

Appendix 5: PowerPoint Presentations from MVP Workshop

Presentations given during Mendon's MVP workshop include: an overview of the MVP process (BRWA), a summary of climate change data and projections for Mendon (Mass Audubon), a review of Mendon's past natural hazards and town response (Mendon Office of Emergency Management), and an overview of nature-based solutions to natural hazards (Mass Audubon).



MENDON

Municipal Vulnerability Preparedness

Community Resilience Building Workshop Part 1

January 31, 2018

- Introductions
- What is the MVP Program?
- What are we doing today? (Part 1)
- What will we do next week? (Part 2)

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| | |
|--------------|--|
| 8:30 | Welcome, Workshop Overview, Introductions |
| 8:50 | GIS Maps and How They Will Be Used |
| 9:00 | Climate Change in the Blackstone Valley |
| 9:30 | Natural Hazards Mendon is Facing |
| 9:50 | Small Group Breakout Session |
| 11:55 | Report Outs and Whole Group Discussion |
| 12:25 | Wrap-up and Next Workshop (Part 2) |

Community Resilience Building WORKSHOP GUIDE



www.CommunityResilienceBuilding.com

Workshop Objectives

Day 1:

- ✓ Understand **connections** – ongoing issues, hazards, and activities in Mendon.
- ✓ Identify & map **vulnerabilities and strengths**.

Day 2:

- ✓ **Develop & prioritize actions** to improve resilience.
- ✓ Opportunities to **advance priority actions**.



Community Resilience Building...

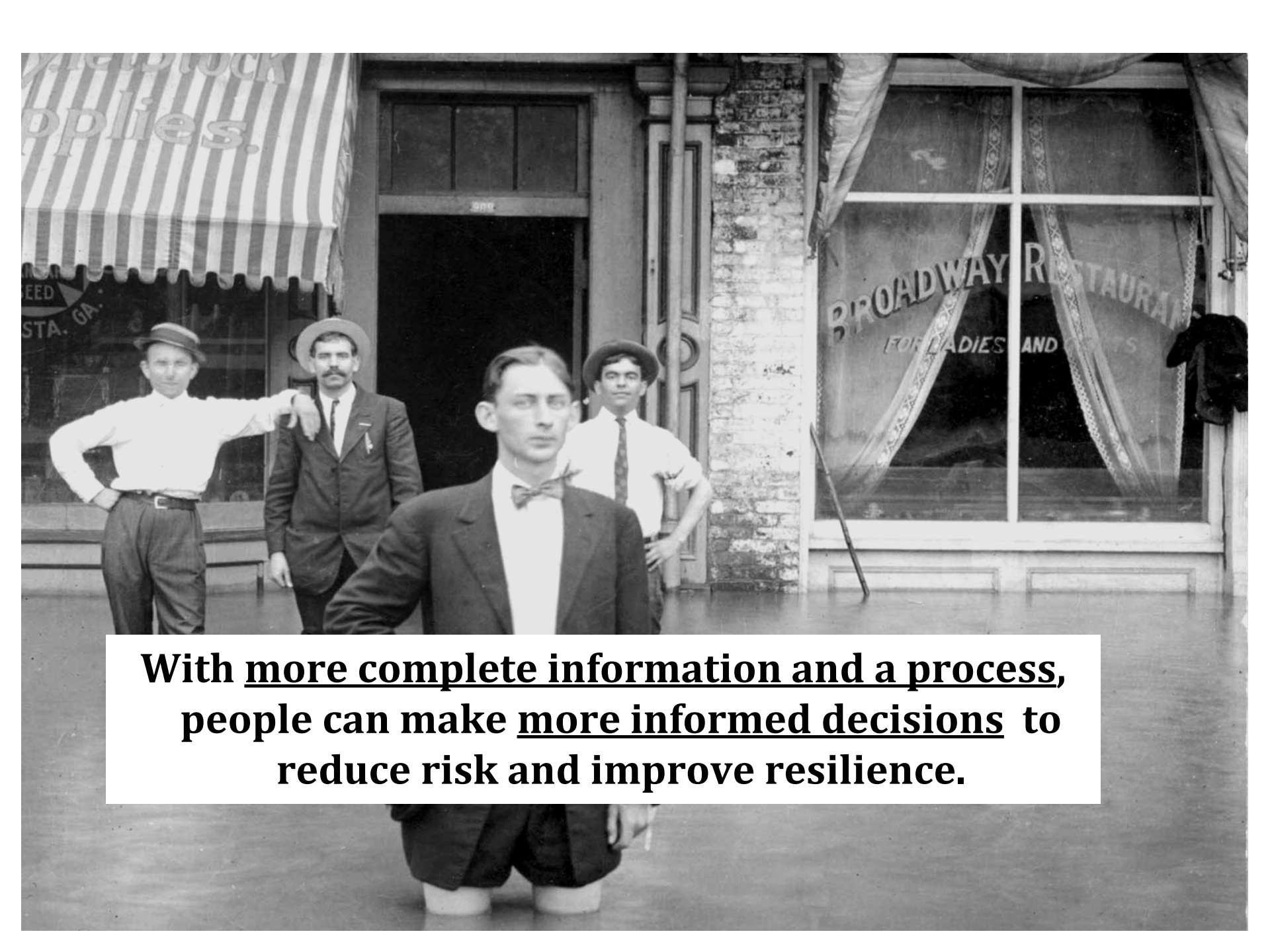
- Implications for Residents
- Business Continuity and Economic Growth
- Public Services and Amenities
- Quality of Life
- Environment
- Infrastructure

Relevant Terms

- **Hazard** = an event or condition that can cause harm or loss. *Which ones? How often & severe? Where?*
- **Vulnerability** = extent to which a community is exposed to or can be damaged by a hazards.
- **Strength** = extent to which a community has and is coping with hazards.
- **Risk** = probability of harmful consequences
- **Resilience** = anticipate, accommodate and/or recover



RISK = HAZARD x EXPOSURE



**With more complete information and a process,
people can make more informed decisions to
reduce risk and improve resilience.**

Climate Change in Mendon

Daniel Brown

Climate Change Program Coordinator

dbrown@massaudubon.org

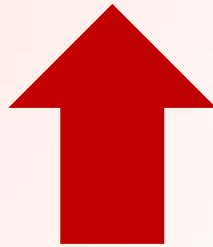


Mass Audubon

Massachusetts

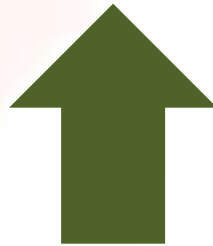
Key Observed Climate Changes

Annual Average
Temperature:



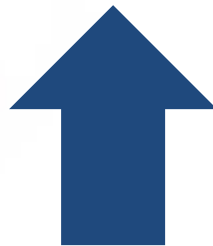
2.9°F
Since 1895

Growing Season:



11 Days
Since 1950

Heaviest 1% of
Storms:



55%
Since 1958

Mendon Projected Climate Changes (2040-2069)

