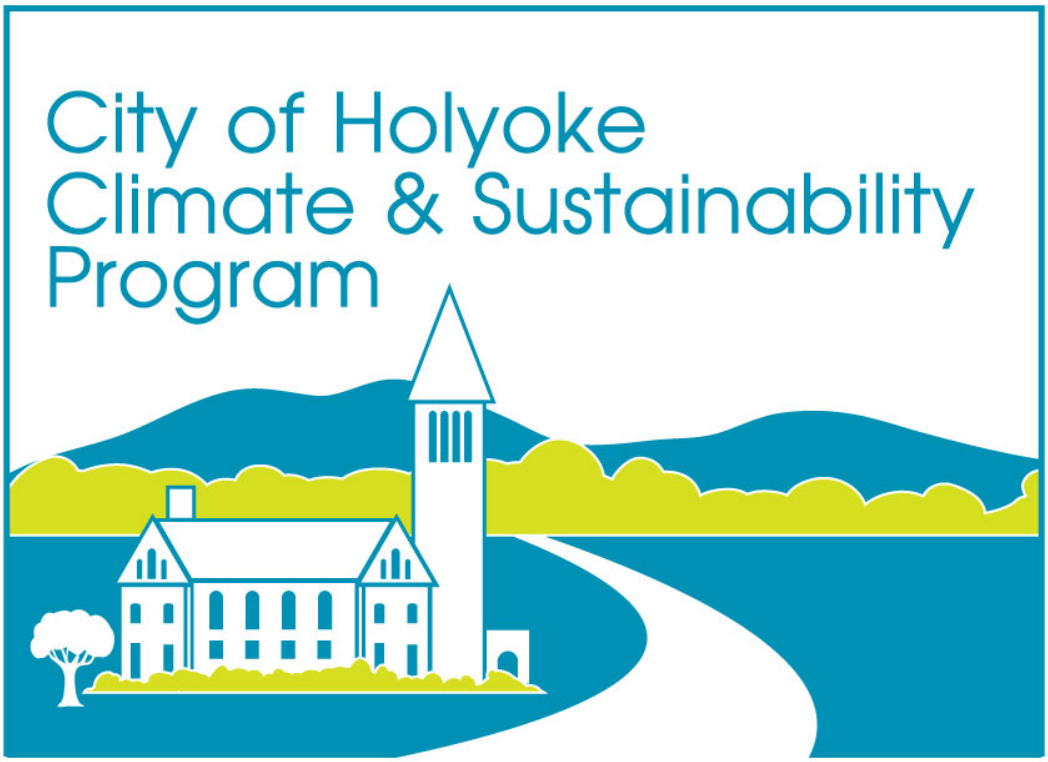
Community Resilience Building Workshop: Summary of Findings

Municipal Vulnerability Preparedness (MVP)



Holyoke, Massachusetts

May 2 & 3, 2018

Prepared by:

CDM Smith

KLA KIM LUNDGREN ASSOCIATES, INC.
Customized Solutions for the Community You Want

Citation: City of Holyoke, (2018) Community Resilience Building Workshop Summary of Findings, Municipal Vulnerability Preparedness (MVP) Program. Holyoke, Massachusetts.

Summary of Findings

1. Overview

The City of Holyoke was awarded a $26,000 grant from the Massachusetts Executive Office of Energy and Environmental Affairs to conduct Community Resilience Building (CRB) workshops in the City. This funding is through a new program called Municipal Vulnerability Preparedness (MVP). Conducting the workshops allows Holyoke to achieve "MVP" designation from the Commonwealth – a designation that gives the City access to further funding to implement resilient actions. The City engaged the consulting firms, CDM Smith and Kim Lundgren Associates, Inc. (KLA), to assist with both efforts. While several documents in the City have addressed natural hazards from a disaster mitigation and emergency response perspective, this funding opportunity gave City leaders their first opportunity to talk about the long-term needs of the City for addressing the hazards and risks that will accompany future climate scenarios according to models generated by the Northeast Climate Center at the University of Massachusetts Amherst (Appendix C). Holyoke remains committed to addressing the anthropogenic causes of climate change, primarily greenhouse gas emissions, and is committed to sourcing 100% of its energy from carbon-free, renewable sources.

2. Community Resilience Building Workshops

In Holyoke, the workshops held in conjunction with the MVP program were a new initiative to immediately identify actions and community-derived priorities that will build resilience in the community. The workshops' central objectives were to:

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

A core team was established for this process, which consisted of:

- Andrew Smith, Conservation and Sustainability
- Marcos Marrero, Planning and Economic Development
- Michael McManus, Department of Public Works
- Chief John Pond, Fire Department

Prior to the workshops, the core team identified preliminary hazards and areas of concerns. These were mapped and presented at the workshops (see Appendix A). The core team, along with the consultant team, identified departments and organizations recommended to attend the workshops. These were: Holyoke Gas & Electric, Office of Planning and Economic Development, Holyoke Water Works, Building Department, Law Department, Council on Aging, Geriatric Authority, Board of Health, Housing Authority, Building Department, Housing Authority, Planning and Economic Development, Planning Board, Members of City Council, Department of Public Works, Police Department, Fire Department, Emergency Management, Auxiliary Police, Local Emergency Planning Committee, Conservation Commissions, Parks and Recreation, Pioneer Valley Planning Commission, Conservation and Sustainability, School Department, Parks and Recreation, Holyoke Mall, Community Development, Enlace de Familias, Nuestras Raices, and Holyoke Community College. All were invited to participate; see section 1.3.3 for a specific list of workshop participants. The workshops were held on two days: Wednesday, May 2, and Thursday, May 3, 2018. Prior to attending the workshops, the participants were asked to fill out a survey, a copy of which can be found in Appendix B, along with the survey results.

2.1 Top Hazards and Vulnerable Areas

At the first workshop, participants were asked to identify connections between ongoing community issues, hazards, and local planning and actions in Holyoke. They were also asked to identify and map vulnerabilities and strengths to develop infrastructure, societal, and environmental risk profiles for Holyoke. Maps reflecting City landmarks and facilities, existing and potential areas of flooding concern, and possible heat impacts were prepared for discussion (see Appendix A). To facilitate this exercise, the following definitions from the World Bank[1] were discussed with participants:

- **Hazard:** A physical process or event (hydro-meteorological or oceanographic variables or phenomena) that can harm human health, livelihoods, or natural resources.

[1] Source: World Bank: https://climatescreeningtools.worldbank.org/content/key-terms-0

- **Risk:** The potential for consequences where something is at stake and where the outcome is uncertain.

- **Exposure**: The presence of people, livelihoods, species or ecosystems, environmental services and resources, infrastructure, or economic, social, or cultural assets in places that could be adversely affected by a hazard.

- **Sensitivity**: The degree to which a system, asset, or species may be affected, either adversely or beneficially, when exposed to climate variability or change or geophysical hazards.

- **Vulnerability or Strength:** The potential effects of hazards on human or natural assets and systems. These potential effects, which are determined by both exposure and sensitivity, may be beneficial or harmful.

As a brainstorming exercise, participants were asked the following triggering questions from the CRB Workshop Guide:

- What hazards have impacted Holyoke in the past? Where, how often, and in what ways?

- What hazards are impacting your community currently?

- What effects will these hazards/changes have on Holyoke in the future (3, 5, 10, 25 years)?

- What/who is exposed to hazards and climate threats within your community?

- Other concerns or considerations?

The hazards, risks, and vulnerabilities from this brainstorming session are presented in Figure 1.

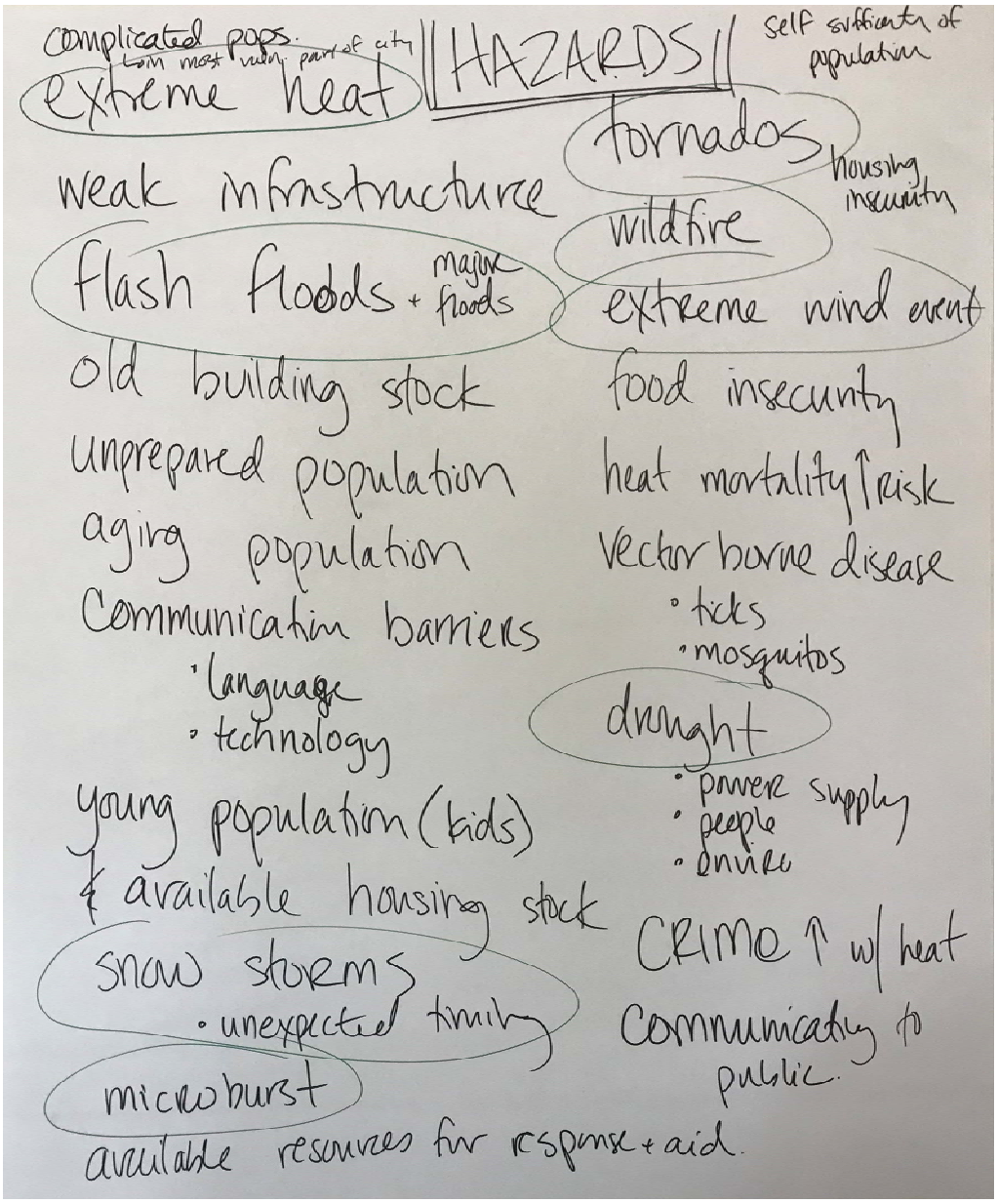


Figure 1
Holyoke Hazards, Risks, and Vulnerabilities (brainstorm results)

2.1.1 Top Hazards

The Massachusetts Executive Office of Environmental Affairs (EEA) summarized the existing and expected future climate conditions by major watershed in the Commonwealth. Holyoke falls into two watersheds; however, the majority of the City is in the Connecticut Basin. Therefore, projections from this basin were used as a basis for discussing future climate change in the City (see Appendix C). The key takeaways[2] from EEA on the future climate conditions are:

[2] These impacts are direct from the document provided by EEA to MVP communities in December 2017 entitled "Massachusetts Climate Change Projections".

