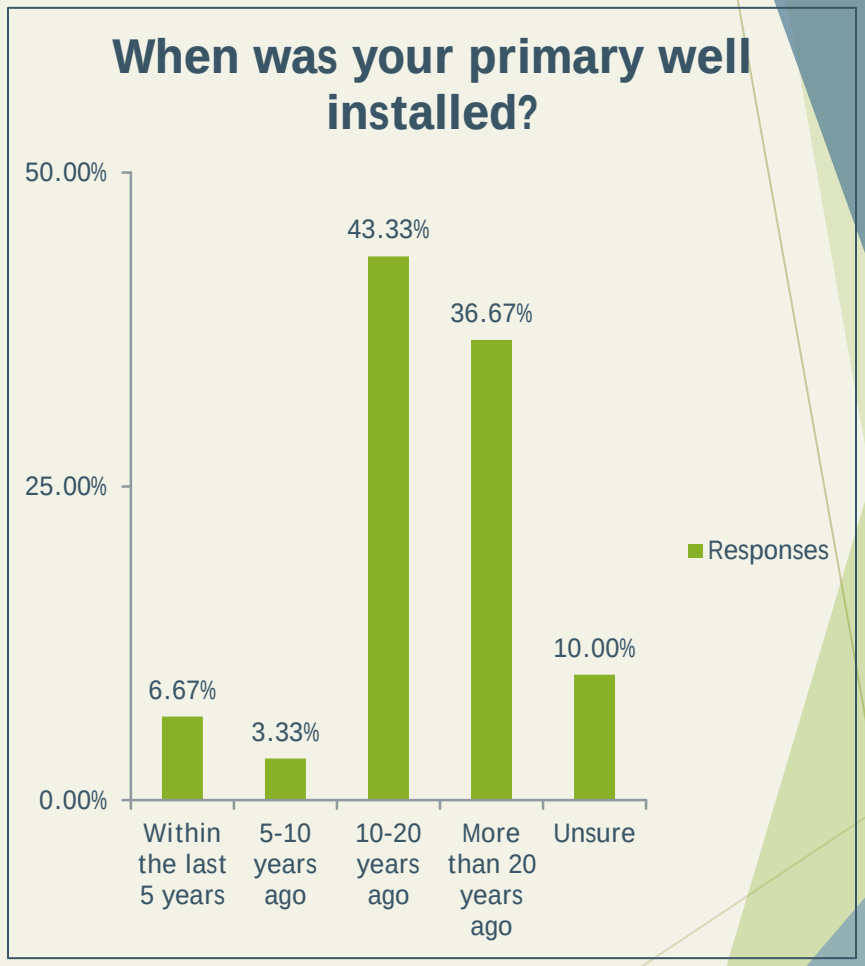
# Natural Hazards: South Side Water Survey

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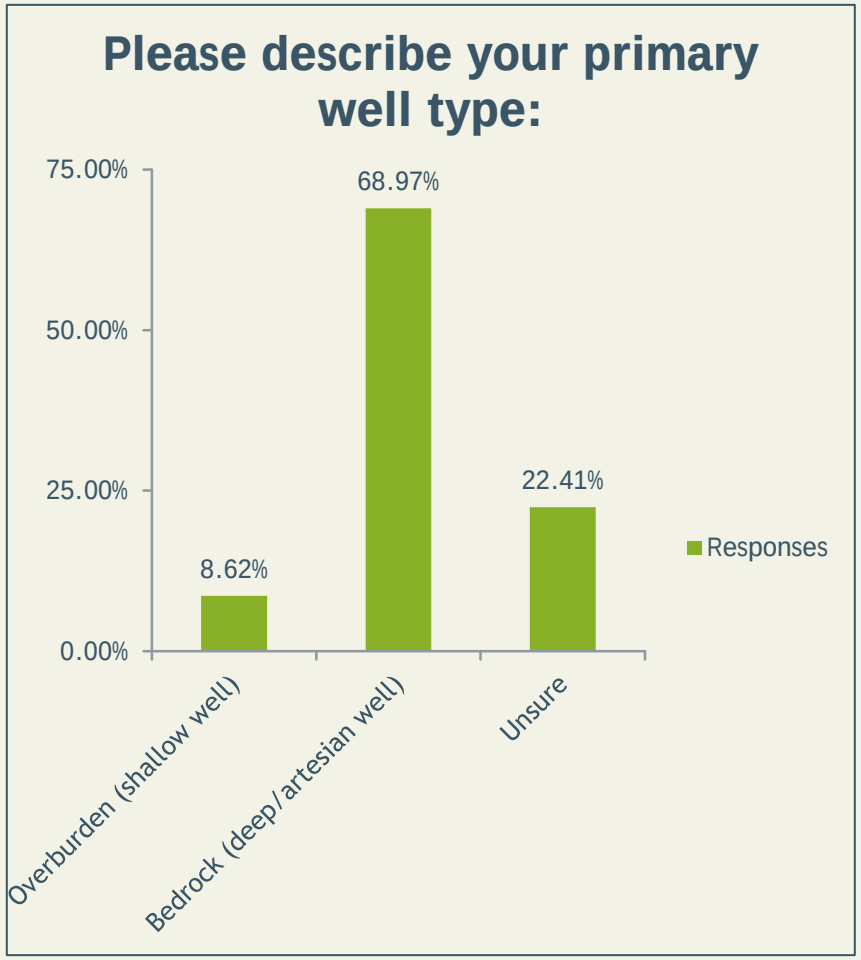