Annual Average
Temperature



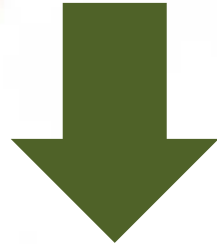
5.3°F

Days Above 90°F



20 Days

Days Below 32°F

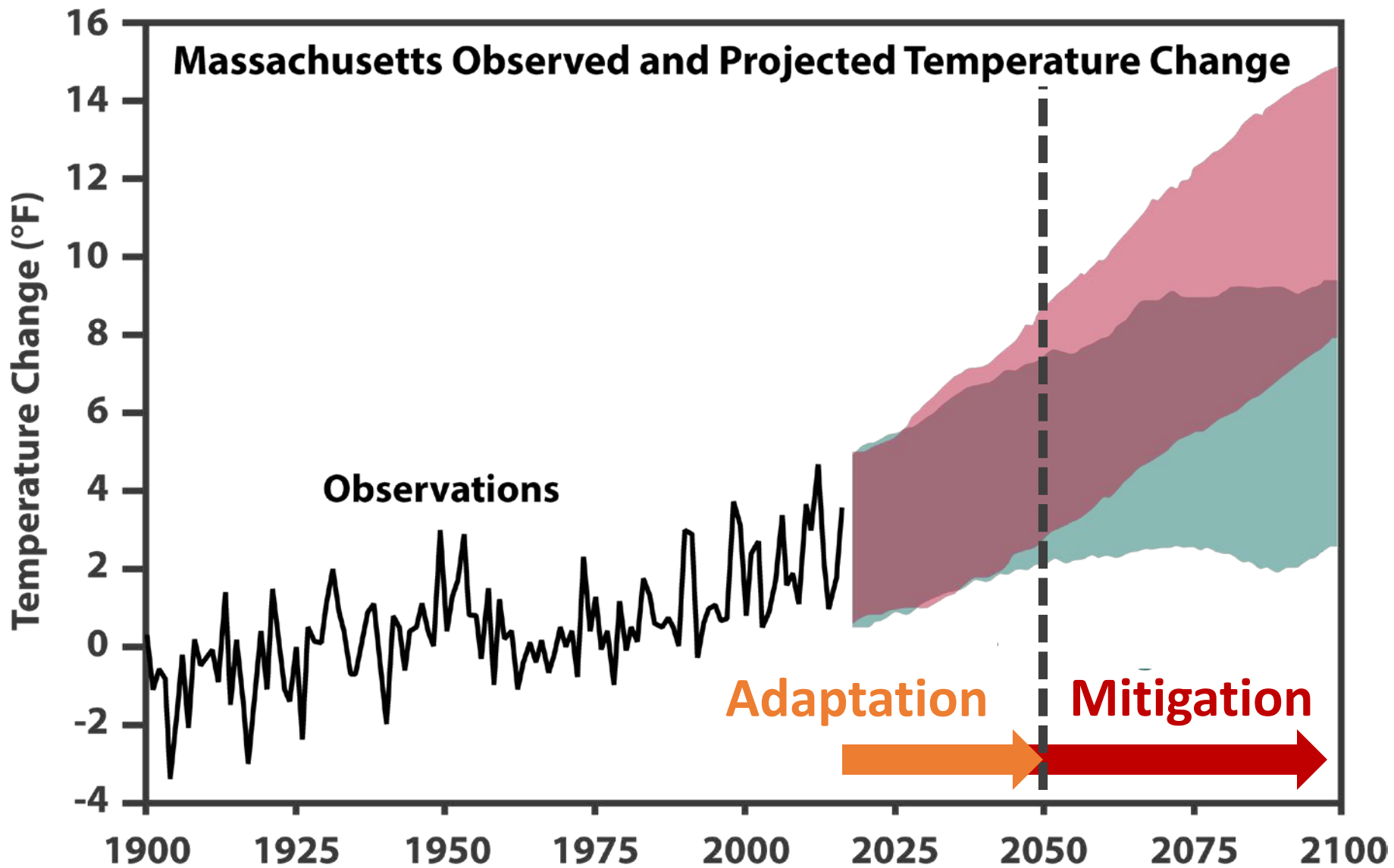


33 Days

Days with >2"
Precipitation



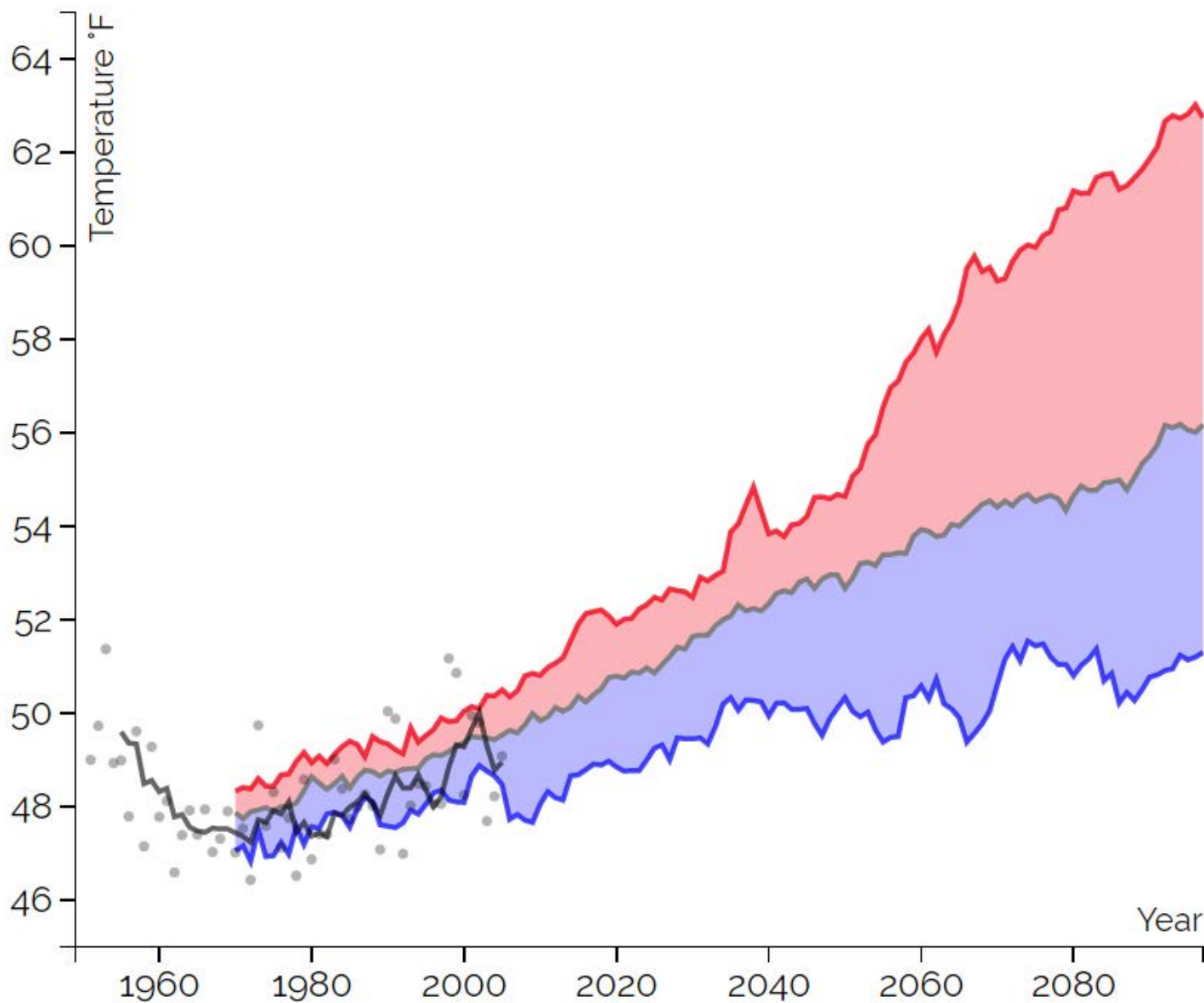
23%



Source: NCICS State Climate Summaries. Observational data from NOAA nClimDiv dataset. Accessed 2017.

Annual Average Temperature

Blackstone

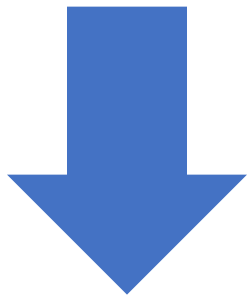


Source: Northeast Climate Science Center, MassClimateChange.org, accessed 2018.

Changing Energy Use and Demand

More Warm Winter Days, Less Heating Demand

(based on annual Heating Degree-Days, base 65)



11 – 24%

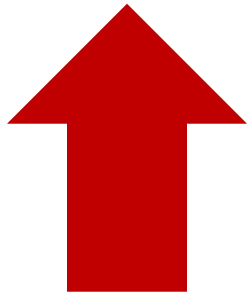
by the 2050s

1971-2000

6651 Heating Degree-days

More Warm Summer Days, More Cooling Demand

(based on annual Cooling Degree-Days, base 65)



59 – 151%

by the 2050s

1971-2000

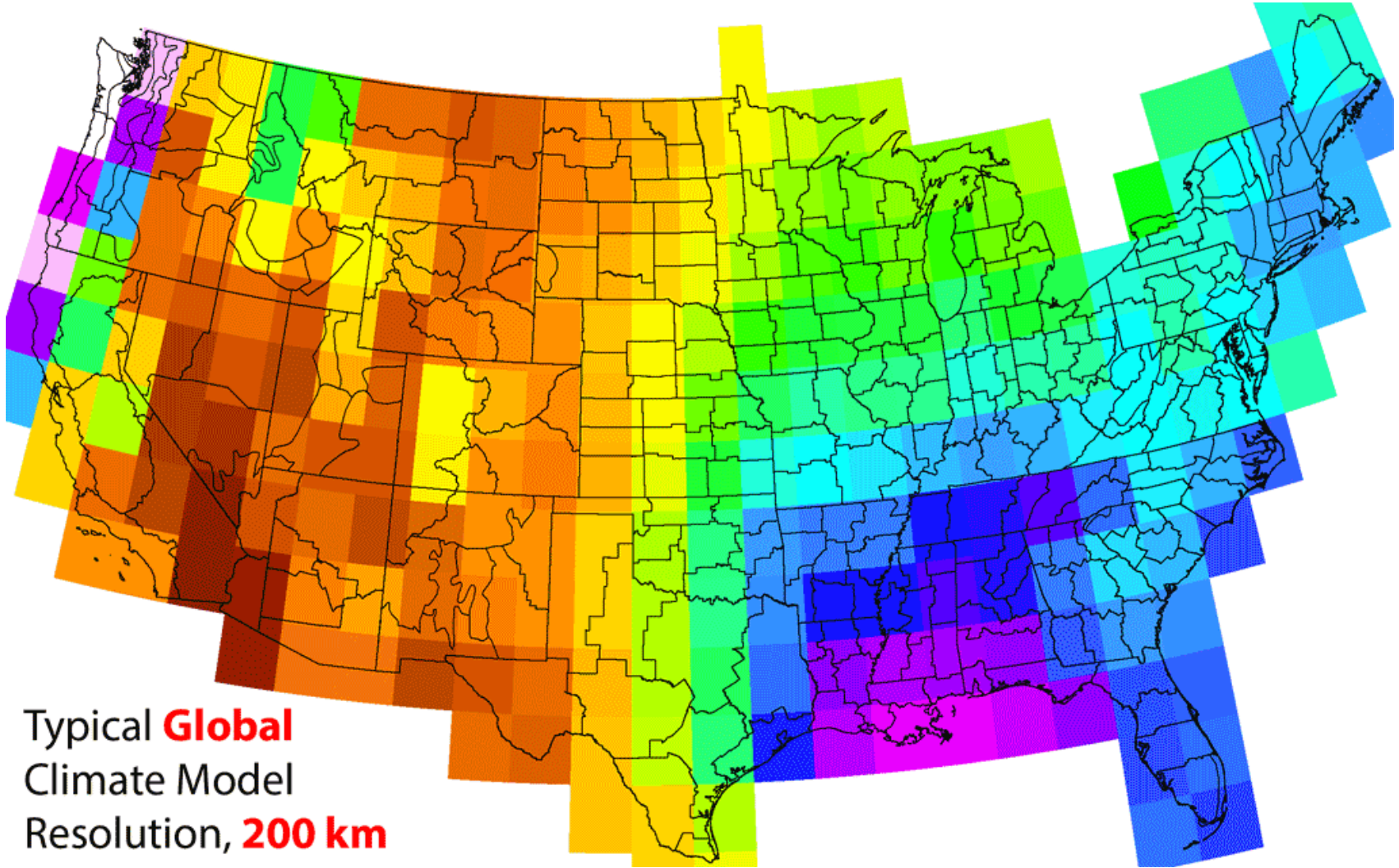
499 Cooling Degree-days

What's in a degree?