- Regardless of geographic scale, rising temperatures, changing precipitation, and extreme weather will continue to affect the people and resources of the Commonwealth throughout the 21st century.

- Average, maximum, and minimum temperatures are expected to increase; Seasonally, maximum summer and fall temperatures are expected to see the highest projected increase and minimum winter and fall temperatures are expected to increase throughout the 21st century.

- Number of days receiving precipitation over one inch are variable, fluctuating between loss and gain of days.

- Seasonal projections for total precipitation are also variable for the Connecticut Basin. The winter season is expected to experience the greatest change with an increase of <1-25% by mid-century, and 7-37% by end of century.

- Annual and seasonal projections for consecutive dry days, or for a given period, are variable throughout the 21st century.

- Precipitation will be more variable. "Extreme" precipitation events are likely to occur more often.

With these climate change impacts in mind, the group was divided into three working groups, each of which was asked to identify the top four hazards from this list or others they felt were important to address. The Top Hazards were:

- Wind events (3 groups)
- Flooding and / or extreme precipitation (3 groups)
- Heat and / or extreme heat (3 groups)
- Disease (1 group)
- Drought (1 group)
- Extreme cold (1 group)

2.1.2 Areas of Concern

Prior to the meeting, the core team identified areas of concern due to hazards from past and potential events. These included:

- Extreme storm events, such as the snowstorm in October 2011 which resulted in snow accumulation on trees with leaves, causing felled trees and debris.

- Microbursts, which recently occurred in East Hampton, but impacted Mount Tom; this closed roads and impacted traffic.

- Flooding events; recently Holyoke has experienced high water events causing isolated flooding along the canals. It was reported that Appleton Street often gets flooded and there are a number of undersized culverts in the City.

- Heat events are an existing and future concern for multiple reasons. 1) Much of the downtown area is paved, resulting in heat island effects. 2) There is little shading in the downtown area. 3) The orientation of the City does not allow for substantial cooling.

2.2 Current Concerns and Challenges Presented by Hazards

Holyoke has faced natural hazards in the past like other Massachusetts communities, including extreme storm events, flooding events, and microbursts. Participants identified other concerns and challenges during the brainstorming session at the first workshop. These included:

- Weak infrastructure, including an older building stock.

- Availability of housing stock and housing insecurity.

- Lack of available resources for response and aid.

- Food insecurity.

- Vector borne disease including ticks and mosquitos.

- Population concerns, including: both an aging and very young population, unprepared people, the self-sufficiency of the population, and complicated populations that are located

in the most vulnerable part of the City, concern about crime increasing with heat, and concern about increased risk of heat mortality.

- Challenges communicating to the public.

- Lack of coordination and consistent communication between municipal departments related to emergency or hazard response procedures, this was a particular concern with those that did not work in a department that would typically be engaged in a response activity.

2.3 Specific Categories of Concerns and Challenges

The working groups further discussed specific concerns and challenges in each of the categories of infrastructure, society, and environment. These findings, characterized as vulnerabilities, are presented in Appendix D in the Risk Matrix and in Table 1 below.

Table 1 Vulnerabilities and Strengths in Holyoke

Infrastructure Vulnerabilities and Strengths	V or S?
Power grid/wireless/transmission lines	V/S
Stormwater/sewer/water/CSOs/undersized culverts	V
Roadways/transportation/limited integrated transportation system	V/S
Housing	V/S
Fire/Police/EMS	V/S
DPW	V
Age of infrastructure	V
Ability to remove downed trees	V
HMP	S
Facilities with back-up generators	V
Dams (canal, levees, floodwalls)	V/S
Communication (Mt. Tom infrastructure, towers, etc.)	V/S
Age of buildings	V
Evacuation Routes	V
Society Vulnerabilities and Strengths	**V or S?**
Emergency planning process	S
Emergency shelter network / management plan	V/S
Multi-layered vulnerable populations	V/S
Diverse population	S
Self- affiliating social networks	S
Food deserts/food scarcity	V
Communications (language, technology)	V/S
Vulnerable neighborhoods	V
Medically vulnerable	V
Aging population	V/S
Low income population	V/S
Day to day population not prepared	V
Vacant buildings	V
Underfunded government	V
Dependent population (systems)	V
Isolated population	V
Public safety	V
Environment Vulnerabilities and Strengths	**V or S?**
Connecticut River: watershed, river, canals	V/S
Reservoirs	S
Urban tree canopy	V/S
Forests	V/S
Parks and recreational areas (including downtown)	S
Conservation land and open space (pervious surfaces)	S
Air quality	V
Pests / disease	V

Note: V = Vulnerability, S = Strength

2.4 Current Strengths and Assets

The working groups discussed strengths and community assets in each of the categories of infrastructure, society, and environment during the latter half of the first workshop. These findings are presented in Appendix D in the Risk Matrix and in Table 1 above. Several strengths of note were discussed, including:

- Holyoke has an existing Hazard Mitigation Plan which identifies natural hazards and possible actions to reduce the potential effect of hazards. The City also had a strong emergency planning process, led by the Fire Department.
- Holyoke has a diverse population which gives it a variety of views and inputs. There are many self-affiliating social networks within the City that provide support for people within the networks.
- The City has open space and water supply, including reservoirs, parks and recreational areas, and conservation land with pervious surfaces.

2.5 Actions to Improve Resilience

The second workshop was focused on developing and prioritizing actions to improve resilience in the City. Having said that, each working group recognized that Holyoke must continue to take action to reduce greenhouse gas emissions across multiple sectors, the transportation sector, in order to prevent the worst impacts of climate change. Each working group developed actions that would reduce vulnerability and enhance strengths for the features identified during the first workshop. The actions target one or multiple of the hazards in each of the categories of infrastructure, society, and environment. These actions were prioritized by each group as a high, medium, or low priority and assigned a timeframe of either short, long, or ongoing. These findings are presented in Appendix D in the Risk Matrix along with the brainstorming notes that provided input into the Matrix, in Appendix E.

2.5.1 Top Recommendations to Improve Resilience

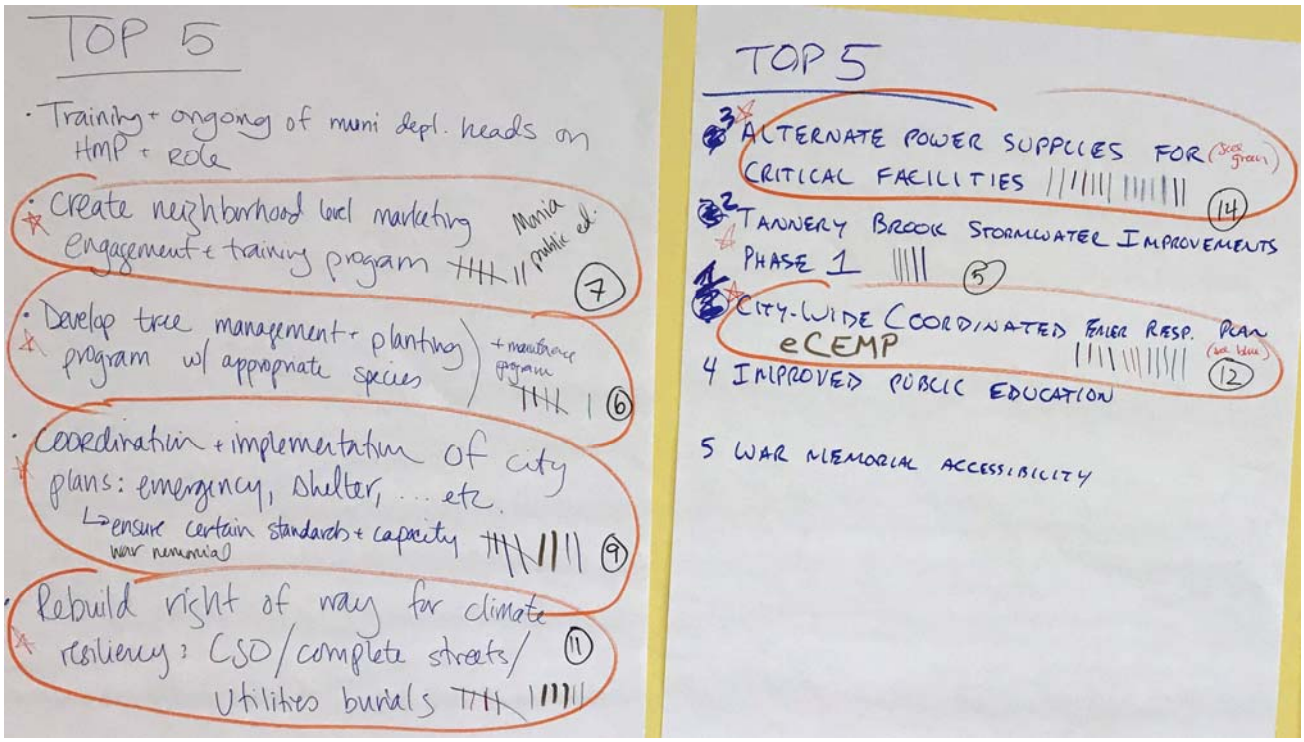
Each working group identified the top five priority actions to improve resilience based on vulnerabilities and strengths identified by their group. These were presented to all workshop participants, who voted on their top priorities. The top five priority actions presented by the working groups are summarized below[3]:

[3] In two cases, actions within a group were subcategorized within a different action, which is why the total does not add up to 13, despite each group presenting five actions each.