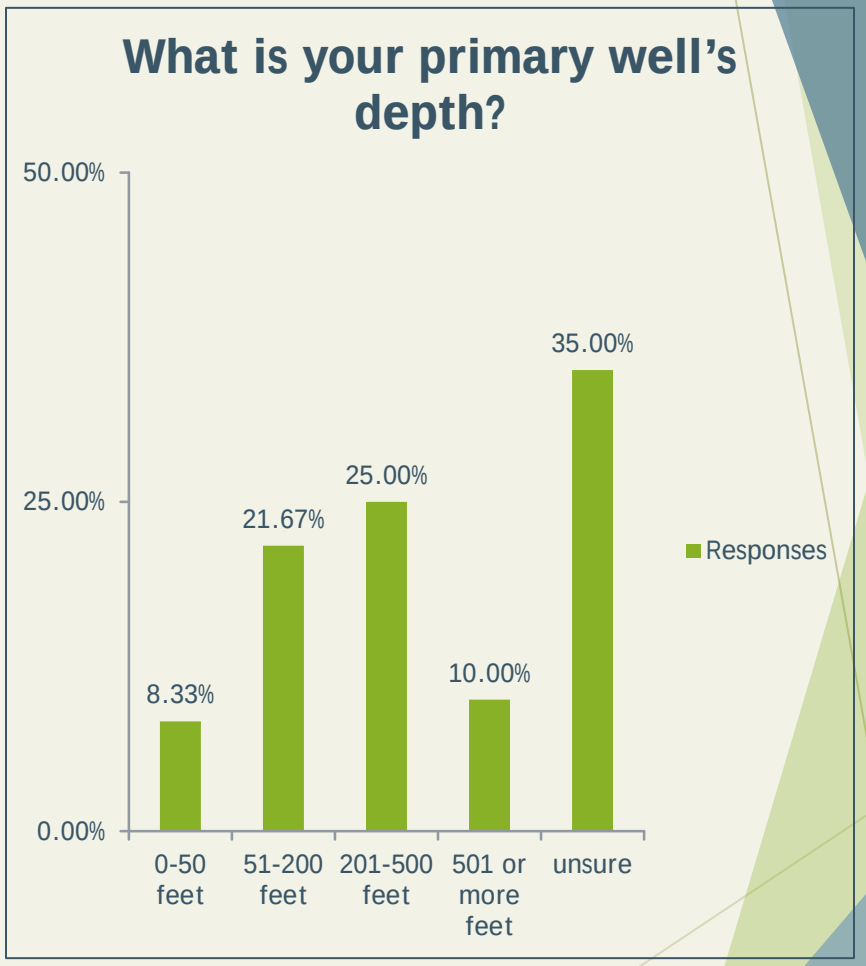


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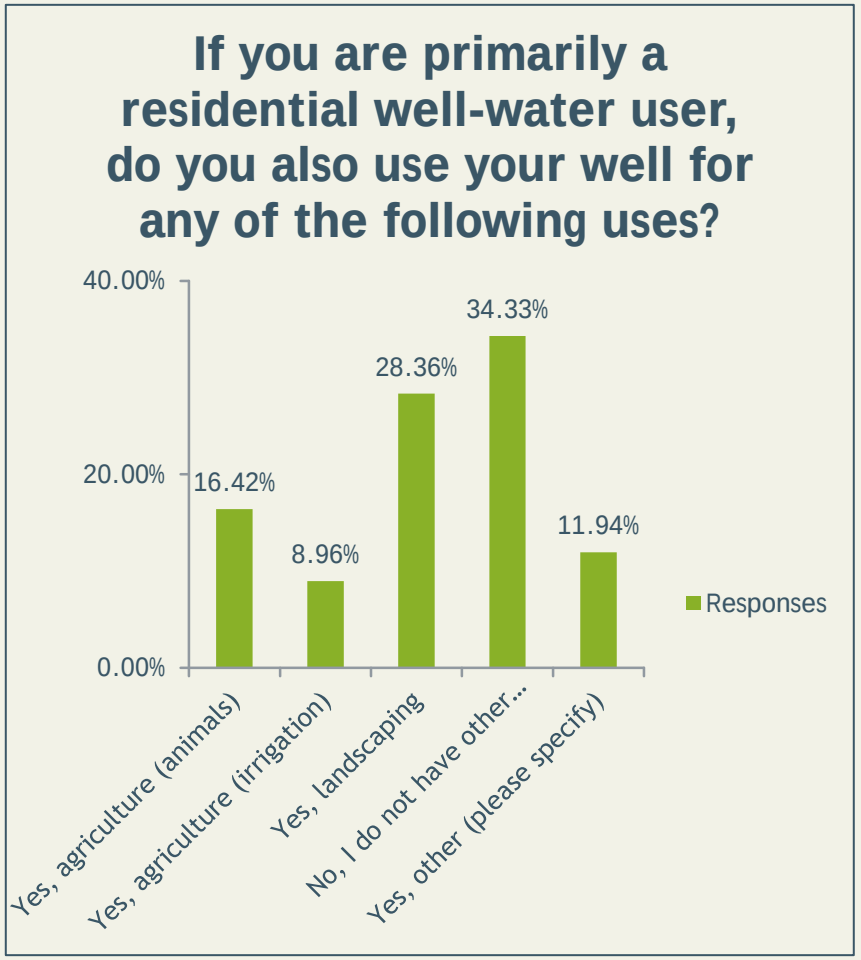


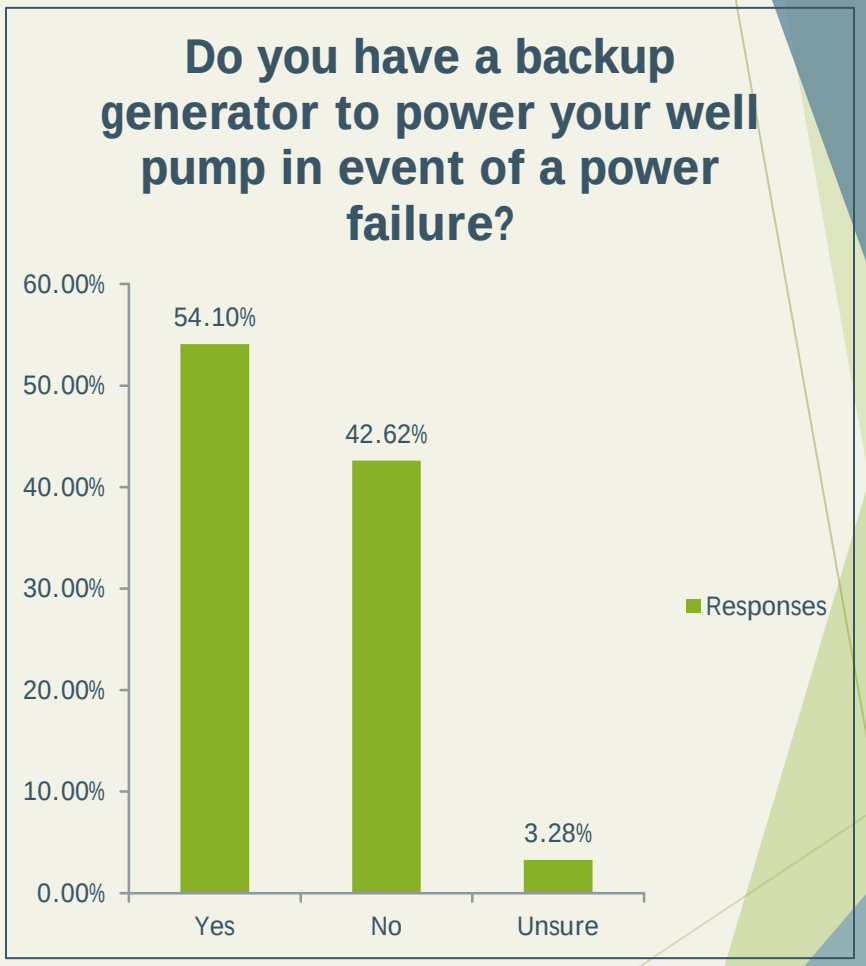


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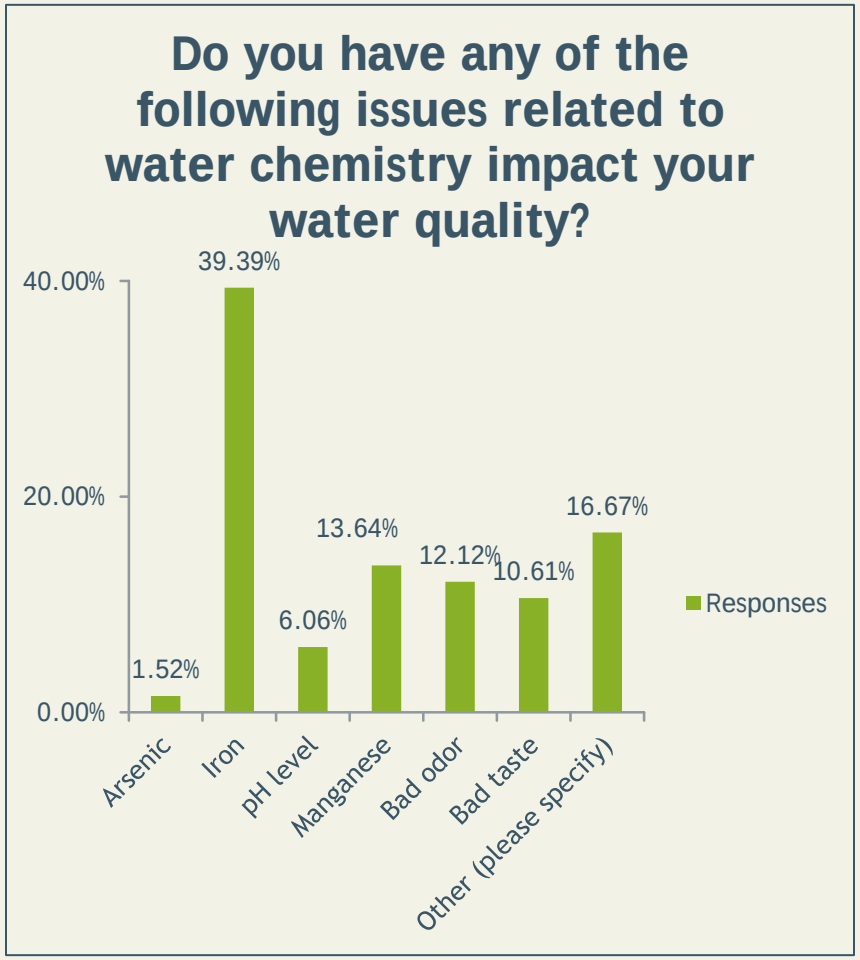