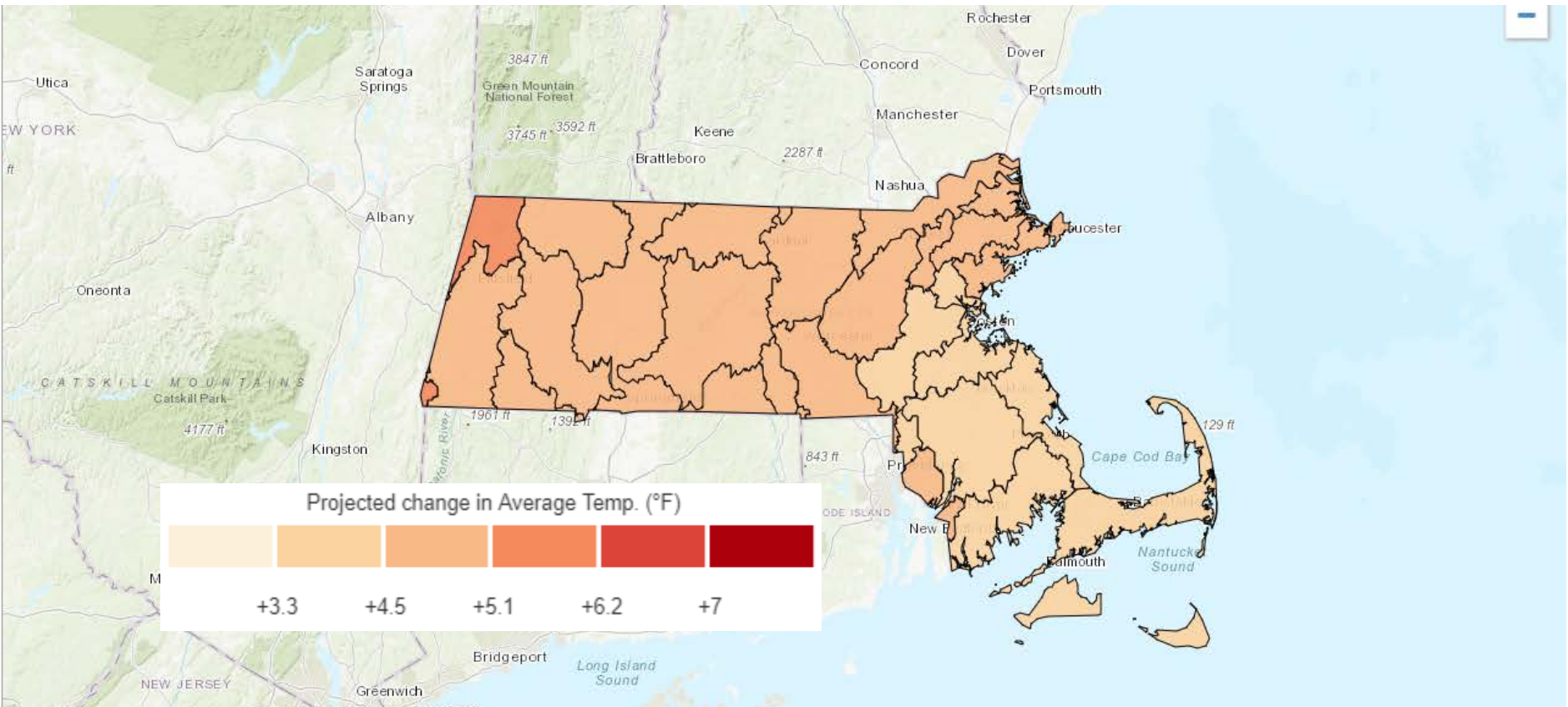
During the last ice age, temperatures were 9° F cooler than today.

Typical Downscaled and Global Climate Model Resolution



Climate Change Indicators by Geographic Scale

2050s Annual Average Temperature Change



HUC-8 Watersheds

Climate Data and Planning

- The current and projected trajectory of many changes in climate are clear.
- Local variations are most often within the projected margin of error of climate models. Local variations are usually not practically significant.
- The resolution of climate data is not usually a limiting factor in planning. At the local scale, other factors may play a larger role.

More Precipitation

**Total annual precipitation
has increased by:**

15%

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

~9,700 filled Prudential Towers



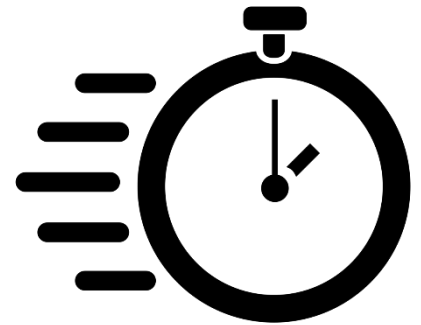
Change in 24-hour, 100-year Design Storms (inches)

| | NOAA TP-40 | NOAA Atlas 14 | Change |
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NOAA Atlas 14: <http://hdsc.nws.noaa.gov/hdsc/pfds/>

An anecdotal rule of thumb for anticipating changes in extreme precipitation...

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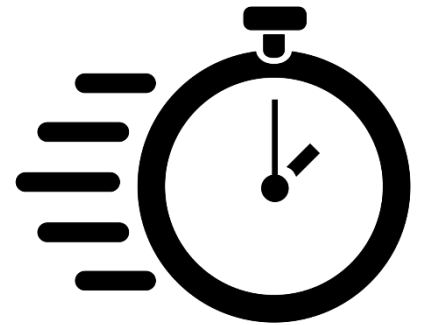
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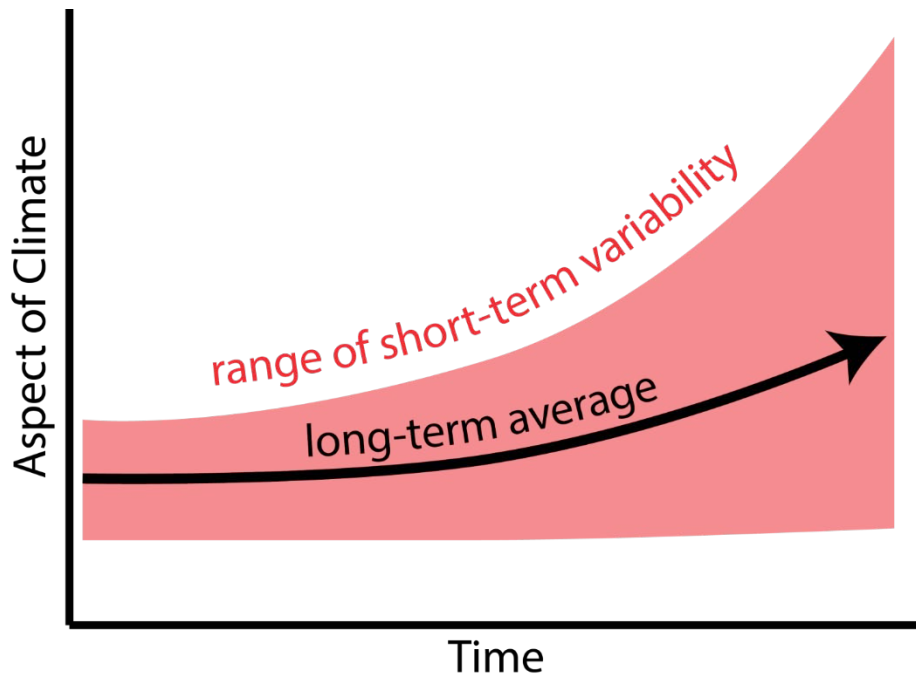
Often:



But projections vary place-to-place.

Long-term change doesn't rule out shorter-term variability.

Example: Even as average temperatures warm, we will still experience winter storms.



Impact Example: Water Infrastructure Freeze Vulnerability

**Rising winter temperatures
reduce spring snow cover.**

+

**Risk of spring cold snaps
remains relatively stable.**

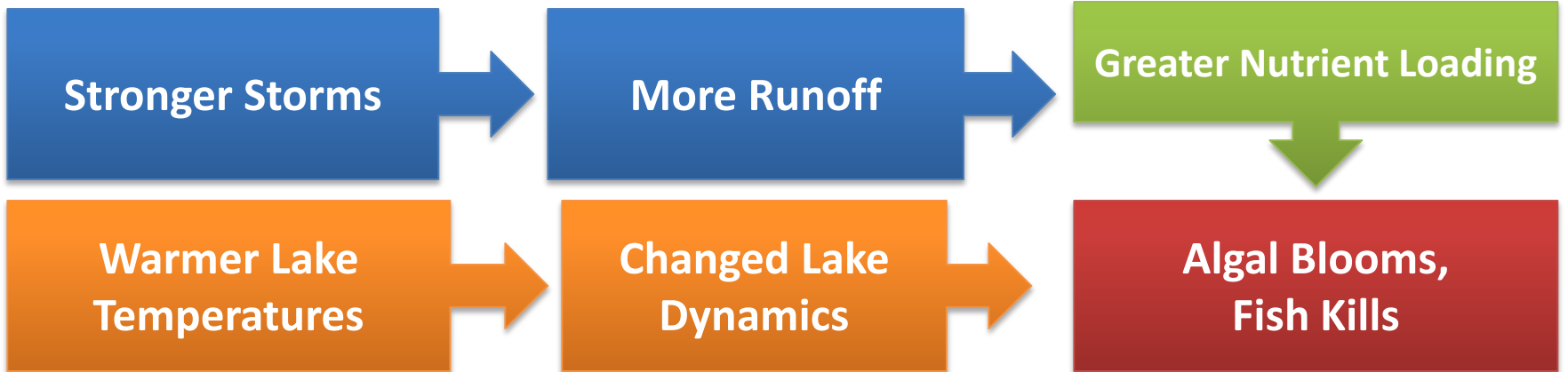
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**Increased subsurface
freeze risk**



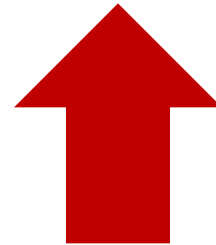
Impact Example: Public Health Algal Blooms