- Conduct a public education campaign, which includes: (3 groups)
  - A two-way education event to learn from the experiences of people that fled Hurricane Maria and now live in Holyoke and
  - Creating a neighborhood level marketing engagement and training program to ensure that everyone in the community understands what they need to do to be resilient.
- Expand outreach programs by tapping community leaders to become climate ambassadors. (1 group)
- Install alternative power supplies at critical facilities, including back-up generators and battery storage. (2 groups)
- Increase renewable energy and battery storage to withstand future low flows in the Connecticut River. (1 group)
- Coordinate and implement City plans and ensure certain standards and capacities are met including: (2 groups)
  - The City-wide coordinated emergency response plan (eCEMP),
  - Upgrade accessibility at War Memorial, and
  - Train municipal department heads on the existing Hazard Mitigation Plan and their role.
- Restore portions of the floodplain by acquiring and demolishing abandoned and vacant buildings. (1 group)
- Develop a tree management, maintenance, and planting program with appropriate species (1 group)
- Rebuild the right of way for climate resiliency, including complete streets, CSO separation, and burying utilities. (1 group)
- Implement Tannery Brook stormwater improvements Phase I project. (1 group)

After each team presented on their top five actions, the list was consolidated to five communitywide priority actions, shown below in Figure 2. Each person was allowed three votes to allocate to any of the top five actions; this voting process determined the prioritized actions which are the Top Recommendations to Improve Resilience in Holyoke:

1. Coordinate and implement City plans and ensure certain standards and capacities are met including: (21 votes)
    a. The City-wide coordinated emergency response plan (eCEMP),
    b. Upgrade accessibility at War Memorial, and
    c. Train municipal department heads on the existing Hazard Mitigation Plan and their role.
2. Install alternative power supplies at critical facilities, including back-up generators and battery storage. (14 votes)
3. Rebuild the right of way for climate resiliency, including complete streets, CSO separation, and burying utilities. (11 votes)
4. Conduct a public education campaign, which includes: (7 votes)
    a. A two-way education event to learn from the experiences of people that fled Hurricane Maria and now live in Holyoke and
    b. Creating a neighborhood level marketing engagement and training program.
5. Develop a tree management, maintenance, and planting program with appropriate species (6 votes)



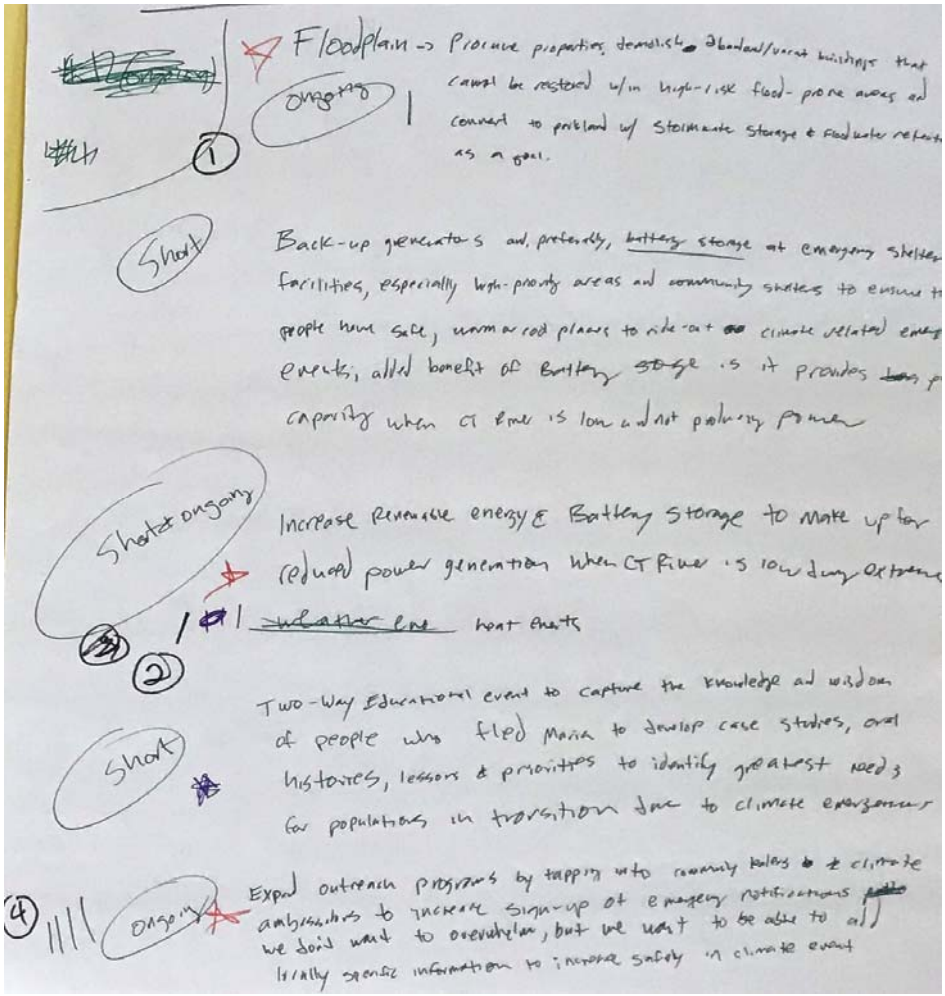


Figure 2
Holyoke Top Actions

3. Acknowledgements

3.1 Leadership and Core Team Members

Thank you to the leadership and core team members for planning and facilitating the process described herein:

- Alex B. Morse, Mayor of Holyoke
- Andrew Smith, Conservation and Sustainability
- Marcos Marrero, Planning and Economic Development
- Michael McManus, Department of Public Works
- Lauren Miller, Lead Facilitator / Consultant Team, CDM Smith
- Timothy Dupuis, Table Facilitator / Consultant Team, CDM Smith
- Kim Lundgren, Table Facilitator / Consultant Team, KLA

3.2 Funding and Facilities

Thank you to the Massachusetts Executive Office of Energy and Environmental Affairs for the funding to make these workshops possible.

Thank you to the Sue Ellen Panitch River Access Center for providing the meeting space.

3.3 Workshop Participants

Thank you to the community representatives that participated in the process, including:

Name		Department/Organization	
Whitney	Anderson	Holyoke Public Schools	*
Brian	Beauregard	Holyoke Gas & Electric	*
Barbara	Bow	OPED	*
Rory	Casey	Mayor's Office	
Dave	Conti	Holyoke Water Works	
Damian	Cote	Building Department	*
Chris	Erchull	Law Department	*
Navae	Fenwick Rodriguez	Council on Aging / Geriatric Authority	*
Brian	Fitzgerald	Board of Health	*
Jamara	Healy	Housing Authority	*
Kevin	Lagimondu	Building Department	*
Jim	Lavelle	Holyoke Gas & Electric	
Matthew	Mainville	Housing Authority	
Marcos	Marrero	Planning and Economic Development / Planning Board	
Chuck	Martelll	Holyoke Gas & Electric	
Todd	McGee	City Council	
Michael	McManus	Public Works	*
James	Neiswanger	Police Department	
John	Pond	Fire Department	*
Steven	Riffenberg	Emergency Management/Auxilliary Police/LEPC	
Anja	Ryan	Conservation Commissions	
Terry	Shepard	Parks and Recreation	*
Emily	Slotnik	PVPC	*
Andrew	Smith	Conservation and Sustainability	*
Anthony	Soto	School Department	
Maureen	Tisdell	Parks and Recreation	*
Lisa	Wray	Holyoke Mall	
Alicia	Zoeller	Community Development	*
Jon	Zwirko	Holyoke Gas & Electric	*
Betty		En Lace de Familias	
Felix		Nuestras Raices	
		Holyoke Community College	

Note: *indicates attendance at the CRB Workshops. Others were invited to the meetings.

4. Appendices

- Appendix A: Base Map(s)
- Appendix B: Participatory Mapping Maps
- Appendix C: Climate projections provided by the Executive Office of Energy and Environmental Affairs
- Appendix D: Holyoke MVP Risk Matrix
- Appendix E: Notes from the MVP Workshops
- Appendix F: Holyoke MVP Meeting Materials

Appendix A: Base Maps and Participatory Mapping Maps

Municipal Vulnerability Preparedness Program
City of Holyoke, MA, MA
Flood Risk Map