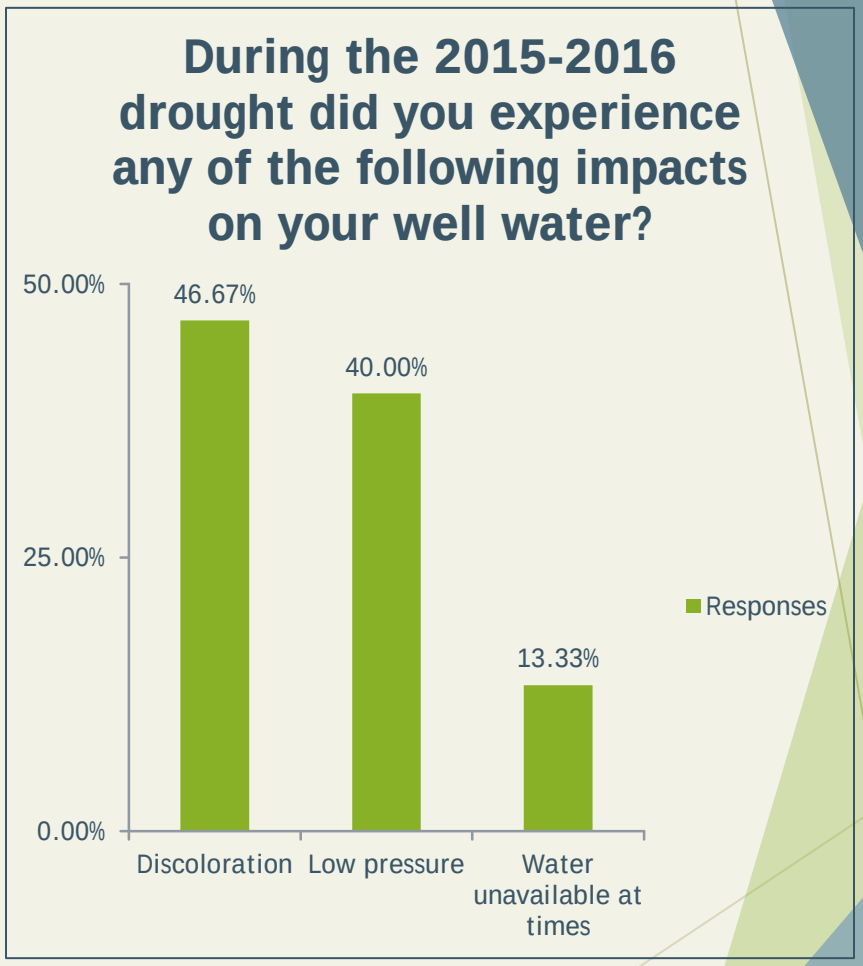


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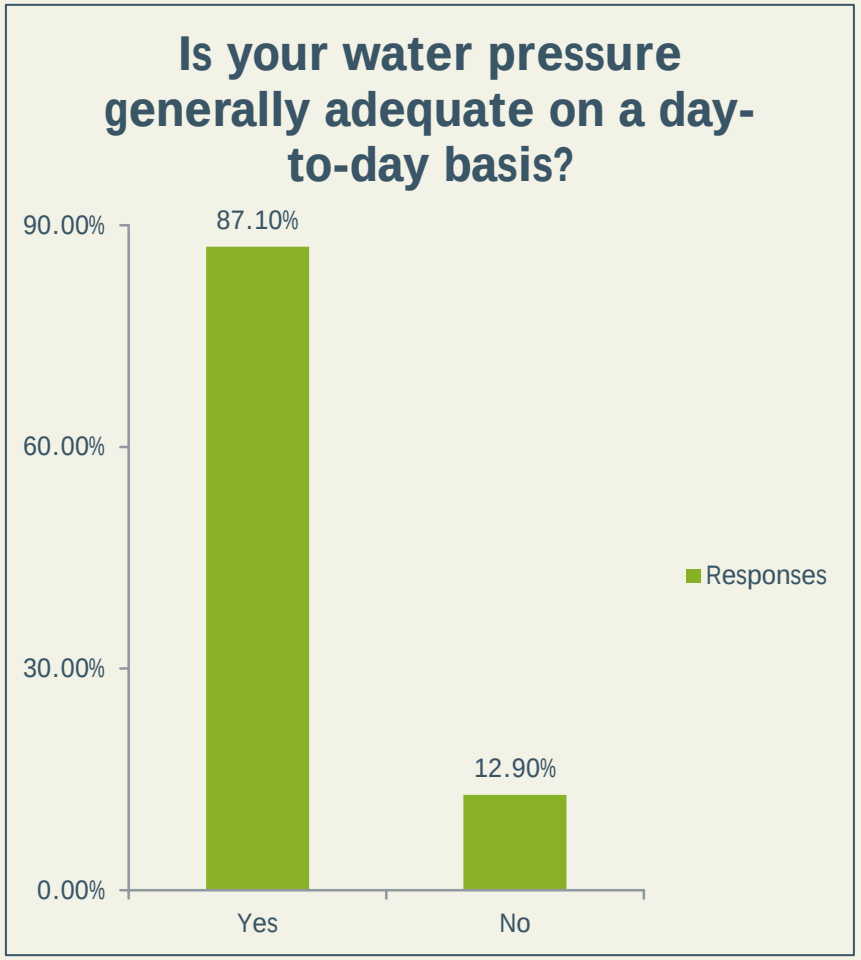
# Natural Hazards: South Side Water Survey