West Monponsett Pond, Halifax, Massachusetts

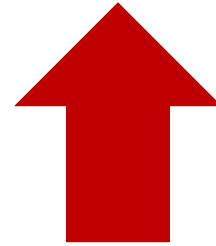


Key Changes for Mendon

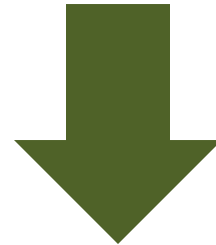
Accelerated Warming Expected



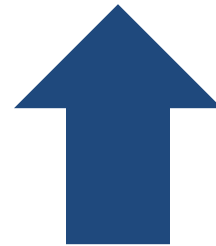
More Hot Days



Fewer Freezing Days



More Heavy Storms





MUNICIPAL VULNERABILITY PREPAREDNESS PROGRAM

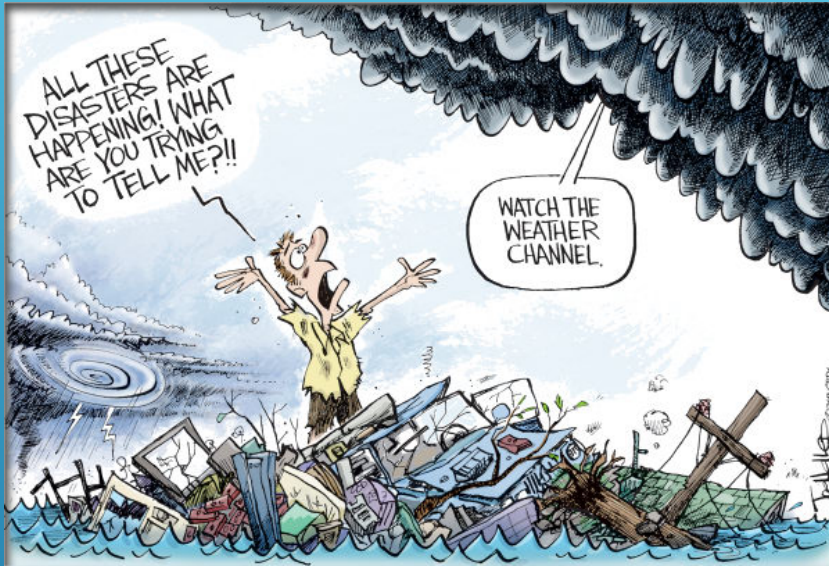
Town of Mendon, Massachusetts

Natural Hazards Impact & Awareness

OFFICE OF EMERGENCY MANAGEMENT

DIRECTOR, MARK BUCCHINO
DEPUTY DIRECTOR, GARRETT WANTE





- ▶ US natural disasters in 2017 cost \$306 billion, the most expensive year since NOAA started keeping track in 1980.

IMPACT

BE DISASTER AWARE

SEPTEMBER
IS NATIONAL
PREPAREDNESS
MONTH



TAKE ACTION TO PREPARE



FEMA

AMERICA'S
PrepareAthon!

Ready®

AWARENESS

- ▶ We should all take action to prepare! We are all able to help first responders in our community by training how to respond during an emergency and what to do when disaster strikes — where we live, work, and visit. The goal of NPM is to increase the overall number of individuals, families, and communities that engage in preparedness actions at home, work, business, school, and place of worship.

FLOOD TSUNAMI FOREST FIRE BREAKDOWN IN PUBLIC SERVICES TOXIC EMERGEN

Are You Prepared for A Natural Disaster?

- Water
- Food
- Flashlights
- Candles
- Blankets
- Radio
- First Aid Kit
- Medicines
- Extra Batteries
- Food for Pets



CHECK OUT WWW.READY.GOV/AMERICA/GETAKIT

[HTTP://STEVE-RUSTAD.PETALUMA3.COM](http://STEVE-RUSTAD.PETALUMA3.COM)

BE PREPARED

HOW NATURAL DISASTERS IMPACT THE TOWN OF MENDON

- ▶ Extreme Precipitation Events
- ▶ Wind
- ▶ Heat Waves and Drought
- ▶ Wild Fire/Brush Fires





Current Mendon Historical Society Building & Founder's Park after the 1938 Hurricane Doug Taylor Photo



Blackstone Street-Hurricane 1938 (Vincent Farm in the distance) Doug Taylor Photo



Muddy brook (ite. 15, Mendon) Doug Taylor Photo



Muddy Brook George St

August 1955 Flood--Mendon Doug Taylor Photo



Muddy Brook Behind Crookets

Aug. 1955 Flood-Mendon, Norman Cox Property (today) in the background. Doug Taylor Photo



1955 Flood --George Street Doug Taylor Photo

MENDON HISTORICAL EVENTS: 1938 HURRICANE & 1955 FLOODING



WIND DAMAGE

| Wind Speed (mph) | Wind Speed (knots) | Description |
|------------------|--------------------|---|
| <1 | <1 | Smoke rises vertically |
| 1-3 | 1-3 | Direction of wind shown by smoke drift |
| 4-7 | 4-6 | Wind felt on face |
| 8-12 | 7-10 | Wind extends light flag |
| 13-18 | 11-16 | Raises dust and loose paper |
| 19-24 | 17-21 | Small trees in leaf begin to sway |
| 25-31 | 22-27 | large branches in motion |
| 32-38 | 28-33 | whole trees in motion; inconvenience felt in walking against wind |
| 39-46 | 34-40 | slight structural damage |
| 47-54 | 41-47 | trees uprooted |

- ▶ Damage from severe thunderstorm winds account for half of all severe reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach **up to 100 mph** and can produce a damage path extending for hundreds of miles.

WIND DAMAGE

NOR'EASTER



- ▶ A Nor'easter is a storm along the East Coast of North America, so called because the winds over the coastal area are typically from the northeast. These storms may occur at any time of year but are most frequent and most violent between September and April.
- ▶ High wind damage includes trees and vegetation, residential roofs and siding, and utility lines resulting in power outages.



- ▶ Sustained winds of 28 MPH and peak wind gust of 45 MPH toppled trees and caused power outages lasting over 24 hours in some neighborhoods of Mendon.

WIND DAMAGE
OCTOBER 29-30,
2017

EXTREME RAINFALL EVENTS

- ▶ In October 2005, remnants of Tropical Storm Tammy and Subtropical Depression Twenty-Two merged with incoming continental cold fronts to produce torrential rains over interior New England.
- ▶ In Mendon, over 7 inches of rain fell between October 13th and October 15th.
- ▶ Lake Nipmuc rose dramatically and flooded low lying residences around the lake.
- ▶ Over 75 calls for flooded basements were handled by Mendon fire fighters between Saturday 10/14 & Sunday 10/15.
- ▶ Flooded basements were not contained to low lying areas. Heavy rains produced scenarios where sump pumps could not handle the amount of water entering the basements of homes all over town.
- ▶ Bellingham Street, Hartford Ave West, Northbridge Road, Blackstone Street, and Uxbridge Road became flooded and were made impassable for hours with some being closed completely for long periods of time during the event.
- ▶ This 3 day event cost the Town thousands of dollars in extra man hours for Police, Fire, 911 Dispatch, and Highway and strained the emergency response capability of the public safety departments.
- ▶ Thousands of dollars of water damage was incurred by local residents and businesses.



ICE AND SNOW EVENTS

- ▶ The Blizzard of 2015 might have been a disappointment for New York, but it will go down in the record books for eastern Massachusetts after as much as 36 inches of snow fell between Monday and Tuesday, making it the snowiest storm on record in Worcester, Mass., and the snowiest January storm for Boston.
- ▶ Widespread snowfall totals of two to three feet were reported across eastern Massachusetts, southeast New Hampshire and Maine. The cities of Auburn, Hudson and Lunenburg, all in Massachusetts, came in with the highest snow accumulation of 36 inches. Northeast Connecticut and eastern Long Island also saw over 30 inches of snow.

JANUARY 2015 BLIZZARD

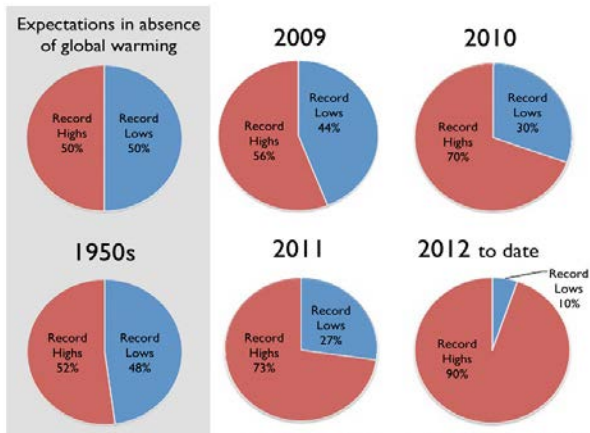


- ▶ The January 2015 Blizzard impacted the Mendon area with over 25 inches of snow, high winds, subzero temperatures, and power outages.
- ▶ Public Safety departments incurred over 75 thousand dollars in overtime, equipment, and material costs.
- ▶ Through a federal disaster declaration approved by President Obama in 2016, Mendon received 30 thousand dollars in reimbursement monies to offset those costs.
- ▶ Many of the municipal buildings had to have their roofs cleared of snow after inspections by the town's building inspector showed potential structural damage may occur under the weight of the heavy snow.
- ▶ The Massachusetts National Guard was called in to assist Mendon fire fighters with clearing fire hydrants of snow and ice.


HEAT WAVES AND DROUGHT CONDITIONS

- ▶ Extreme **heat** events are responsible for more deaths annually than hurricanes, lightning, tornadoes, floods, and earthquakes combined. At the same time, low-humidity **heat waves** associated with **droughts** and fueled in part by climate change contribute to the dry conditions that are driving wild fires.

More New Record High Than Low Temps in U.S.



1950s data from Meehl et al., all other data from NOAA



What is a Heat Wave?