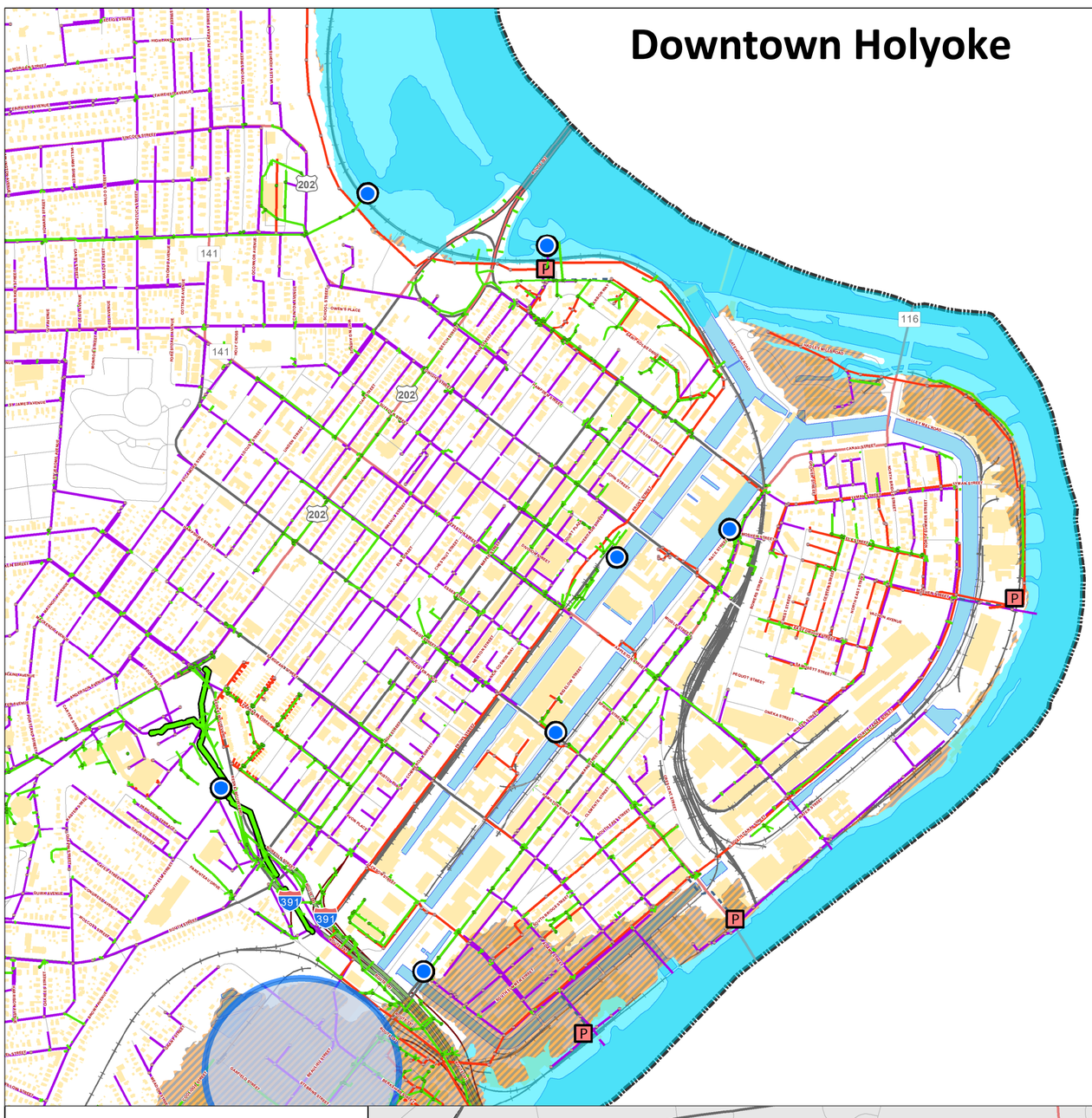
1 inch = 1,400 feet

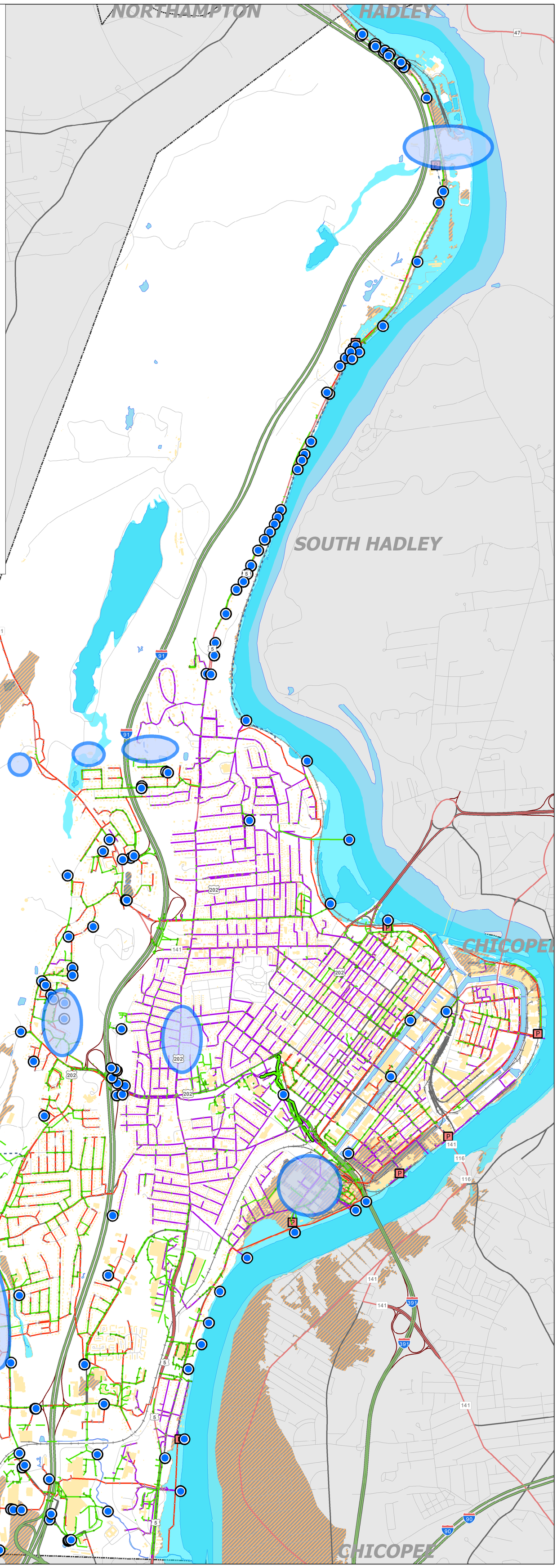
0 1,400 2,800 4,200 5,600

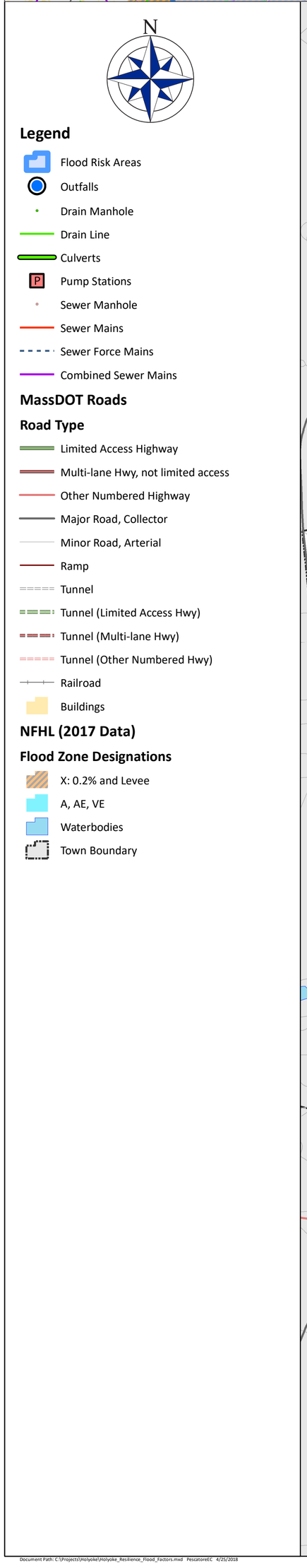
Feet

CDM Smith

Downtown Holyoke







Legend

- Flood Risk Areas
- Outfalls
- Drain Manhole
- Drain Line
- Culverts
- Pump Stations
- Sewer Manhole
- Sewer Mains
- Sewer Force Mains
- Combined Sewer Mains

MassDOT Roads

Road Type

- Limited Access Highway
- Multi-lane Hwy, not limited access
- Other Numbered Highway
- Major Road, Collector
- Minor Road, Arterial
- Ramp
- Tunnel
- Tunnel (Limited Access Hwy)
- Tunnel (Multi-lane Hwy)
- Tunnel (Other Numbered Hwy)
- Railroad
- Buildings

NFHL (2017 Data)

Flood Zone Designations

- X: 0.2% and Levee
- A, AE, VE
- Waterbodies
- Town Boundary

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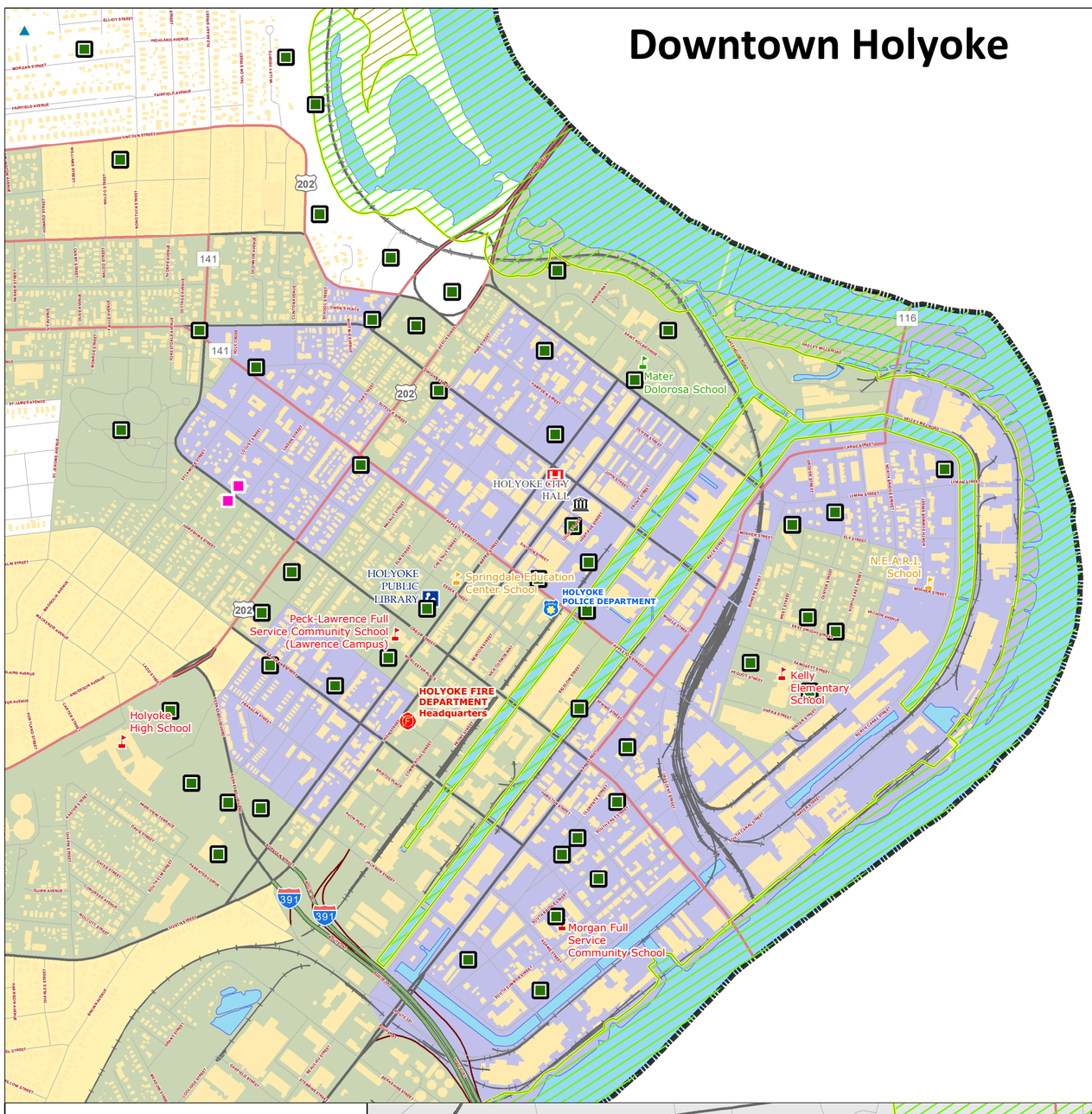
Municipal Vulnerability Preparedness Program
City of Holyoke, MA, MA
Infrastructure