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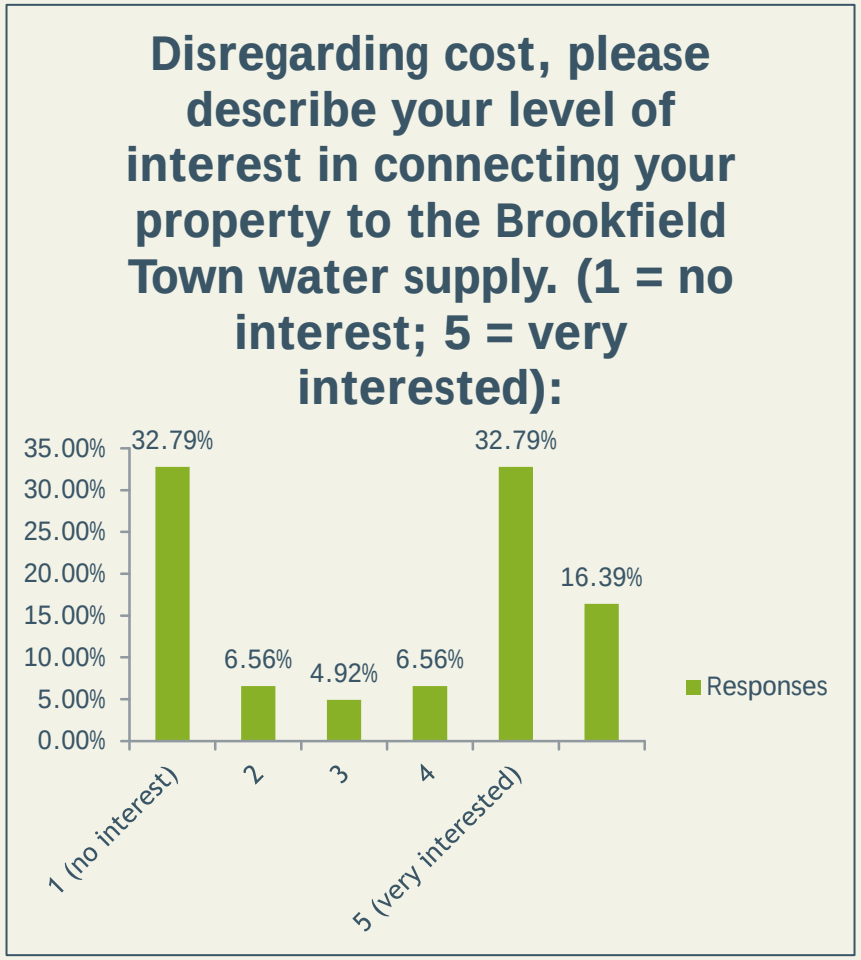
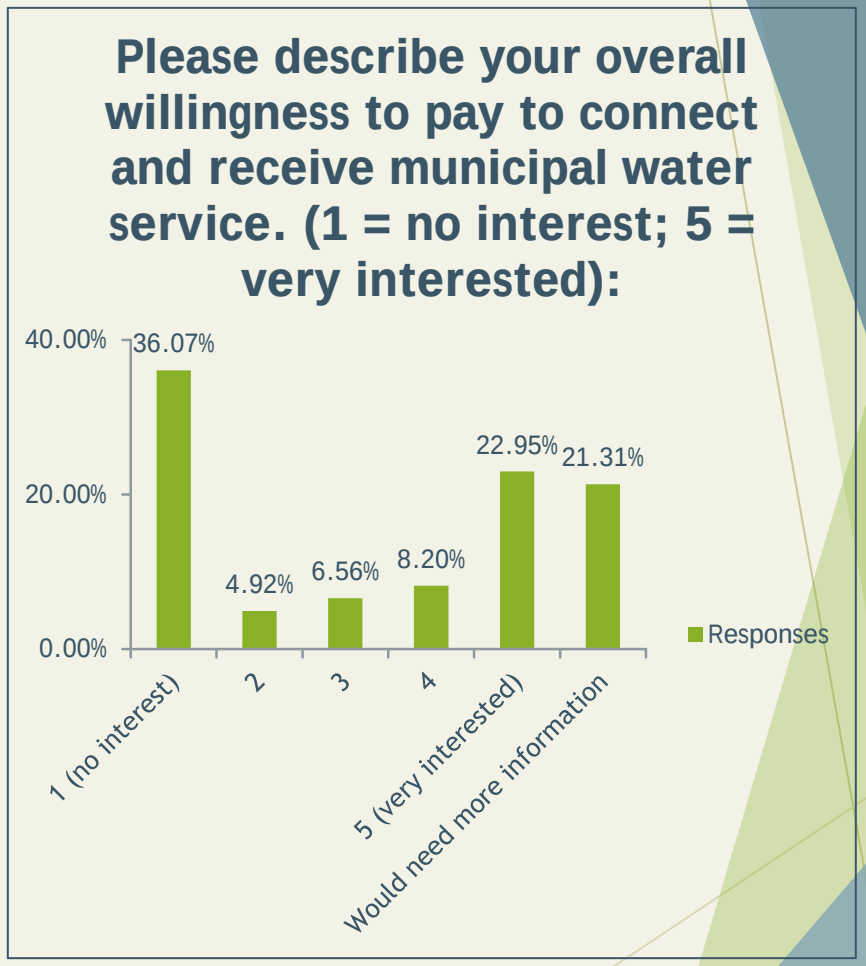
# Natural Hazards: South Side Water Survey

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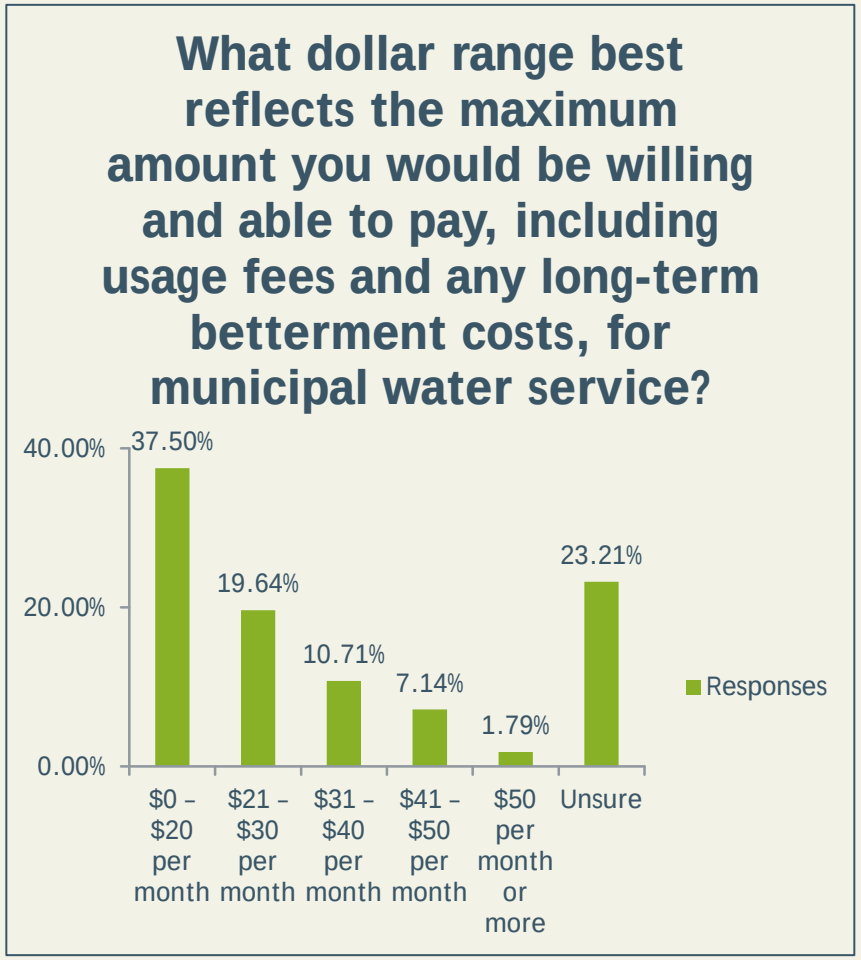
# Natural Hazards: South Side Water Survey