- Abnormally hot and humid weather lasting at least 2 days
- Heat waves can occur anywhere in the country and cause heat illness or even death

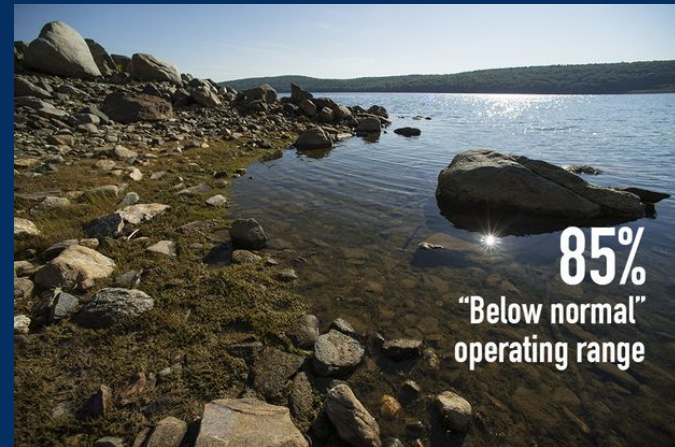
weather.gov/heat 

HEAT WAVES

- ▶ In the Mendon community, when a heat wave occurs, cooling centers are opened and staffed at the Mendon Housing Authority recreation center at 9 Blackstone Street and the Mendon Senior Center at 66 Providence Street.
- ▶ Public Safety personnel work diligently with the Council on Aging and the Senior Center Director to maintain an updated “persons at risk” list and to check on these residents during any type of heat emergency.

SEVERE DROUGHT CONDITIONS

- ▶ It's the worst drought in 14 years with severe drought conditions across 62-percent of Massachusetts – NECN August 4, 2016



DROUGHT MANAGEMENT TASK FORCE

- ▶ The Drought Management Task Force (DMTF) consists of officials from state and federal agencies and professional organizations with responsibility for areas likely to be affected by drought conditions. It also includes representatives of agencies that provide data used to assess the severity of drought conditions or that have the ability to respond to drought conditions, and public health and safety professionals.
- ▶ Mendon Emergency Management officials reported up to the Massachusetts Emergency Management Agency weekly on existing drought conditions within the Mendon community.
- ▶ One resident in Mendon reported that their well had run dry and they had no water during the worst of the drought conditions. In our efforts to assist the resident, the fire department filled water jugs daily to allow the occupants to remain in their home.



- ▶ A wildfire is an unplanned, unwanted fire burning in a natural area, such as a forest, grassland, or prairie. As building development expands into these areas, homes and businesses may be situated in or near areas susceptible to wildfires. This is called the wildland urban interface.
- ▶ Wildfires can cause death or injury to people and animals, damage or destroy structures, and disrupt community services including transportation, gas, power, communications, and other services. The impact may cover large areas with extensive burning, embers traveling more than a mile away from the wildfire itself, and smoke causing health issues for people far away from the fire. Wildfires damage watersheds leave areas prone to flooding and mudslides for many years.
- ▶ Wildfires can occur anywhere in the country. They can start in remote wilderness areas, in national parks, or even in your back yard. Wildfires can start from natural causes, such as lightning, but most are caused by humans, either accidentally—from cigarettes, campfires, or outdoor burning—or intentionally.
- ▶ Wildfires can occur at any time throughout the year, but the potential is always higher during periods with little or no rainfall, which make brush, grass, and trees dry and burn more easily. High winds can also contribute to spreading the fire. Your community may have a designated wildfire season when the risk is particularly high.

WILD FIRES / BRUSH FIRES

FIRE WEATHER WATCH

RED FLAG WARNING

- ▶ **Fire weather watch** = dangerous fire weather conditions are possible over the next 12 to 72 hours
- ▶ A **red flag warning** is a forecast warning issued by the United States National Weather Service to inform area firefighting and land management agencies that conditions are ideal for wildland fire combustion, and rapid spread





THANK YOU FOR YOUR TIME!

- ▶ *"To the Pilgrims, Civil Defense meant a blunderbuss, in addition to the stockade; a reliable warning system; a leader to turn to for direction and a pooling of resources for survival. What began in Plymouth has become an American tradition. It was exemplified in Paul Revere and the Minuteman and later in the Westward Movement. The will to survive has characterized America's growth and greatness. The banding together for protection and assistance in times of peril has made us strong"*
- ▶ Governor Endicott Peabody,
November 16, 1963

- 1) Extreme Precipitation Events**
- 2) Wind**
- 3) Drought and Heat Waves**
- 4) Wildfire/Brushfire**

Process for Workshop Part 1



NOAA Coastal Services Center

- Current and future hazards?
- What are our strengths & vulnerabilities?
- Look at each hazard in context of Infrastructural, Societal, Environmental

Identify: Hazards

Develop Risk Matrix Features:

Infrastructure

Societal

Environmental





Hazards



Infrastructure Vulnerability/Strength

Infrastructure

- **What infrastructure/facilities are exposed?**
 - *Water supplies, nursing homes, schools, hazardous materials, etc...*
- **What makes this infrastructure vulnerable?**
 - *Location, age, building codes, type of housing, etc...*
- **Consequences of this infrastructure vulnerability?**
 - *Lack of access to critical facilities – hospitals, fire trucks, etc.*

POSSIBLE ACTIONS: What can be done?

- *Assess housing stock in vulnerable areas?*
- *Prioritize future development in lower-risk areas?*
- *Design and build Nature Based Solutions?*
- *Integrate risks into capital improvement plans?*



Societal Vulnerability/Strengths

Societal

- **Population characteristics in high-risk areas?**
 - *Elderly, low income, special needs, etc...*
- **How will hazards intensify these characteristics?**
 - *Where are areas for improvement in the community?*
- **Strengths of your community?**
 - *Active civic groups, organizations, associations?*

POSSIBLE ACTIONS: What can be done?

- *Improve existing programs (which ones)?*
- *Increase awareness via education/outreach on hazards?*
- *Increase involvement by citizens (on what and with whom)?*



Environmental Vulnerability/Strengths

Environmental

- **Natural resources important to your community and where?**

Wetlands, ponds, streams, forests, farms, etc.

- **Benefits natural resources provide and where?**

Storm buffering, flood protection, erosion control, water quality, recreation, etc...

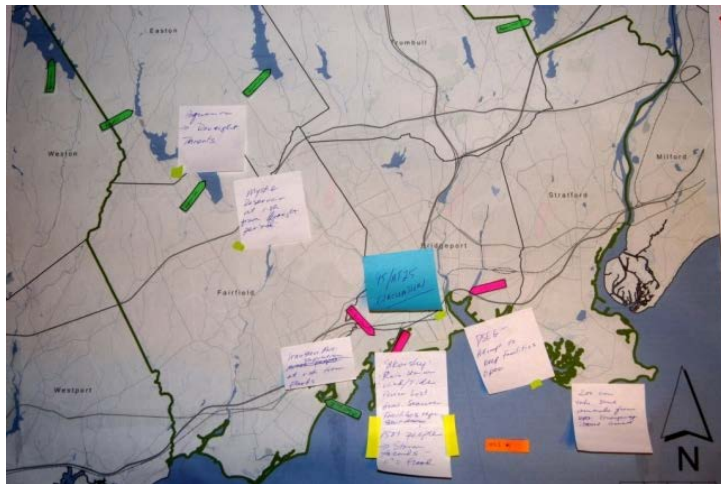
- **High risk areas and effects of hazards?**

Impact without and with more natural resources

POSSIBLE ACTIONS: What can be done?

- *Conserve wetlands?*
- *Conserve land located adjacent to flood zones?*
- *Green infrastructure in neighborhoods?*

Participatory Mapping Examples



Workshop Part 1's Activities

Elements

- Participatory process for assessing a community's vulnerability/strengths
- Risk Matrix and Base Maps

Process and outputs:

- Break into small groups
- Complete assessment using Risk Matrix/Base Maps
- Report out to the larger group

Risk Matrix/Base Map

Step #1: List top hazards

Step #2: Vulnerabilities and Strengths

- Infrastructure; Societal; Environmental
 - Indicate location and ownership

Step #3: Mark your Base Maps

Step #4: Fill in the Risk Matrix

Resources in the room...

Guiding Questions, Risk Matrix, Base Map, Facilitator(s)

Report outs

- Each small group reports out on its priority hazards, vulnerabilities and strengths
- Lead facilitator captures and groups ideas by similarity

Expectations of Participants

- Be active participants
- Your ideas & expertise are needed
- Respect contributions of others
- Be creative and remain optimistic
- Stay on task (as defined by your facilitators)
- Be accountable for your group's discussions



Your Turn!

"Thank you for calling. Please hold – on as tight as you can."



MENDON

Municipal Vulnerability Preparedness

Community Resilience Building Workshop

Part 2

February 7, 2018

This presentation was prepared by the Blackstone River Watershed Association and Mass Audubon through a grant awarded to the Town of Mendon as part of the Massachusetts Environmental Affairs' Municipal Vulnerability Preparedness (MVP) Program. Additional slides were provided by The Nature Conservancy.