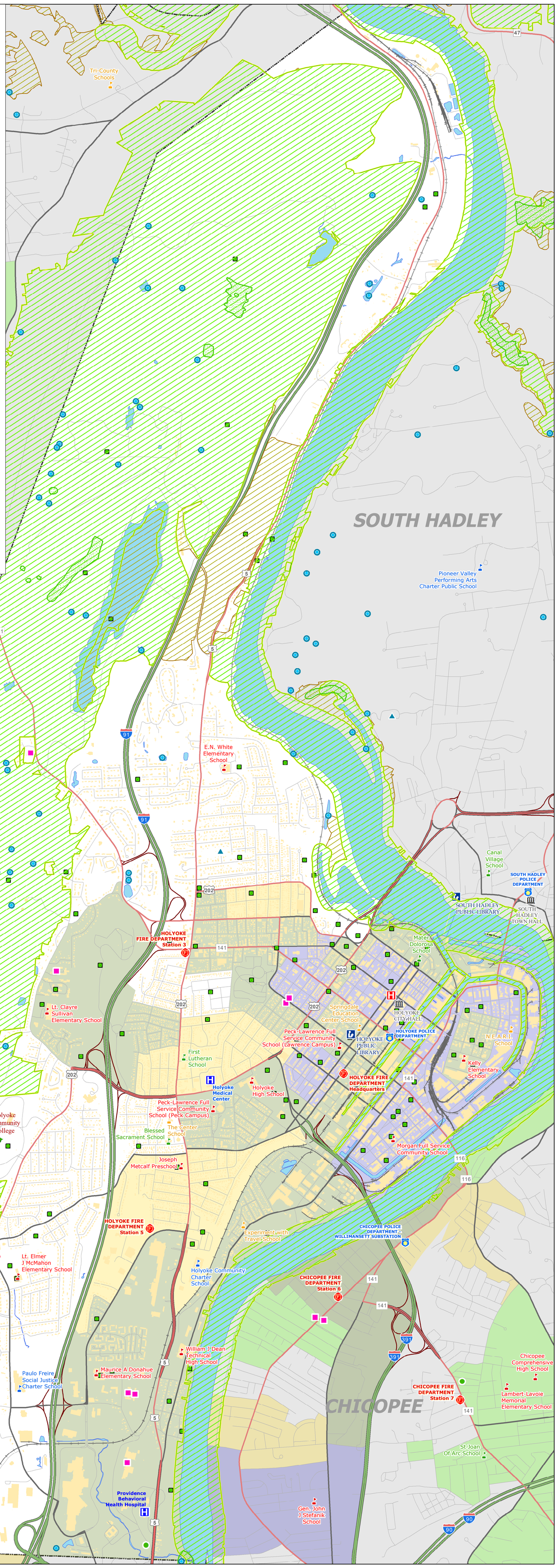
1 inch = 1,400 feet

0 1,400 2,800 4,200 5,600 Feet

CDM Smith

Downtown Holyoke





N

Legend

- Potential Vernal Pools
- NHESP Natural Communities
- NHESP Estimated Habitats of Rare Wildlife
- NHESP Priority Habitats of Rare Species
- Open Space

Infrastructure

- City Hall
- Buildings
- Waterbodies
- Town Boundary
- Public
- Private
- Charter
- Special Education
- Colleges and Universities
- Police Stations
- Fire Stations
- Acute Care Hospitals
- Community Health Centers
- Libraries

Healthcare

Facility Type

- Assisted Living Facility
- Nursing Home
- Rest Home

MassDOT Roads

Road Type

- Limited Access Highway
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- Ramp
- Tunnel
- Tunnel (Limited Access Hwy)
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- Railroad

Environmental Justice 2010 Populations

EJ Criteria, by Block Group

- Minority
- Income
- English isolation
- Minority and Income
- Minority and English isolation
- Income and English isolation
- Minority, Income and English isolation

Municipal Vulnerability Preparedness Program
City of Holyoke, MA, MA
Impervious Surfaces and Vulnerable Populations

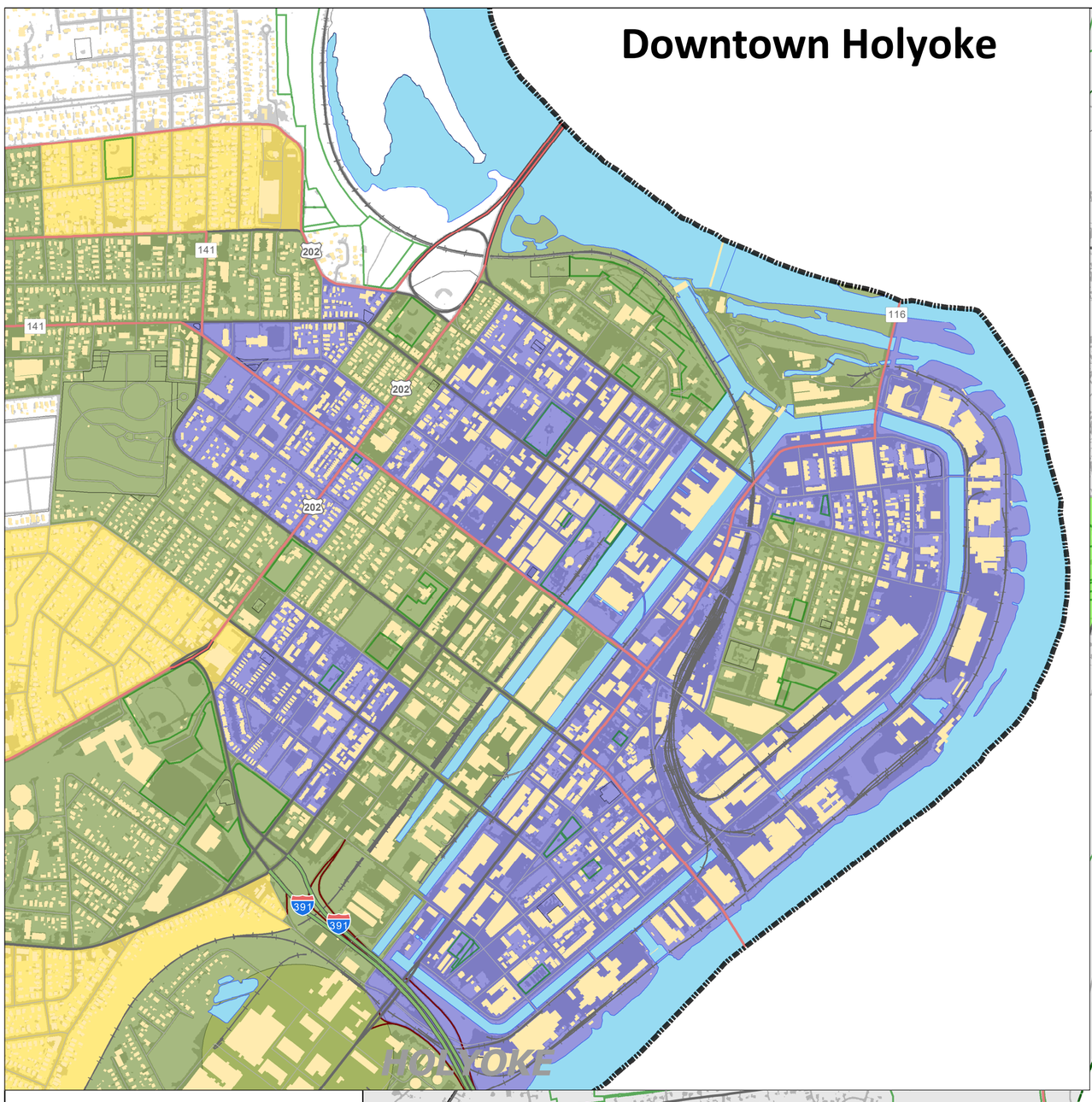
1 inch = 1,400 feet

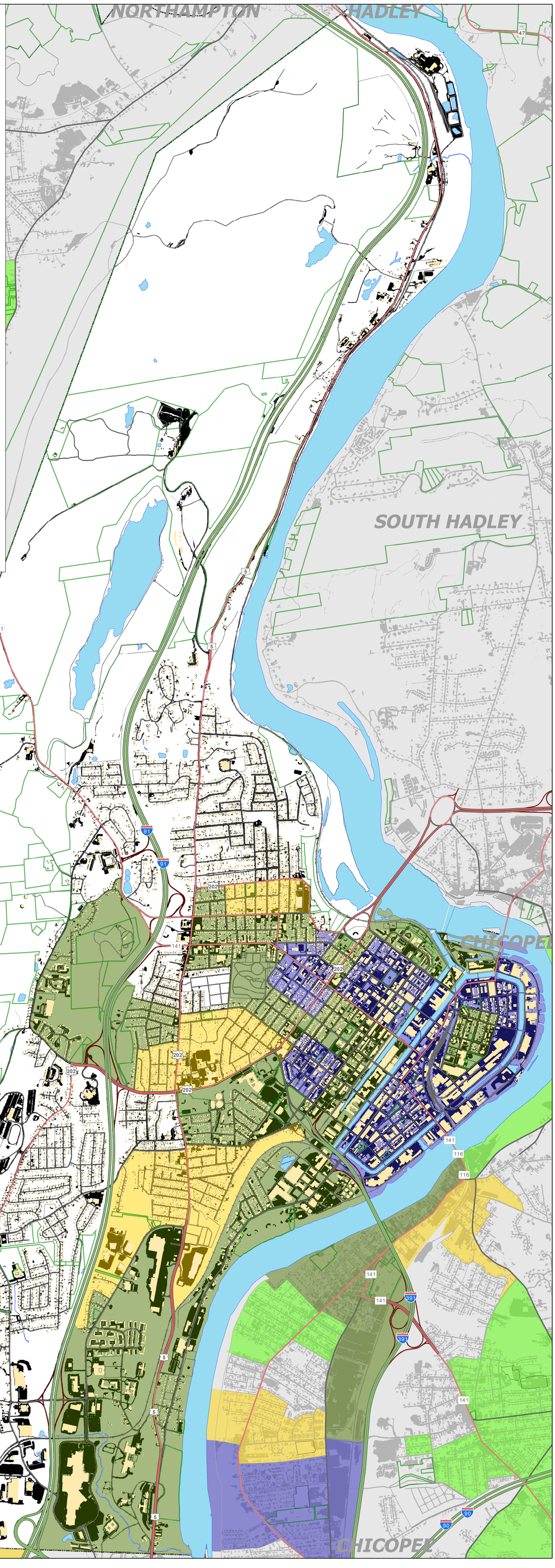
0 1,400 2,800 4,200 5,600

Feet

CDM Smith

Downtown Holyoke





N

Legend

- Open Space Outline: Non-Protected
- Open Space Outline: Protected
- Buildings
- Waterbodies
- Town Boundary
- Impervious Surface