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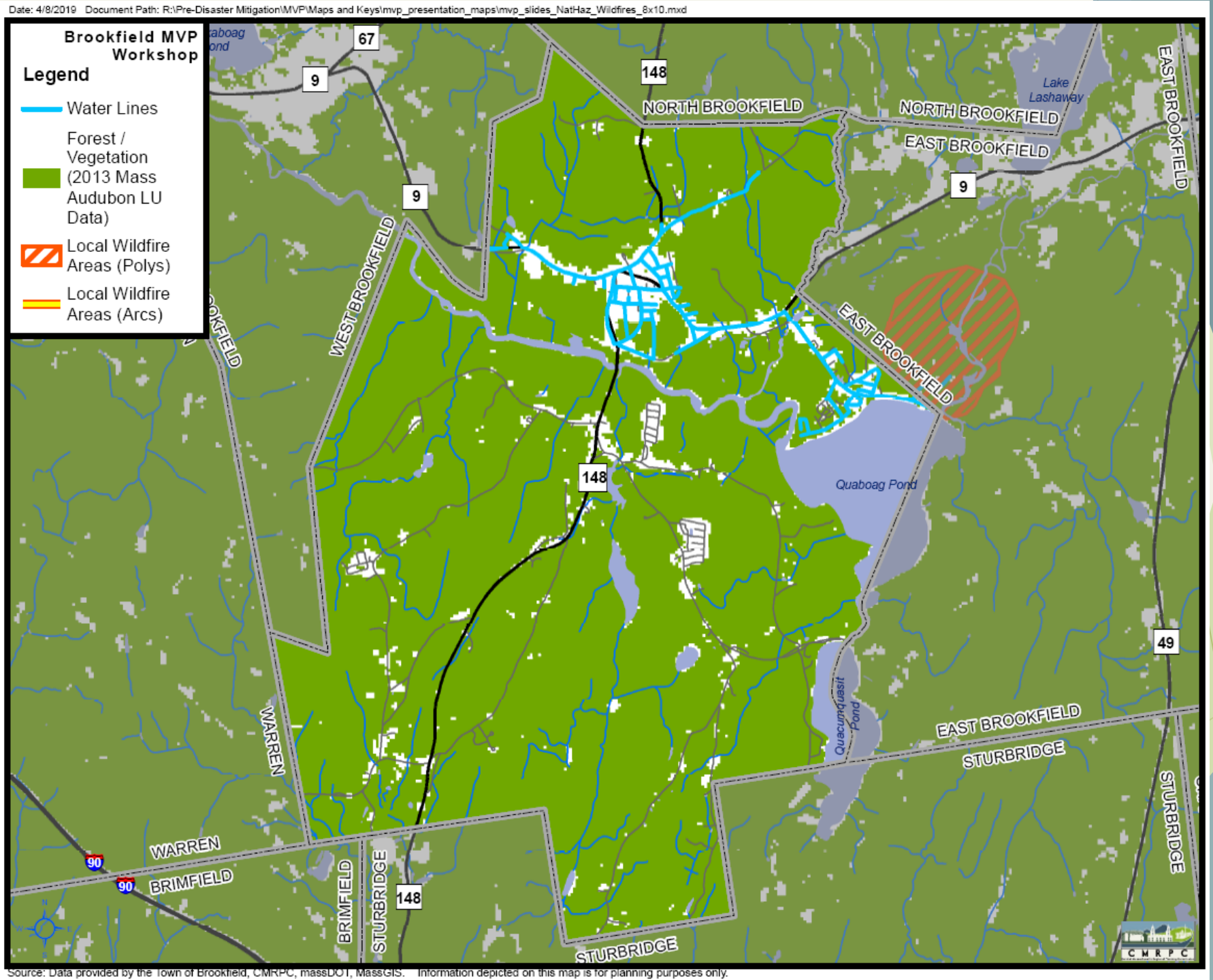
# Natural Hazards: Wildfires

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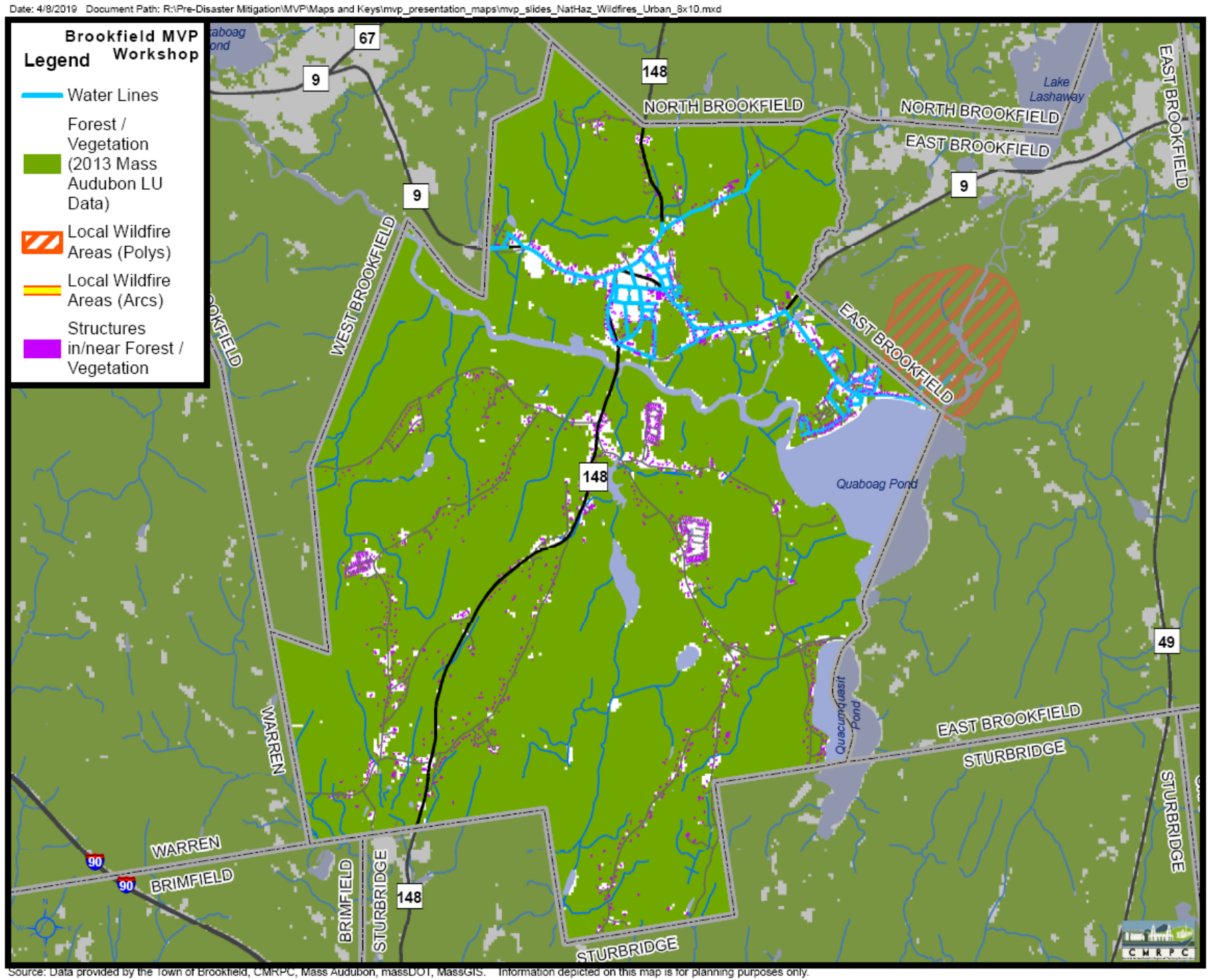
# Natural Hazards: Wildland/Urban Interface