Mass.gov

 Mass Audubon

The Nature Conservancy 
Protecting nature. Preserving life.™



Introduction

- Introductions
- What is the MVP Program?
- What did we do last week? (Part 1)
- What will we do today? (Part 2)

The Nature
Conservancy



Protecting nature. Preserving life.™



CLEAN
AIR



COOL®
PLANET

**A
G
E
N
D
A**

| | |
|--------------|--|
| 8:30 | Welcome, Workshop Overview, Introductions |
| 8:35 | Climate Change in the Blackstone Valley (refresher) |
| 8:45 | Nature Based Solutions for MVP Actions |
| 9:05 | Recap of Week 1 and Instructions for Week 2 |
| 9:20 | Small Group Work Sessions |
| 11:00 | Break and Rearrange for Whole Group Discussion |
| 12:15 | Wrap-up, Next Steps, and Adjourn at 12:30 |

Climate Change in Mendon Refresher

Daniel Brown

Climate Change Program Coordinator

dbrown@massaudubon.org



Mass Audubon

Mendon Projected Climate Changes (2040-2069)

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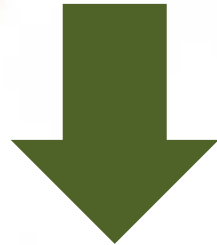
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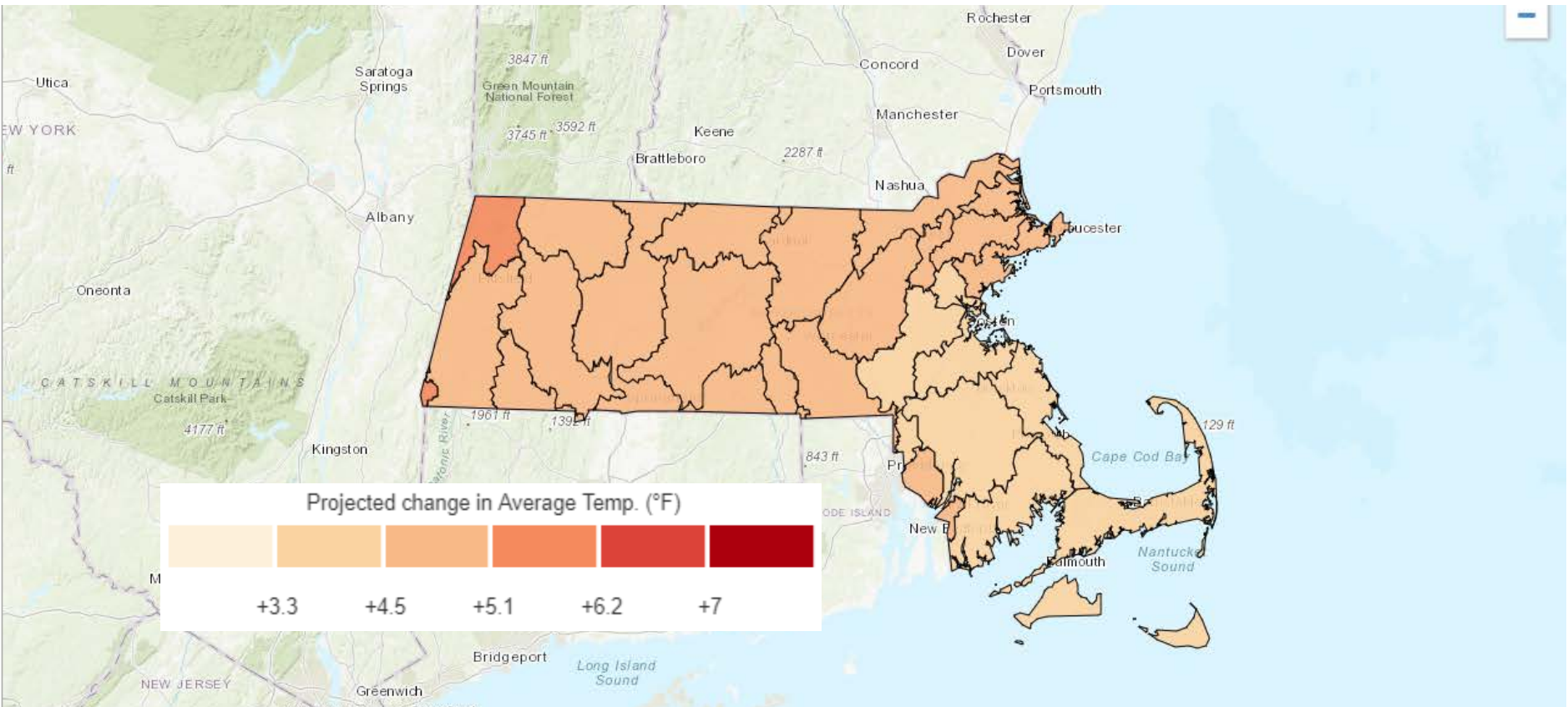
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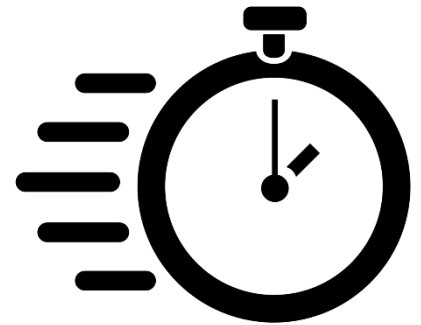
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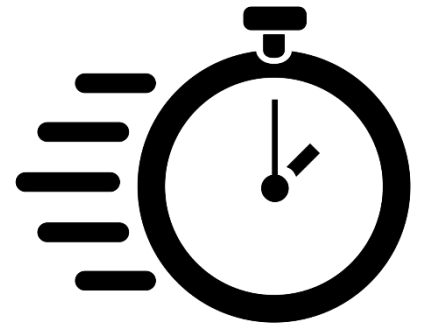
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An anecdotal rule of thumb for anticipating changes in extreme precipitation...

Models often project a return period shorter by a factor of 2 to 4.



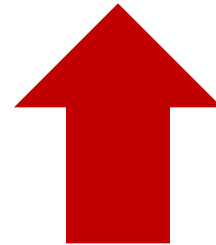
Often:



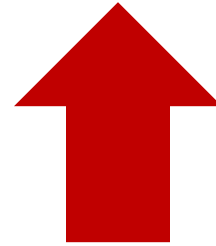
But projections vary place-to-place.

Key Changes for Mendon

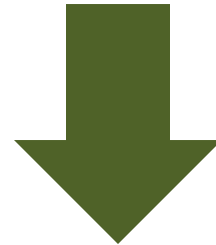
Accelerated Warming Expected



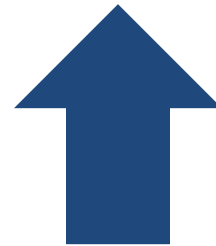
More Hot Days



Fewer Freezing Days



More Heavy Storms



Nature Based Solutions in Mendon



**Shaping
the Future
of Your
Community**

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Shaping the Future of Your Community Program

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CHARLES D. BAKER
GOVERNOR

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KARYN E. POLITO
LIEUTENANT GOVERNOR

By His Excellency
CHARLES D. BAKER
GOVERNOR

EXECUTIVE ORDER NO. 569

**ESTABLISHING AN INTEGRATED CLIMATE CHANGE STRATEGY
FOR THE COMMONWEALTH**

WHEREAS, climate change presents a serious threat to the environment and the Commonwealth's residents, communities, and economy;

WHEREAS, extreme weather events associated with climate change present a serious threat to public safety, and the lives and property of our residents;

WHEREAS, the Global Warming Solutions Act (the "GWSA") directs the Secretary of Energy and Environmental Affairs and the Department of Environmental Protection to take certain steps to reduce greenhouse gas emissions and prepare for the impacts of climate change, including setting statewide greenhouse gas emissions limits for 2020, 2030, 2040 and 2050;

WHEREAS, the statewide greenhouse gas emissions limit for 2020 is 25% below the 1990 level of emissions and the corresponding limit for 2050 is 80% below the 1990 level of emissions, but no interim limits have yet been set for 2030 or 2040;

WHEREAS, the Commonwealth can provide leadership by reducing its own emissions from state operations, planning and preparing for impending climate change, and enhancing the resilience of government investments;

WHEREAS, the transportation sector continues to be a significant contributor to greenhouse gas emissions in the Commonwealth, and is the only sector identified through the GWSA with a volumetric increase in greenhouse gas emissions;

WHEREAS, the generation and consumption of energy continues to be a significant contributor to greenhouse gas emissions in the Commonwealth, and there is significant potential

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NO. 10303



Baker Administration's Support



EO Language:
“...strategies that **conserve and sustainably employ the natural resources** of the Commonwealth to **enhance climate adaptation, build resilience and mitigate climate change...**”

Nature-Based Solutions



Nature-Based Solutions *use* natural systems, *mimic* natural processes, or *work in tandem with* traditional approaches to address natural hazards like **flooding**, **erosion**, **drought**, and **heat islands**.

Incorporating nature-based solutions in local planning, zoning, regulations, and built projects can help communities reduce their exposure to these impacts, resulting in reduced costs, economic enhancement, and safer, more resilient communities.

Green Infrastructure

Green Infrastructure: A network of waterways, wetlands, woodlands, wildlife habitats, and other natural areas that support native species, maintain natural ecological processes, sustain air and water resources and contribute to health and quality of life.

(McDonald, Benedict and O'Conner, 2005).



Low Impact Development (LID)



LID is a category of **Green Infrastructure (GI)**:

- **Works *with* nature**
- **Manages stormwater** as close to the source as possible
- **Preserves natural landscape** (or creates natural features).
- **Treats rain as a resource** rather than a waste product.

Hazards



Riverine flooding



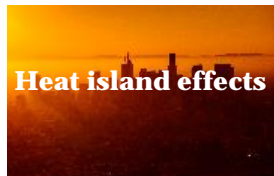
Coastal flooding



Coastal erosion



Stormwater flooding



Heat island effects

Nature-based solutions

Open space preservation

Ecosystem restoration

Low Impact Development

Municipal benefits



Avoided Costs



Enhanced Safety



Environmental Services

Enhanced Safety

Whittenton Dam Removal, Taunton, MA

Costs

- Estimated Cost of Dam Repair = \$1.9 Million
- Ongoing Cost of Dam maintenance = variable
- 2005 Evacuation Costs = \$1.5 Million
- Dam Removal Costs = \$440,000



Benefits

- Reduced risk of residential & commercial flooding
- Increased revenue from river based recreation
- Avoided costs of future evacuation and/or repair
- Increased property values
- Water quality benefits



Enhanced Safety **Avoided Costs**

Avoided costs

Land Protection as Water Protection

- Quabbin & Wachusett Reservoirs serve 2.5 million
- Over 20 years, Massachusetts Water Resources Authority spent \$130M to protect 22,000 acres of watershed lands
- Avoided ratepayer cost of \$250M on a filtration plant and \$4M/yr in operations



Avoided Costs

Preserve Services

Massachusetts Forests Mitigate Climate Change

- MA forests **sequester 14%** of the state's gross annual carbon emissions
- Average acre stores **85 tons carbon**
- Capacity **increases** over time as forests mature