MassDOT Roads

Road Type

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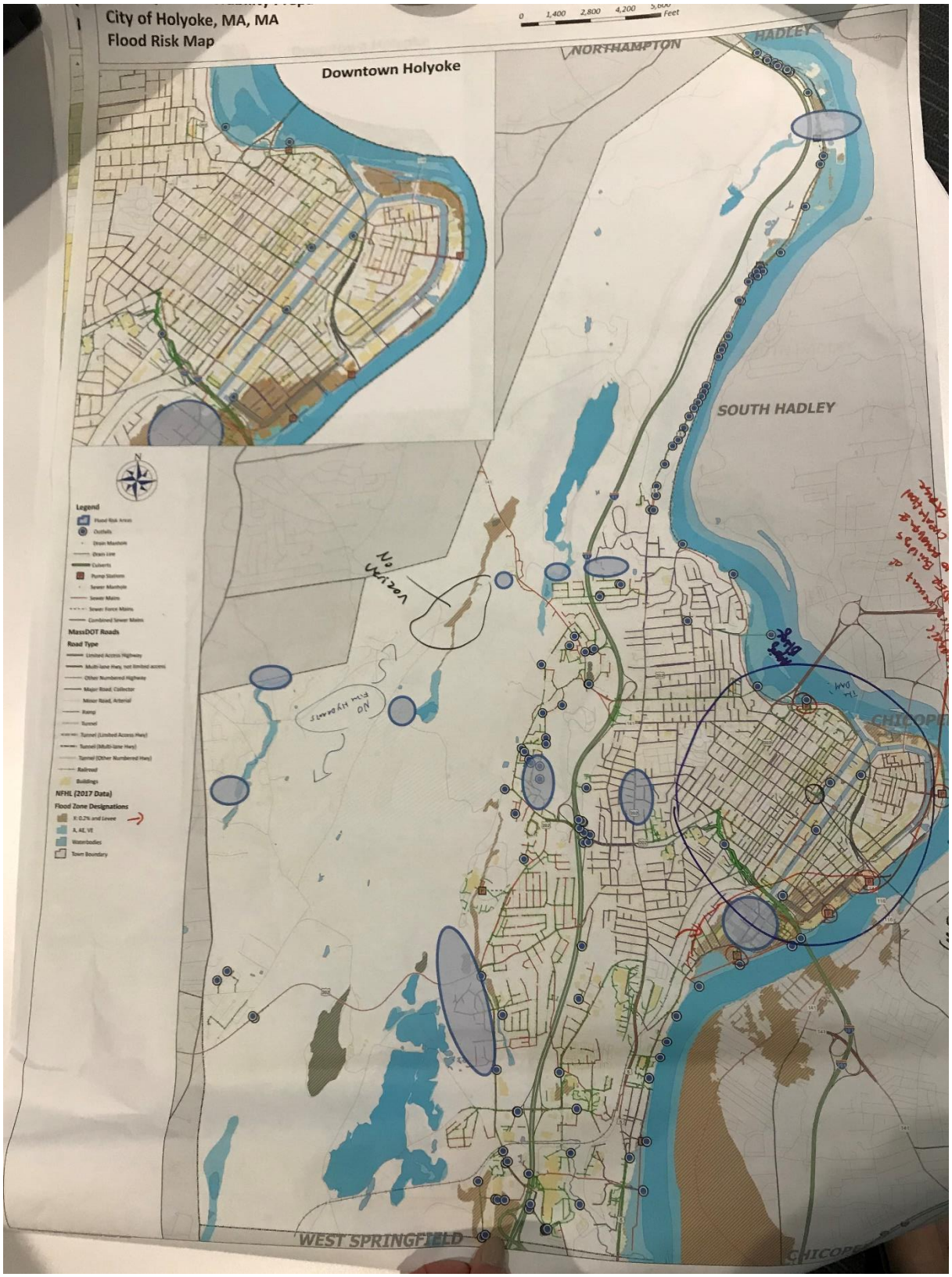
Mater Dolorosa School
HOLYOKE CITY HALL
War Memorial
Senior Center
HOLYOKE PUBLIC LIBRARY
Springdale Education Center School
HOLYOKE POLICE DEPARTMENT
Peck-Lawrence Full Service Community School (Lawrence Campus)
HOLYOKE FIRE DEPARTMENT Headquarters
Holyoke High School
391
391
Morgan Full Service Community School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Flood Risk Map
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Downtown Holyoke
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HADLEY
SOUTH HADLEY
CHICOPEE
WEST SPRINGFIELD
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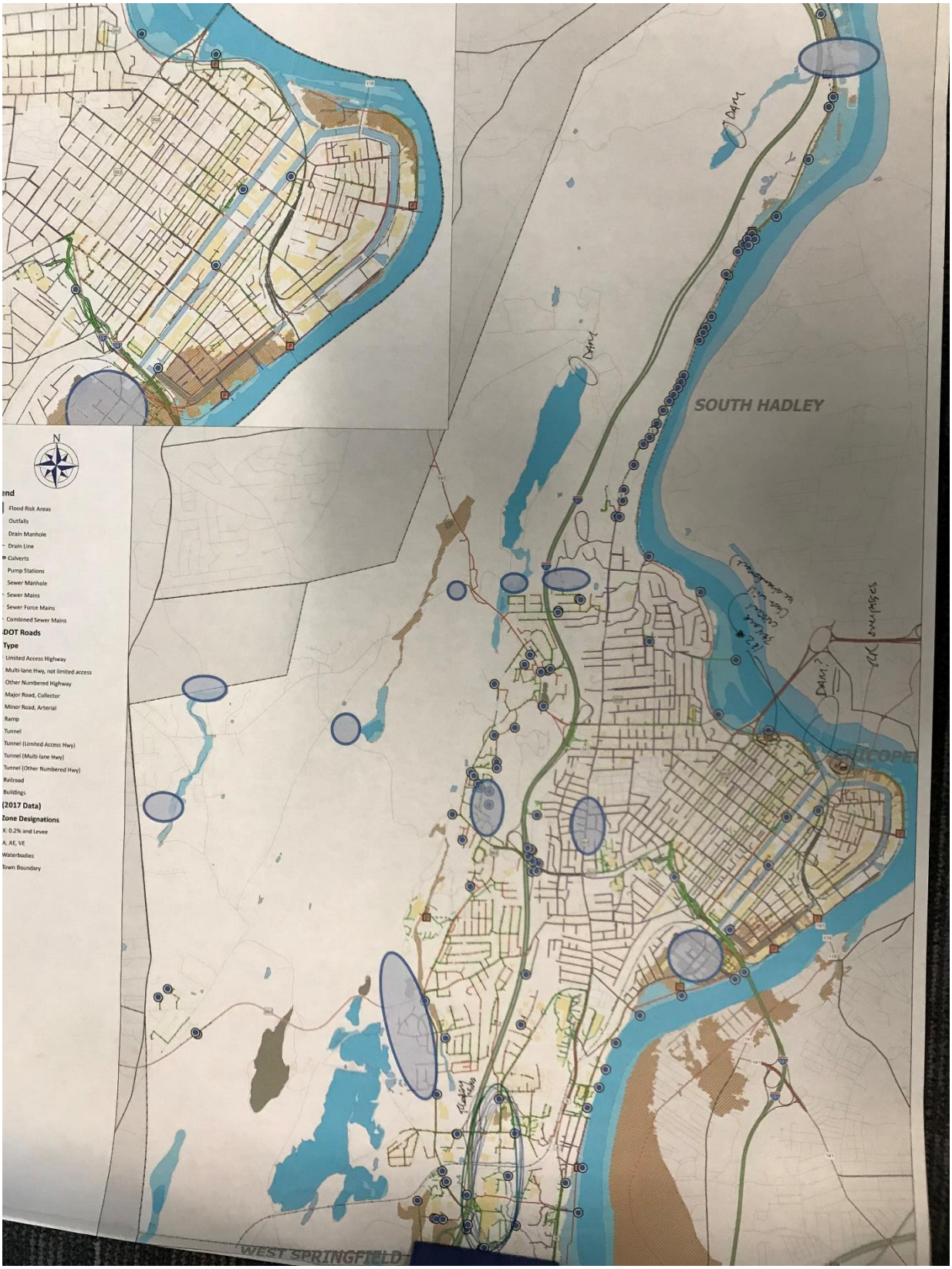
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(2017 Data)
Zone Designations
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Town Boundary

Appendix B: Pre-Workshop Survey Questions and Results

Holyoke Municipal Vulnerability Preparedness program

Pre-Workshop Survey: April/May 2018

Thank you in advance for your involvement in the two-part Community Resilience Building Workshop series for Holyoke's Municipal Vulnerability Preparedness (MVP) planning process and our upcoming Community Resilience Building workshops on May 2 and May 3, 2018.

We are excited to work with you to identify and prioritize actions to improve Holyoke's resilience to climate change. These actions will aim to reduce impacts from climate-related hazards to infrastructural, societal, and environmental components to our community – today, and in the future.

We are asking participants to complete this brief survey, which focuses on how the community currently perceives, assesses, and acts to reduce risks. This will help us understand your concerns and priorities to make the most of our workshops.

We look forward to your feedback!

- Andrew Smith, Conservation & Sustainability Director, City of Holyoke

- Lauren Miller, MVP Trained Facilitator / Consultant, CDM Smith

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1. Enter your Name and Organization.

*2. Which of the following observed climate change impacts have already impacted your department / organization? Select all that apply.

- [ ] Increased frequency and magnitude of rain storms
- [ ] Increased frequency and magnitude of ice and snow storms
- [ ] Changes in precipitation patterns
- [ ] Increased seasonal / annual temperatures
- [ ] Temperature swings
- [ ] High wind events (including hurricanes, nor'easters, etc.)
- [ ] Other (please specify)

*3. What climate-related hazards is your department / organization most concerned about experiencing?

- [ ] Flooding
- [ ] Drought
- [ ] Power grid strain and/or outages
- [ ] Wildfire
- [ ] Heat waves
- [ ] Vector-borne diseases
- [ ] Changes in growing season
- [ ] Decrease in snow cover
- [ ] Exacerbated respiratory conditions (i.e. asthma, allergies)
- [ ] Other (please specify)

*4. From your department or organization's opinion, which of the following is Holyoke most vulnerable to as the result of climate change? (Example climate change impacts are: Increased frequency and magnitude of rain, snow, or ice storms, Changes in precipitation patterns, Increased seasonal/annual temperatures, Temperature swings, Drought, High wind events)

Please rank based on order of vulnerability.
1 = Most vulnerable 8 = Least vulnerable.

Compromises to transportation infrastructure (roads, rail, bridges, trails, etc.)

Availability of utilities (water, wastewater, energy, communications, etc.)

Access to critical facilities (schools, libraries, emergency shelters, medical facilities, etc.)

Human injury, illness, or loss of life

Business interruptions (closures, economic losses, etc.)

Ability to maintain order and/or provide public amenities

Damage, contamination, or loss of ecosystems and natural resources (forests, wetlands, waterways, etc.)

Damage or loss of cultural resources (i.e. museums, historic properties, etc.)

Government closures and interruptions

School closures and interruptions

*5. In your opinion, how prepared is your department / organization to address climate change vulnerabilities?

Not Prepared: We expect operations would be significantly impacted by climate-related hazards.				Prepared: We have plans, tools, and resources in place to be resilient to climate change hazards.
○	○	○	○	○

*6. Please rank the importance of each statement to your department / organization to help us determine our collective priorities for reducing climate change vulnerabilities and work towards a more resilient Melrose.