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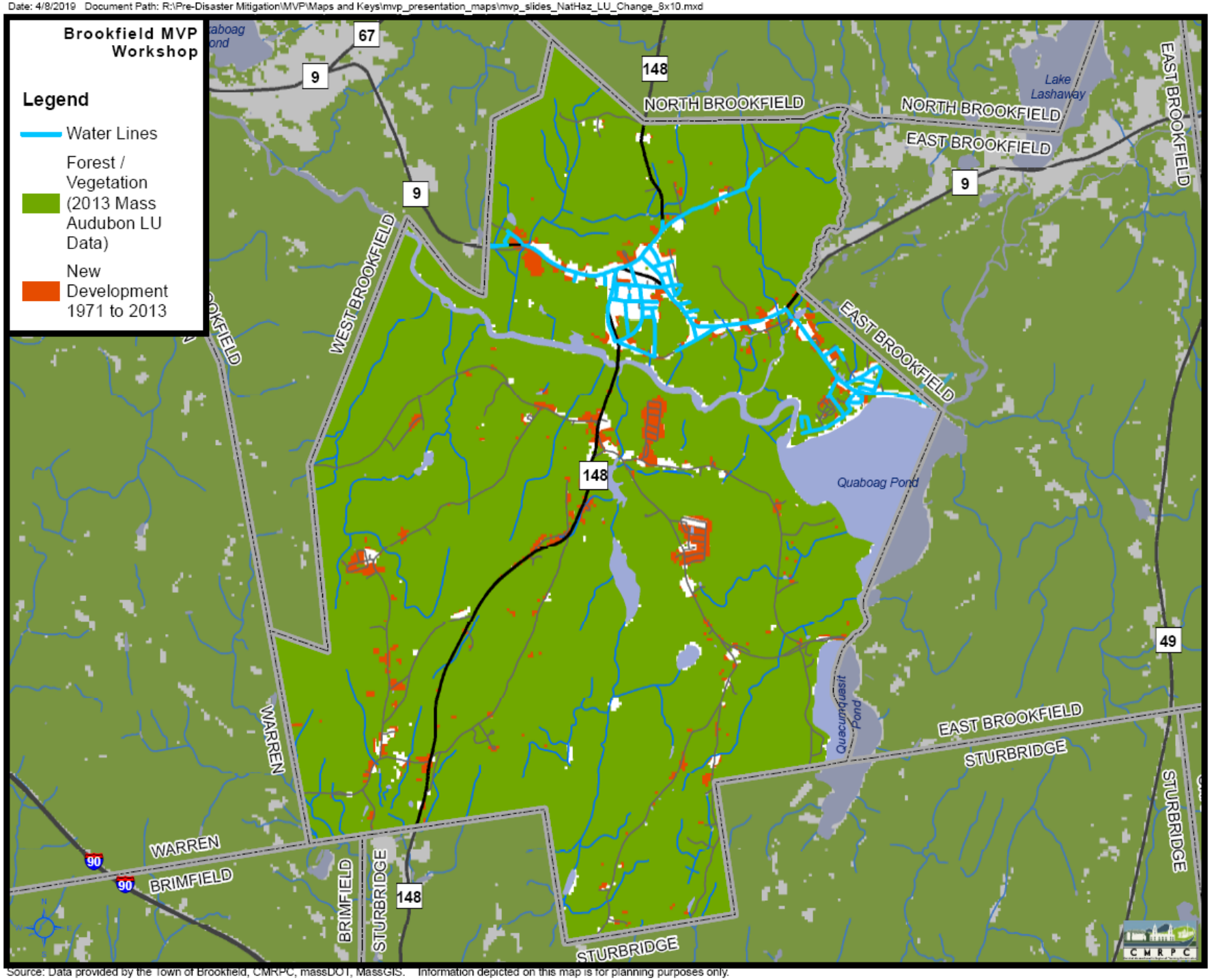
# Natural Hazards: Wildfires & New Development

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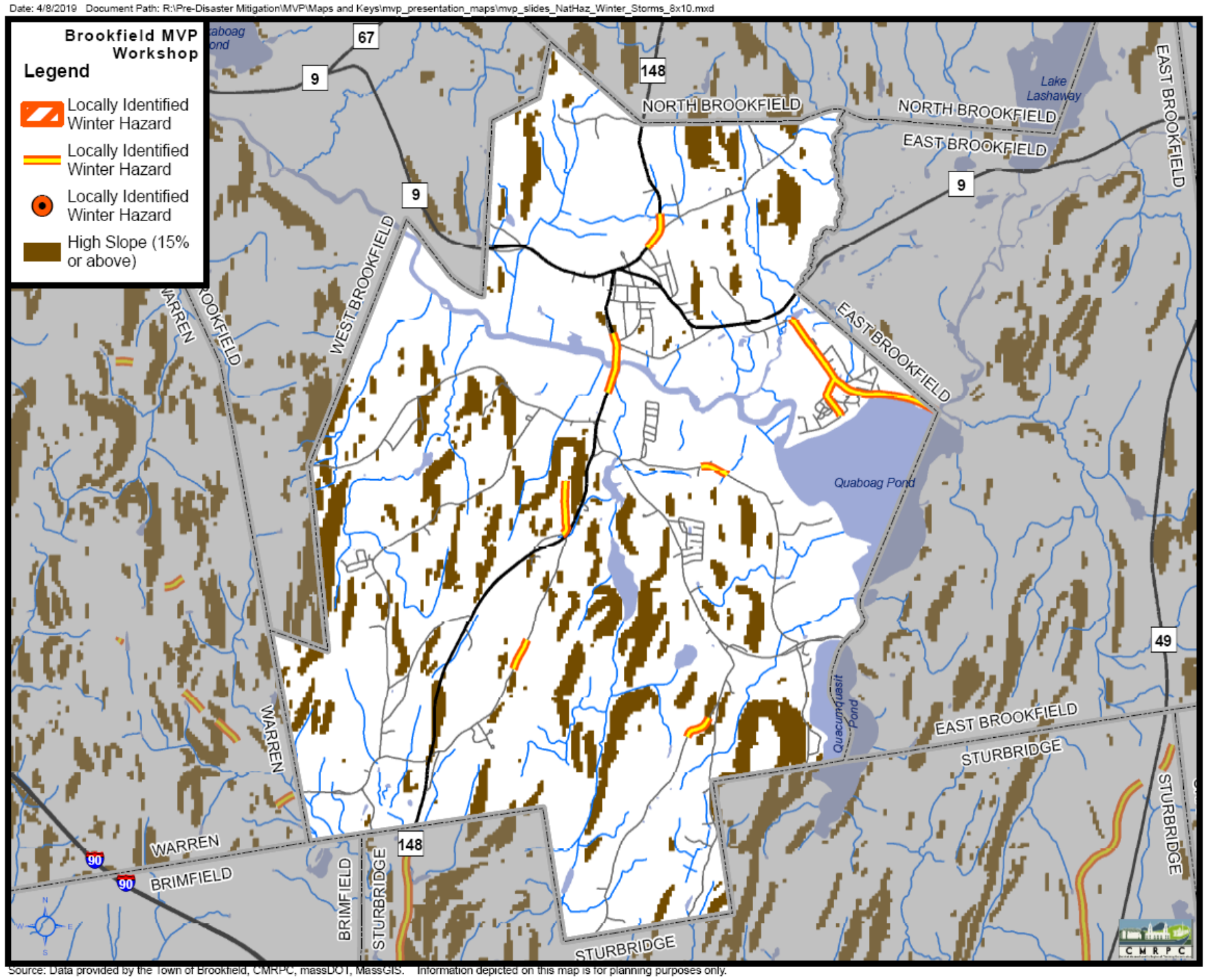
# Natural Hazards: Winter Storms