**Environmental
Services**

Co-benefits

Low Impact Development

| Benefit | Reduces Stormwater Runoff | | | | Increases Available Water Supply | Increases Groundwater Recharge | Reduces Salt Use | Reduces Energy Use | Improves Air Quality | Reduces Atmospheric CO ₂ | Reduces Urban Heat Island | Improves Community Livability | | | | | Improves Habitat | Cultivates Public Education Opportunities |
|-----------------------------|-------------------------------|------------------------|-----------------------------------|------------------|----------------------------------|--------------------------------|------------------|--------------------|----------------------|-------------------------------------|---------------------------|-------------------------------|------------------------------------|-------------------------|-----------------------------|-------------------|------------------|---|
| | Reduces Water Treatment Needs | Improves Water Quality | Reduces Grey Infrastructure Needs | Reduces Flooding | | | | | | | | Improves Aesthetics | Increases Recreational Opportunity | Reduces Noise Pollution | Improves Community Cohesion | Urban Agriculture | | |
| Practice | | | | | | | | | | | | | | | | | | |
| Green Roofs | ● | ● | ● | ● | ○ | ○ | ○ | ● | ● | ● | ● | ● | ◐ | ● | ◐ | ◐ | ● | ● |
| Tree Planting | ● | ● | ● | ● | ○ | ◐ | ○ | ● | ● | ● | ● | ● | ● | ● | ● | ◐ | ● | ● |
| Bioretention & Infiltration | ● | ● | ● | ● | ◐ | ◐ | ○ | ○ | ● | ● | ● | ● | ● | ◐ | ◐ | ○ | ● | ● |
| Permeable Pavement | ● | ● | ● | ● | ○ | ◐ | ● | ◐ | ● | ● | ● | ○ | ○ | ● | ○ | ○ | ○ | ● |
| Water Harvesting | ● | ● | ● | ● | ● | ◐ | ○ | ◐ | ◐ | ◐ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ● |

● Yes ◐ Maybe ○ No

Source: Center for Neighborhood Technology's The Value of Green Infrastructure

Floodplain Buyout: Woloski Park, Middleborough, MA



- 10 home buyout in Taunton River floodplain
- FEMA's Hazard Mitigation Grant Program funded 75% of ~\$1Million cost
 - 25%: Town and The Nature Conservancy

Benefits:

- Avoided safety risk
- Avoided emergency evacuation and property recovery costs
- High quality habitat is restored, floodplain and ecosystem services recovered



Enhanced Safety



Avoided Costs



Environmental Services

Return on Investment Studies in MA

Trust for Public Land

- Outdoor recreation generates:
 - \$10 billion in consumer spending
 - \$739 million in state and local tax revenue
 - 90,000 jobs
 - \$3.5 billion in annual wages and salaries
- Agriculture, forestry, commercial fishing, and related activities generate:
 - \$13 billion in output
 - 147,000 MA Jobs
- **Conservation Projects Return \$4 : \$1 spent**



Return on Investment Studies in MA

Dept. Ecological Restoration

DER aquatic restoration projects produce an average employment demand of **12.5 jobs** and **\$1.75 Million** in total economic output from each \$1 Million spent, contributing to a growing “restoration economy” in Massachusetts



Return on Investment Studies Northeast US Scientific Reports

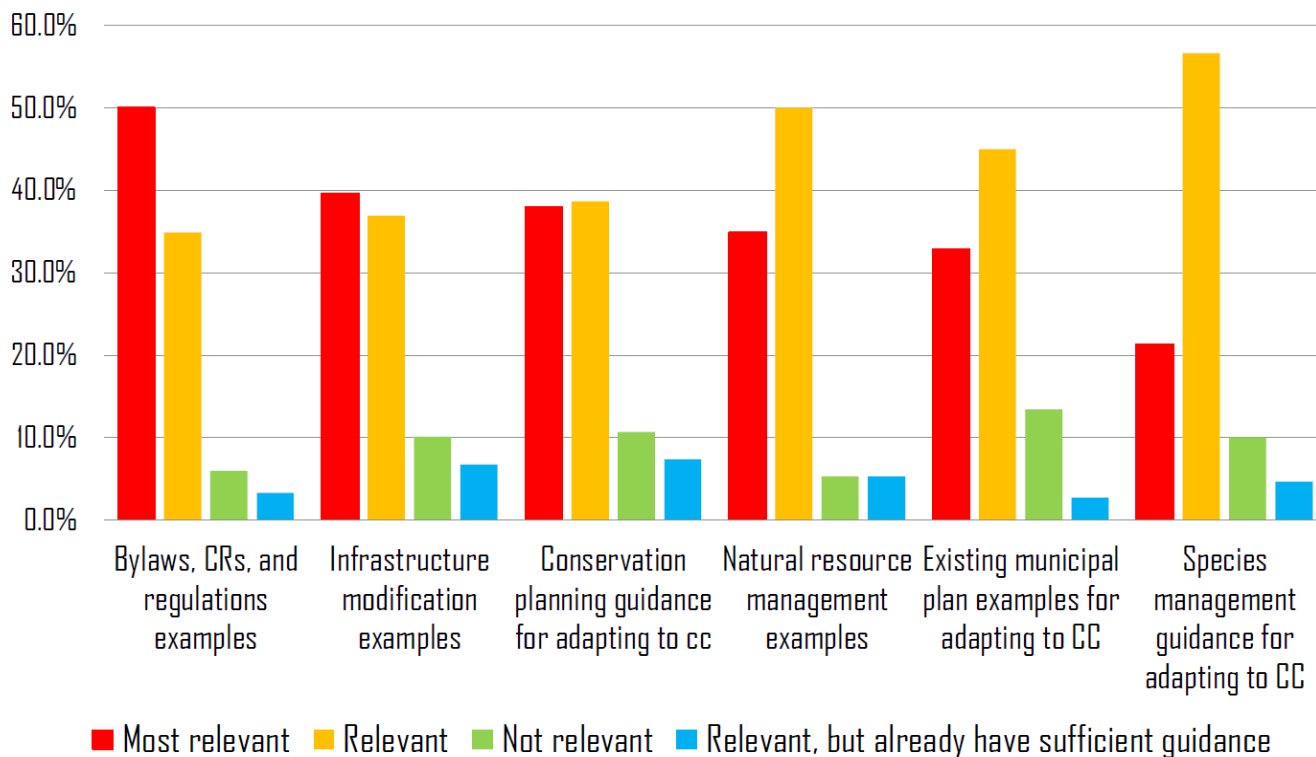
- In Hurricane Sandy, wetlands reduced \$625,000,000 in direct flooding damages in New Jersey
- In New England, wetlands reduce storm damage by approximately 16%



<https://www.nature.com/articles/s41598-017-09269-z>

Identifying Barriers

From the Climate Action
Tool survey, 2015



*Note! 70% of respondents were municipal professionals, but most already engaged in land conservation.

Reviewing Bylaws & Regulations

- Mass Audubon reviewed Mendon's bylaws, zoning, subdivision rules/regs, and stormwater bylaw in April 2016
- Compared to best practices
- Offered recommendations to encourage these nature based solutions



How to Compare Local Land Use Regulations with Best Practices

Key Areas of Analysis

The following analysis framework is designed to assist communities in Massachusetts in applying cost-effective Low Impact Development (LID) techniques. Specifically, this template enables you to evaluate local land use regulations in relation to models and examples from the Commonwealth of Massachusetts' Smart Growth/Smart Energy Toolkit and other sources in relation to the use of LID and Green Infrastructure (GI) techniques. The focus is primarily on residential development, but the concepts are also applicable to other forms of development and redevelopment.

Best practices minimize the alteration of natural green infrastructure such as forests; reduce creation of impervious surfaces; support retention of naturally vegetated buffers along wetlands and waterways; minimize grading and alterations to natural flow patterns; and support the use of LID techniques as the preferred, most easily permitted methods for managing stormwater.

Get more details on LID's many cost-savings and other benefits, and our customizable bylaw review chart, at: www.massaudubon.org/LIDCost.

Local coordination across municipal boards and permits is also important for supporting LID. Application of these practices can result in significant savings in infrastructure maintenance costs, as well as improved water quality and protection of water supplies, while supporting property values and overall quality of life. Sustainable development

| Best Practices Guidelines | | | | Mendon Regulations | | | |
|--|---|---|---|--|---|---|--|
| Factor | Conventional Approach | Better | Best | Zoning | Subdiv Regs | Site Plan | Stormwater/LID Bylaw/Regs |
| 4. Common driveways | Often not allowed, or strict limitations | Allow for 2-3 residential units | Allow for up to 4 residential units | Allowed for 2 single family units under Open Space Communities bylaw. Noted that they may be used "on a limited basis" – intention is for duplexes only. | Not addressed within 4.19 | NA | NA |
| 5. Limit clearing, lawn size, require retention or planting of native vegetation/naturalized areas | Not addressed or general qualitative statement not tied to other design standards | Encourage minimization of clearing/grubbing | Require minimization of clearing/grubbing with specific standards | Landscape must be preserved as much as possible – "shall be treated as fixed determinants of road and lot configuration rather than as malleable elements that can be changed to follow a development scheme." OS Bylaw encourages smaller lawns | Trees of special importance and those over 12" diameter and 4' tall should be preserved wherever possible. Must be cleared within 5' of street line. However, no mention of minimizing clearing/grubbing. | Landscape should be preserved in its natural state by minimizing tree and soil removal and grading changes. Development must relate harmoniously with natural landscape and terrain. Sensitive areas should be preserved. Retention of OS and ag land, roadside plantings, and vegetated buffers can increase integration into existing landscape | Should reduce to maximum extent practicable. |

Open Space Residential Development Zoning S. 3.04

✓ *By Right – Preferred*

- Potential updates
 - Require planning as contiguous area
 - Clearly link to OS plan in town (and future master plan)
 - Offer density bonus
 - Require Low Impact Design
 - Increase minimum OS requirement
 - Allow flexibility in OS requirement to allowing space for both sewer and drinking water



Zoning

- More flexible dimensional standards (lot size, set backs, frontage)
- Limit clearing and grading
- Allow common drives for residential units



Subdivision Rules & Regs

✓ Preferred OSRD

- Limit clearing & grading
- Allow easy siting of LID features such as bioswales
- Allow permeable paving/sidewalks where appropriate
- Reduce parking requirements
- Expand stormwater design standards to include LID
- Reduce road width, dead end/cul-de sac turnaround space



Stormwater/LID Bylaw

- ✓ Encourages LID features to reduce pervious areas
- Allow permeable paving/sidewalks where appropriate
- Expand stormwater design standards to specifically include LID
- Encourage curb cuts & bioswales



The power of a bylaw change: Westford, MA

- Adopted a Conservation Subdivision bylaw in 1978
- Requires two preliminary plans: conservation and conventional

Benefits

- 1,700 Acres of land protected
- Preserved local habitat and water resources
- Created 13 miles of hiking trails & public recreation
- Town received benefits from millions of dollars' worth of open space – without purchasing it



Rail Trail in Westford

Funding

Certified MVP Communities Receive Priority Ranking

- MA Clean Water State Revolving Fund Program (CWSRF)
- MA Office of Coastal Zone Management (CZM)
- MA Department of Agricultural Resources (MDAR)
- MA Executive Office of Energy and Environmental Affairs (EEA)
- MA Department of Environmental Protection (DEP)
- Mass Environmental Trust (MET)



Environmental
Protection





Thank you!