	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important
Protecting critical facilities (e.g. transportation networks, hospitals, fire stations, etc.)					
Protecting and reducing damage to utilities					
Protecting neighborhoods: both property and social fabric					
Strengthening emergency services (e.g. police, fire, ambulance)					
Promoting cooperation among public agencies, citizens, non-profits, and businesses					
Preventing new or further development in hazard areas					
Enhancing the function of natural features (e.g. streams, wetlands, etc.)					
Protecting historical and cultural landmarks					
Preserving natural ecosystems and biodiversity					

7. If you have additional comments you would like to share prior to the workshop, please provide them here.

DONE

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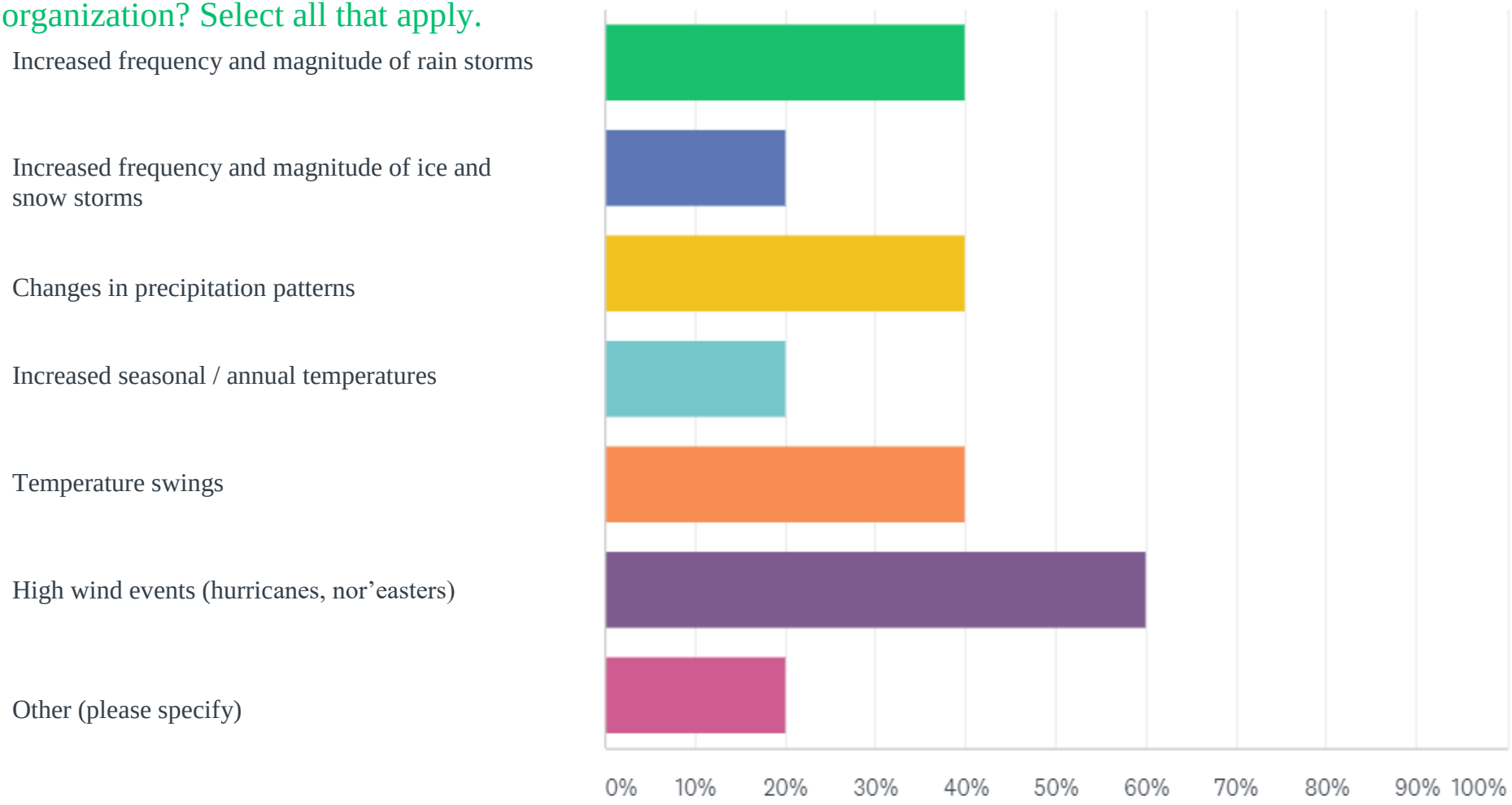
Holyoke Municipal Vulnerability Preparedness program

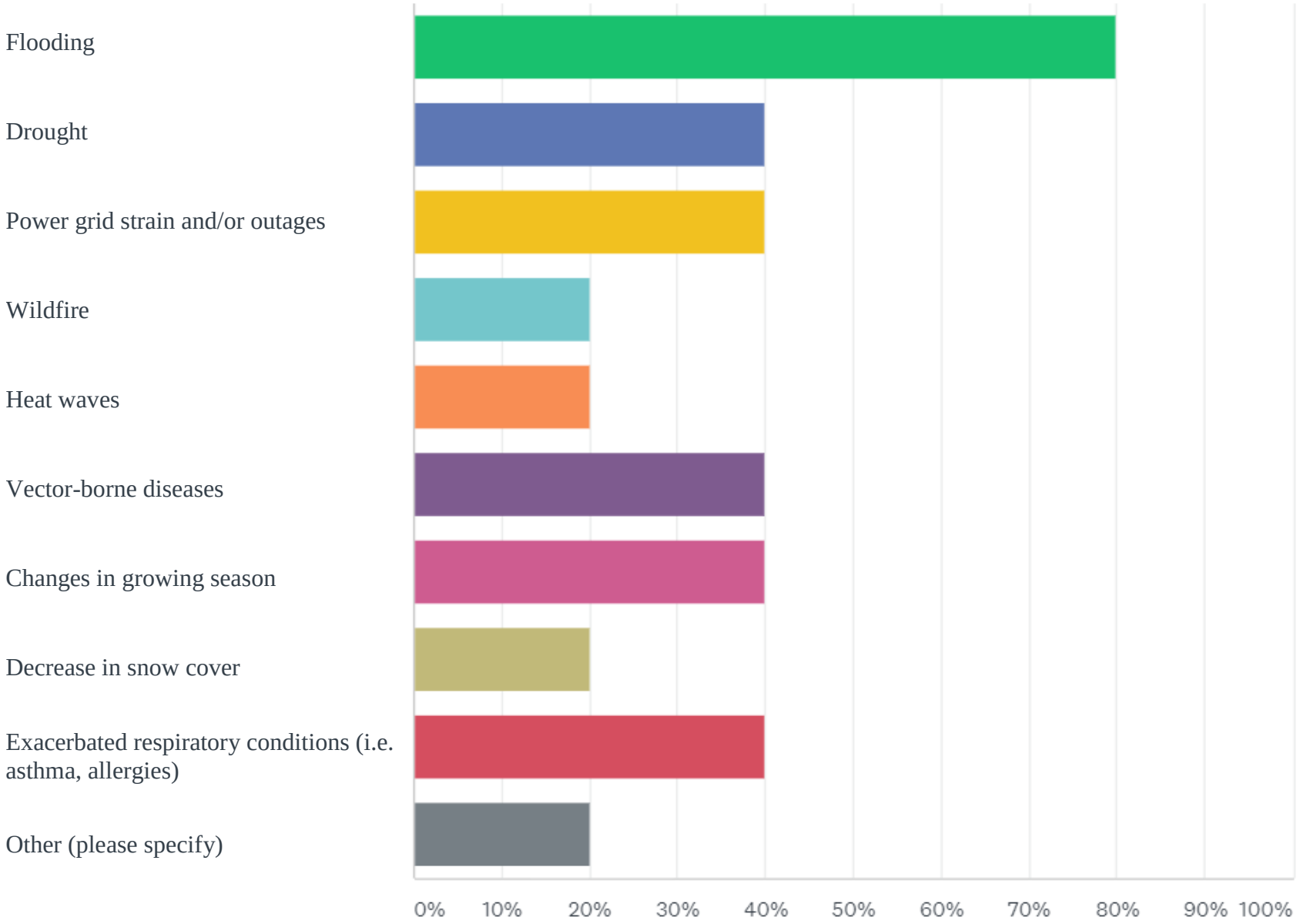
Pre-Workshop Survey Results

2. Which of the following observed climate change impacts have already impacted your department / organization? Select all that apply.



Other response: "Hurricane Maria evacuees from Puerto Rico. Expected and observed drought conditions in the west and midwest along with projected increases in precipitation in New England has us planning for more food production as an opportunity.

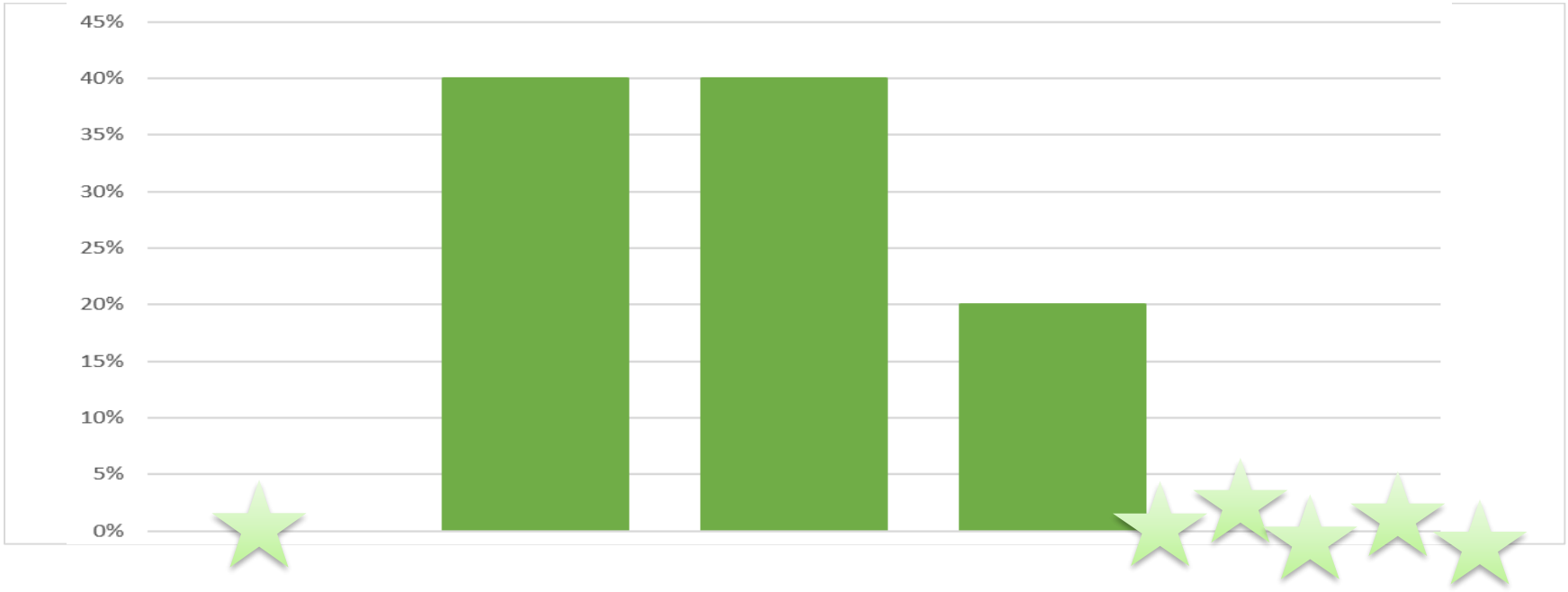
3. What climate-related hazards is your department / organization most concerned about experiencing?