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# Natural Hazards: Extreme Storms


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# Critical Infrastructure & Facilities

- What infrastructure and facilities are critical to the region and its residents? Which do we most need or desire to protect from hazards?
  - Those needed to respond to hazard events or which would exacerbate hazard scenarios, if affected
  - Those needed to perform day-to-day municipal operations and to support basic services and economic activity
  - Major employers and institutions, natural and cultural resources, recreational and historic sites, etc…

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# Vulnerable Populations

- Vulnerability is not just about utilities, facilities, or businesses
  - Disproportionate populations of potentially vulnerable demographic groups (elderly, children, etc.) or socioeconomic groups (low income households, etc.) living/working in high-risk areas
  - Can be on neighborhood scale, or at specific locations
  - Cultural vulnerability (cultural or language isolation)
  - These will evolve over time, as climate and populations change

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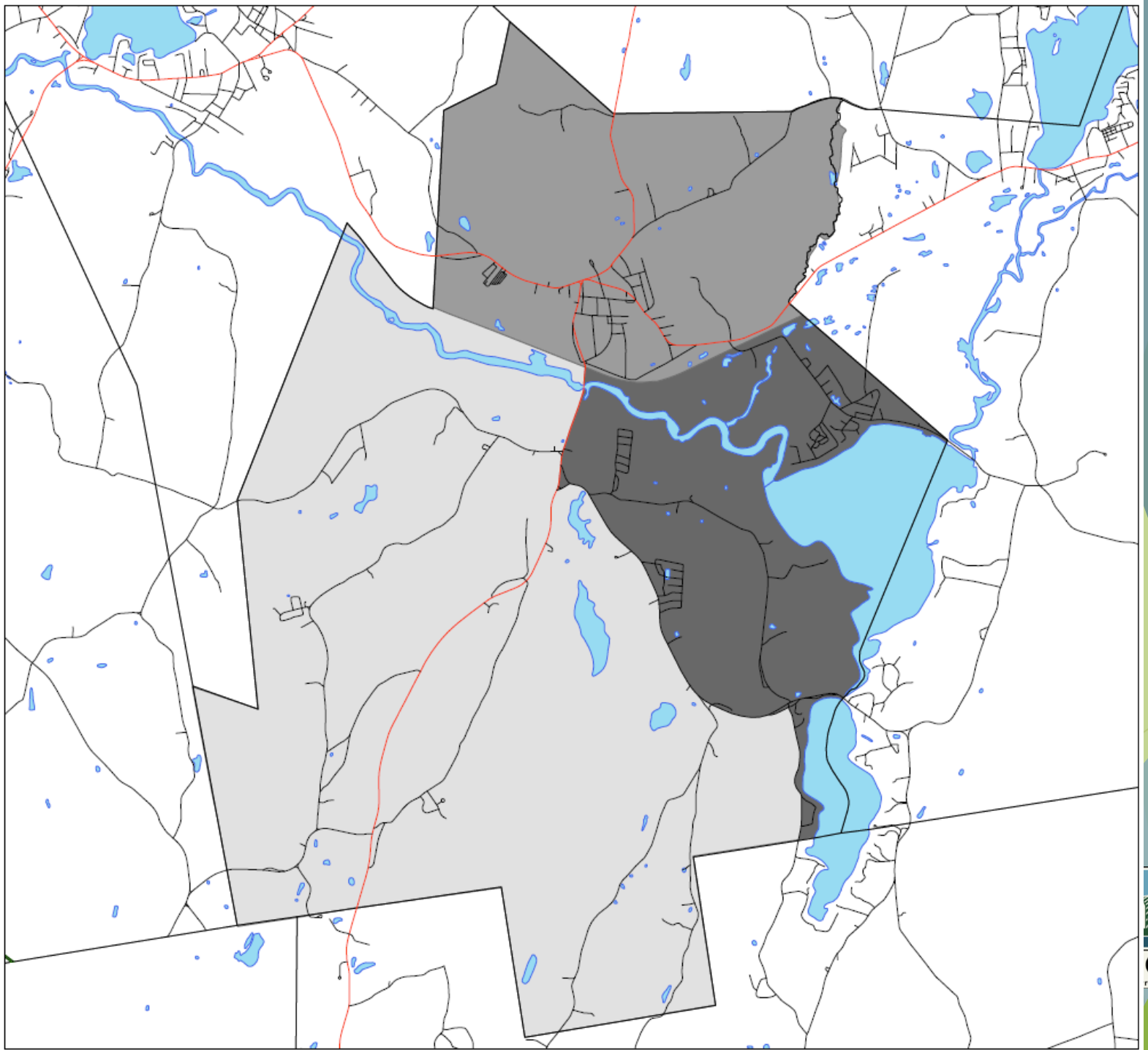
# Vulnerable Populations: Seniors

**Municipal Vulnerability Preparedness (MVP) Workshop: Brookfield**

**Percent Seniors 65+**

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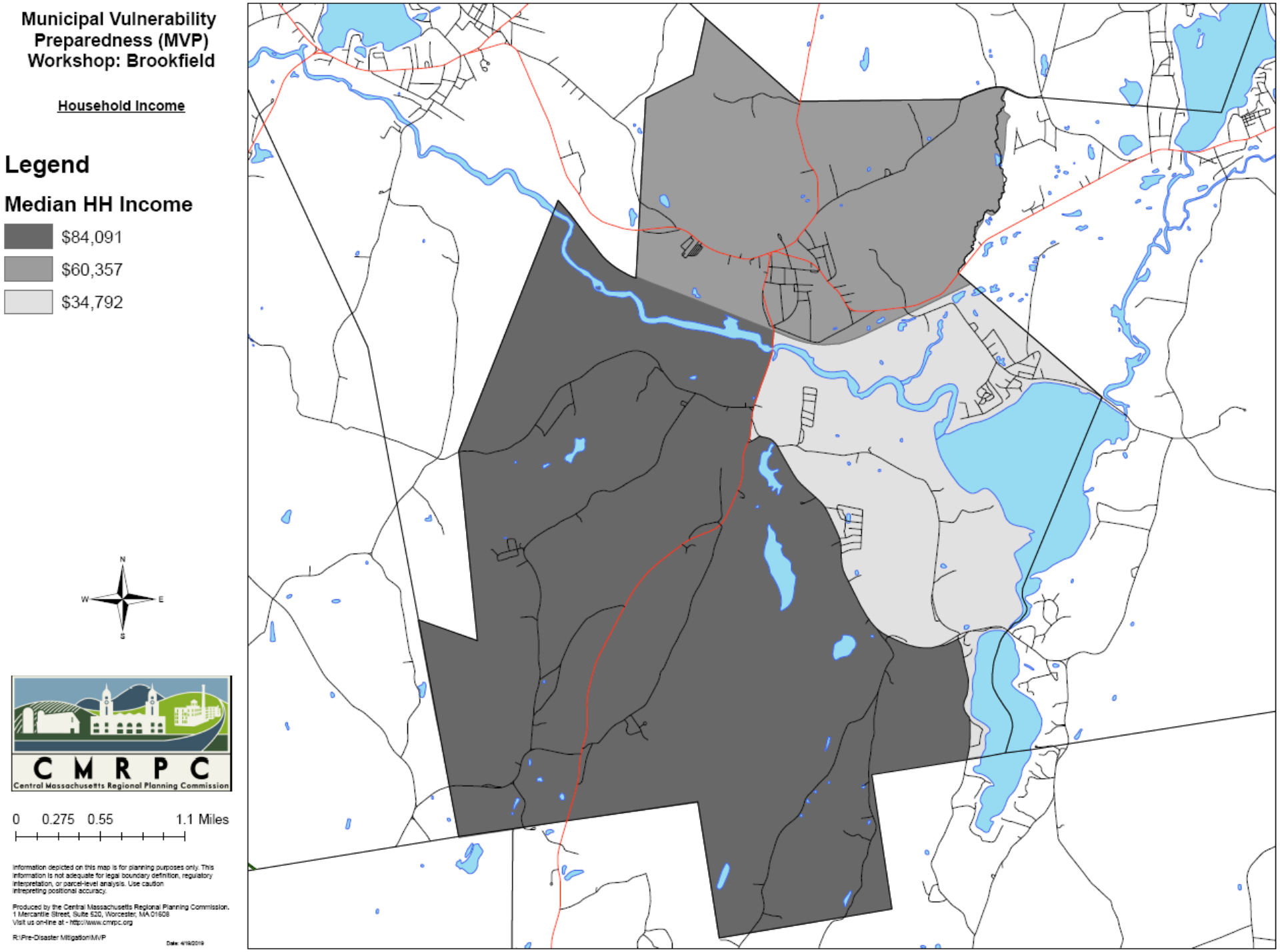
# Vulnerable Populations: Median Income