**Shaping
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of Your
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Shaping the Future of Your Community Program

massaudubon.org/shapingthefuture

Community Resilience Building WORKSHOP GUIDE



www.CommunityResilienceBuilding.com

Workshop Objectives

Day 1:

- ✓ Understand **connections** – ongoing issues, hazards, and activities in Mendon.
- ✓ Identify & map **vulnerabilities and strengths**.

Day 2:

- ✓ **Develop & prioritize actions** to improve resilience.
- ✓ Opportunities to **advance priority actions**.



Community Resilience Building...

- **Implications for Residents**
- **Business Continuity and Economic Growth**
- **Public Services and Amenities**
- **Quality of Life**
- **Environment**
- **Infrastructure**

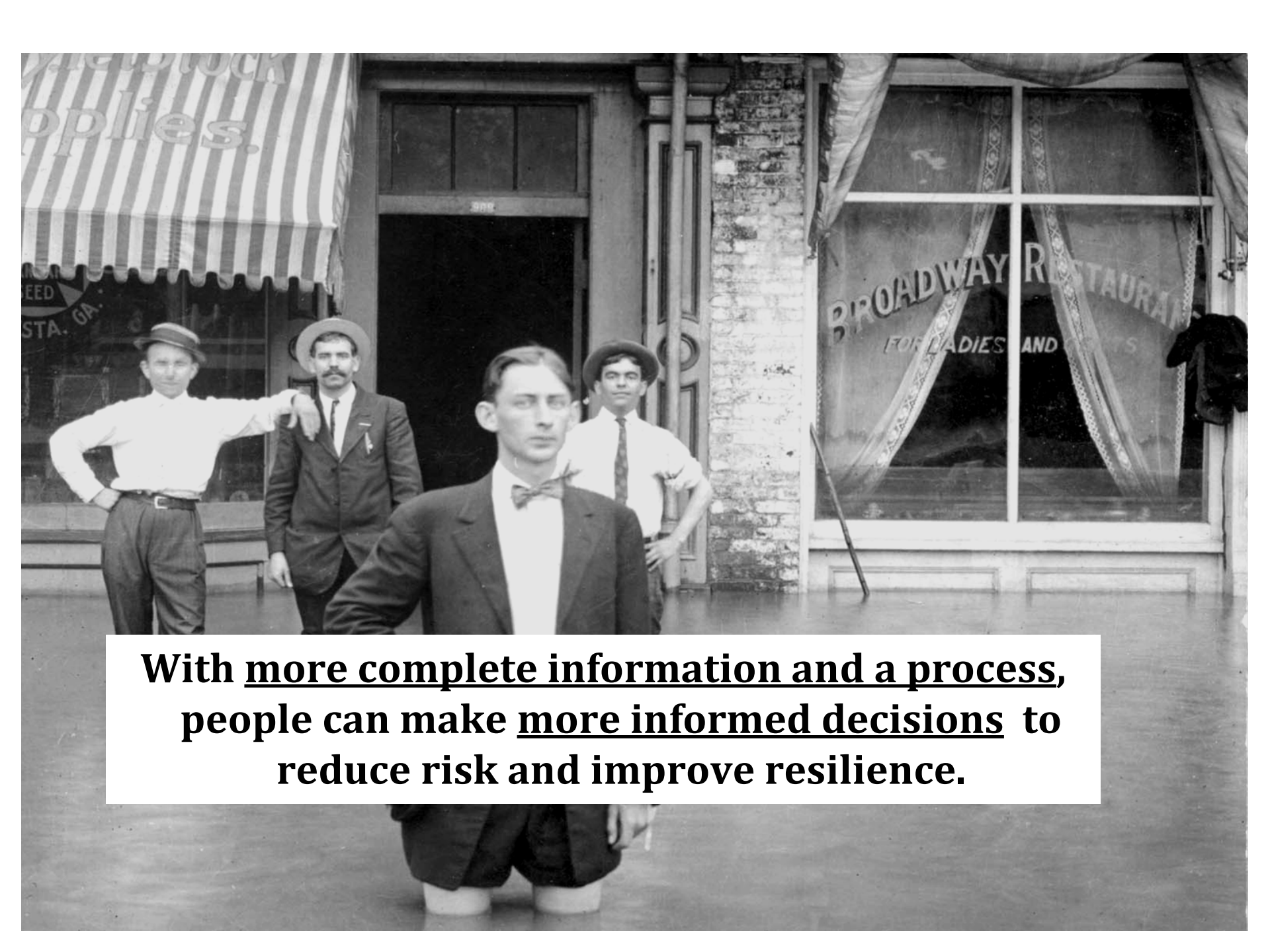


Relevant Terms

- **Hazard** = an event or condition that can cause harm or loss. *Which ones? How often & severe? Where?*
- **Vulnerability** = extent to which a community is exposed to or can be damaged by a hazards.
- **Strength** = extent to which a community has and is coping with hazards.
- **Risk** = probability of harmful consequences
- **Resilience** = anticipate, accommodate and/or recover



RISK = HAZARD x EXPOSURE



**With more complete information and a process,
people can make more informed decisions to
reduce risk and improve resilience.**

Results from Workshop Part 1



- **Current and future hazards** (Extreme Precipitation Events, Wind, Drought and Heat Waves, Wildfire/Brushfire, etc.)
- **Identification of strengths & vulnerabilities**
- **Look at each hazard in context of Infrastructural, Societal, Environmental**

Identify Actions for Each Sector

Infrastructural
Societal
Environmental



Identify Priority and Urgency for Actions

**High, Medium or Low
(Priority)**



**Short-Term, Long-
Term or Ongoing
(Urgency)**



Infrastructure

- **What infrastructure/facilities are exposed?**
 - *Water supplies, nursing homes, schools, hazardous materials, etc...*
- **What makes this infrastructure vulnerable?**
 - *Location, age, building codes, type of housing, etc...*
- **Consequences of this infrastructure vulnerability?**
 - *Lack of access to critical facilities – hospitals, fire trucks, etc.*

POSSIBLE ACTIONS: What can be done?

- *Assess housing stock in vulnerable areas?*
- *Prioritize future development in lower-risk areas?*
- *Design and build Nature Based Solutions?*
- *Integrate risks into capital improvement plans?*

Societal

- **Population characteristics in high-risk areas?**
 - *Elderly, low income, special needs, etc...*
- **How will hazards intensify these characteristics?**
 - *Where are areas for improvement in the community?*
- **Strengths of your community?**
 - *Active civic groups, organizations, associations?*

POSSIBLE ACTIONS: What can be done?

- *Improve existing programs (which ones)?*
- *Increase awareness via education/outreach on hazards?*
- *Increase involvement by citizens (on what and with whom)?*

Environmental

- **Natural resources important to your community and where?**

Wetlands, ponds, streams, forests, farms, etc.

- **Benefits natural resources provide and where?**

Storm buffering, flood protection, erosion control, water quality, recreation, etc...

- **High risk areas and effects of hazards?**

Impact without and with more natural resources

POSSIBLE ACTIONS: What can be done?

- *Conserve wetlands?*
- *Conserve land located adjacent to flood zones?*
- *Green infrastructure in neighborhoods?*

Actions emerging from CRB Workshops

Sheltering Capacity

- Mutual aid agreements between municipalities with regional high school or better equipped shelters (kitchen, showers, etc.) and smaller surrounding municipalities...
- Expansion of high school referendum (Guilford, CT)
 - Option A: Standard upgrade of high school
 - Option B: Standard upgrade with hurricane-proof roof and enhanced sheltering
 - Residents selected Option B plus additional sheltering to accommodate adjoining municipalities
- Community Centers Educational Programs (many municipalities)
 - Enhanced and more routine training on pre-disaster preparedness, shelter in place, and awareness amongst elderly populations
 - Neighbor-Helping-Neighborhood program (focus on monitoring elderly populations during snowstorms and heat waves (several municipalities))

Actions emerging from CRB Workshops

Emergency Evacuation (most municipalities)

- Enhanced way finding signage coupled with education at local libraries
 - “Natural Hazard Week” – outreach at libraries, churches, fire houses, local community center.
 - Distribution of printed evacuation routes
 - Updated maps for municipal websites
- Broader and better communication alerts regarding evacuation timing
 - Identify emergency management thresholds to trigger voluntary and mandatory evacuation. Can help to elevate potential of traffic jams.
 - Identify local road routes to safety that avoid state roads
 - Enhance awareness of shelter in place options and needs

Resources in the room...

- **Guiding Questions**
- **Risk Matrix**
- **Base Map**
- **Facilitator(s)**
- **Your Knowledge**



Report outs

- Each small group reports out on its top four priority actions
- Workshop participants combine and group actions by similarity
- Workshop participants determine the top four priority actions



Expectations of Participants

- Be active participants
- Your ideas & expertise are needed
- Respect contributions of others
- Be creative and remain optimistic
- Stay on task (as defined by your facilitators)
- Be accountable for your group's discussions





Your Turn!

"Thank you for calling. Please hold – on as tight as you can."