**Municipal Vulnerability Preparedness (MVP) Workshop: Brookfield**

**Household Income**

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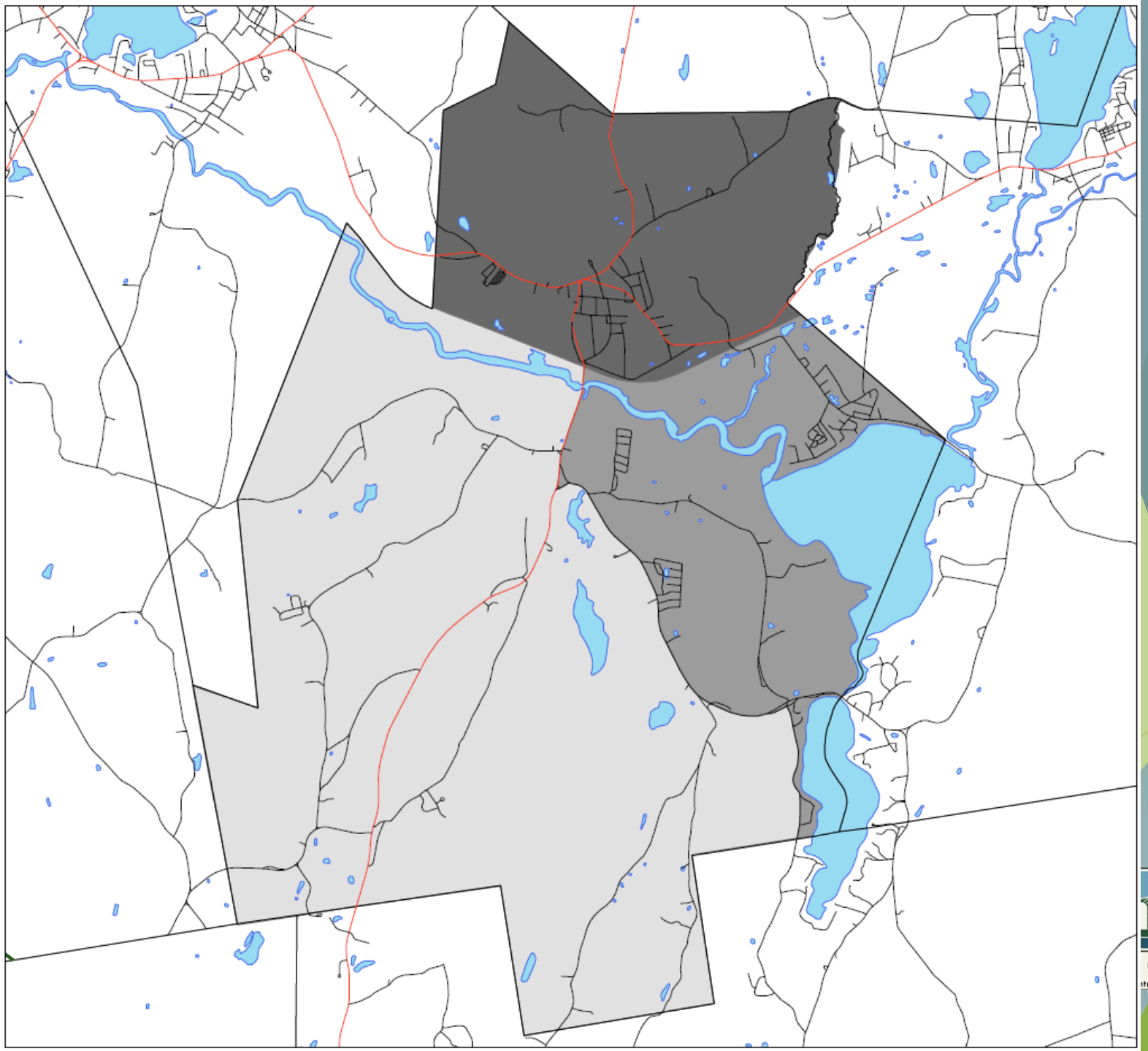
# Vulnerable Populations: Renter-Occupied Housing

**Municipal Vulnerability Preparedness (MVP) Workshop: Brookfield**

**Percent Renters**

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# Questions?

**Andrew Loew**
**Central Massachusetts Regional Planning Commission**
Phone: (508) 459-3339
aloew@cmrpc.org

# Municipal Vulnerability Preparedness Workshop

## Town of Brookfield

April 25, 2019
8:30 AM – 4:30 PM
Brookfield Town Hall
6 Central Street, Brookfield, MA 01506

| NAME | AFFILIATION | EMAIL |
|---|---|---|
| Ken Cleveland | Com.Com | KEN.CLEVELAND@AOL.COM |
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| Donald R. Taft | Water Comm | DTaft9492@Gmail.com |
| Cathy LaRocca | Grant Writer/Facilitator | |
| Dennis Clarke | Brookfield Water Superintendent | clarke@brookfieldma.us |
| Mike Blanchard | Brookfield Police | mblanchard@brookfieldma.us |
| PETER PELOQUIN | CMRPC | |
| Cindy Thompson | Brookfield Highway | highway@brookfieldma.us |
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| Peter Martell | Fire | chief_martell@brookfieldfd.com |
| BOB CORRY | QUABOAG LAND TRUST | RACORRY@GMAIL.COM |



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# Municipal Vulnerability Preparedness Workshop

## Town of Brookfield

April 25, 2019
8:30 AM – 4:30 PM
Brookfield Town Hall
6 Central Street, Brookfield, MA 01506

| NAME | AFFILIATION | EMAIL |
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| Eli Goldman | CMRPC | |
| Hoamy Tran | CMRPC | |
| Andrew Loew | CMRPC | |
| Todd Olanyk | Mass Wildlife | Todd.Olanyk@mass.gov |
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