Other response: “Making difficult decisions about which parts of the region to abandon and which parts of the region to protect.”

4. Which of the following is Holyoke most vulnerable to as the result of climate change?

5. In your opinion, how prepared is your department / organization to address climate change vulnerabilities?



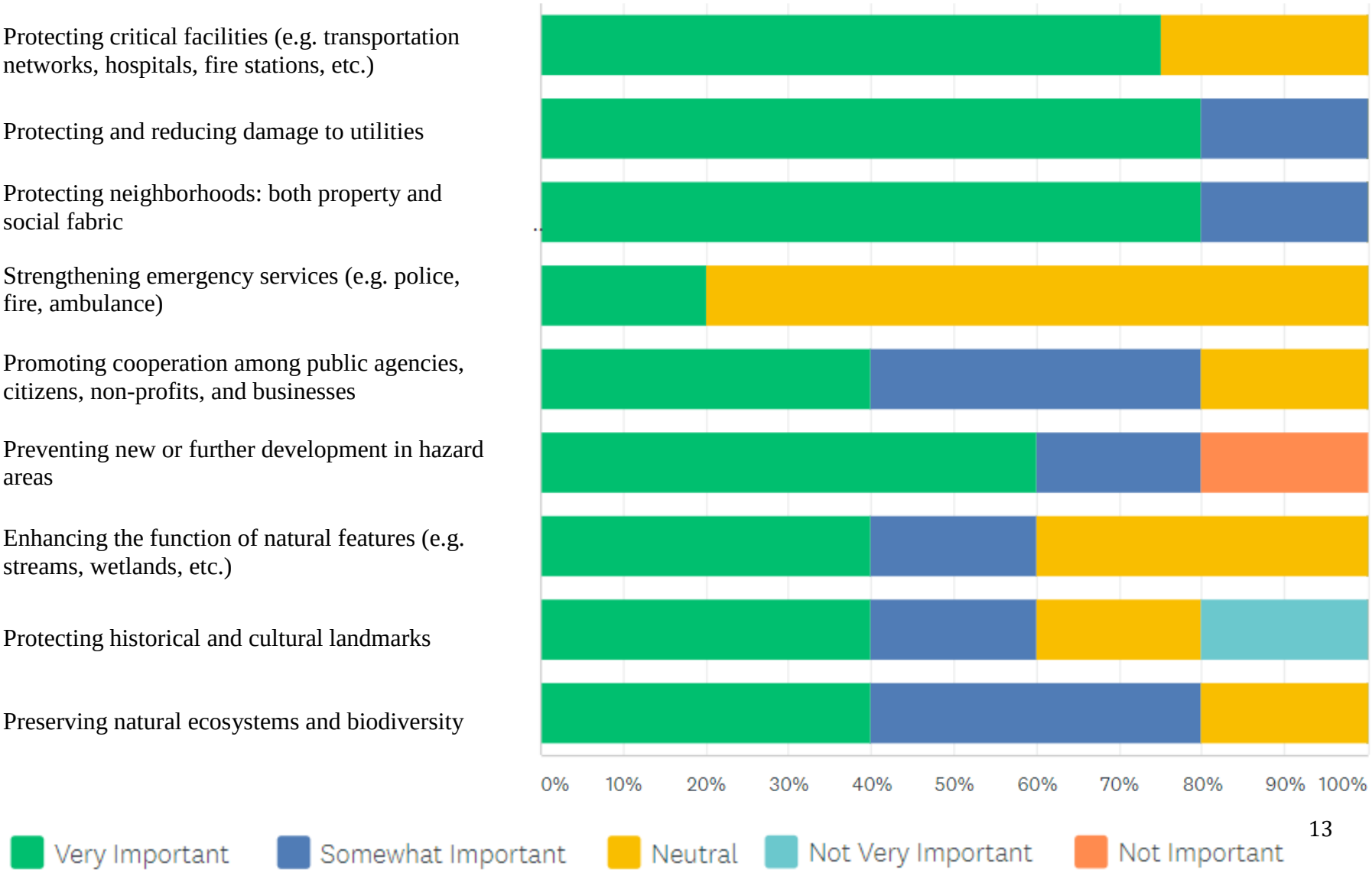
NOT PREPARED:

We expect operations would be significantly impacted by climate change hazards

PREPARED:

We have plans, tools, and resources in place to be resilient to climate

6. Please rank the importance of each statement to your department / organization to help us determine our collective priorities for reducing climate change vulnerabilities and work towards a more resilient Holyoke.



7. If you have additional comments you would like to share prior to the workshop, please provide them here.

“Holyoke is likely one of the most resiliently built Cities in america given it's access to water, location away from the coast and dense development. There are opportunities for us in a world with an altered climate that will wreck even more disruptions to other cities.”

Appendix C: Climate projections provided by the Executive Office of Energy and Environmental Affairs

MASSACHUSETTS CLIMATE CHANGE PROJECTIONS

Researchers from the Northeast Climate Science Center at the University of Massachusetts Amherst developed downscaled projections for changes in temperature, precipitation, and sea level rise for the Commonwealth of Massachusetts. The Executive Office of Energy and Environmental Affairs has provided support for these projections to enable municipalities, industry, organizations, state government and others to utilize a standard, peer-reviewed set of climate change projections that show how the climate is likely to change in Massachusetts through the end of this century.

Temperature and Precipitation Projections

The temperature and precipitation climate change projections are based on simulations from the latest generation of climate models[1] from the International Panel on Climate Change and scenarios of future greenhouse gas emissions.[2] The models were carefully selected from a larger ensemble of climate models based on their ability to provide reliable climate information for the Northeast U.S., while maintaining diversity in future projections that capture some of the inherent uncertainty in modeling climate variables like precipitation. The medium (RCP 4.5) and high (RCP 8.5) emission scenarios were chosen for possible pathways of future greenhouse gas emissions. A moderate scenario of future greenhouse gas emissions assumes a peak around mid-century, which then declines rapidly over the second half of the century, while the highest scenario assumes the continuance of the current emissions trajectory.

Fourteen climate models have been run with 2 emission scenarios each, which lead to 28 projections. The values cited in the tables below are based on the 10-90th percentiles across the 28 projections, so they bracket the *most likely* scenarios. For simplicity, we use the terms "…expected to…," and "…will be…," but recognize that these are estimates based on model scenarios and are *not predictive forecasts*. The statewide projections comprising county- and basin-level information are derived by statistically downscaling the climate model results.[3] They represent the best estimates that we can currently provide for a range of anticipated changes in greenhouse gases. Note that precipitation projections are generally more uncertain than temperature.

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[1]These latest generation of climate models are included in the Coupled Model Intercomparison Project Phase 5 (CMIP5), which formed the basis of projections summarized in the IPCC Fifth Assessment Report (2013).

[2] Future greenhouse gas emissions scenarios are typically expressed as "Representative Concentration Pathways" (RCPs). They indicate emissions trajectories that would lead to certain levels of radiative forcing by 2100, relative to the pre-industrial state of the atmosphere; RCP4.5 equates to +4.5W m^{-2}, and RCP 8.5 would be +8.5W m^{-2}. In effect, they represent different pathways that society may or may not follow, to reduce emissions through climate change mitigation measures.

[3] The Local Constructed Analogs (LOCA) method (Pierce et al., 2014) was used for the statistical downscaling of the statewide projections.

The downscaled temperature and precipitation projections for the Commonwealth are provided at three geographic scales (Table 1) for annual and seasonal temporal scales (Table 2), and can be accessed through the Massachusetts Climate Change Clearinghouse website (www.massclimatechange.org). The statewide projections are included in this guidebook, but temperature and precipitation projections at each of the Commonwealth's major basins are accessible on the website and as a supplemental PDF to this guide.

These climate projections are provided to help municipal officials, state agency staff, land managers, and others to identify future hazards related to, or exacerbated by changing climatic conditions. For the Municipal Vulnerability Preparedness (MVP) program participants, we recommend using climate projections downscaled to the major basin scale (Table 1) as there are regional differences across several climate indicators (Table 3). These projections can help MVP communities to think through how future hazards in their community may change, given projected changes in temperature and precipitation.

Regardless of geographic scale, rising temperatures, changing precipitation, and extreme weather will continue to affect the people and resources of the Commonwealth throughout the 21st century. A first step in becoming more climate-resilient is to identify the climate changes your community will be exposed to, the impacts and risks to critical assets, functions, vulnerable populations arising from these changes, the underlying sensitivities to these types of changes, and the background stressors that may exacerbate overall vulnerability.

Table 1: Geographic scales available for use for Massachusetts temperature and precipitation projections

Geographic Scale	Definition
Statewide	Massachusetts
County	Barnstable, Berkshire, Bristol, Dukes, Essex, Franklin, Hampden, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, Worcester
Major basins[4]	Blackstone, Boston Harbor, Buzzards Bay, Cape Cod, Charles, Chicopee, Connecticut, Deerfield, Farmington, French, Housatonic, Hudson, Ipswich, Merrimack, Millers, Narragansett Bay & Mt. Hope Bay, Nashua, North Coastal, Parker, Quinebaug, Shawsheen, South Coastal, Sudbury-Assabet-Concord (SuAsCo), Taunton, Ten Mile, Westfield, and Islands (presented here as Martha's Vineyard basin and Nantucket basin)

Table 2: Definition of seasons as applied to temporal scales used for temperature and precipitation projections

Season	Definition
Winter	December-February
Spring	March-May
Summer	June-August
Fall	September-November

[4] Many municipalities fall within more than one basin, so it is advised to use the climate projections for the basin that contains the majority of the land area of the municipality.

Table 3: List and definitions of projected temperature indicators

Climate Variable	Climate Indicator	Definition
Temperature	Average temperature	Average annual or seasonal temperature expressed in degrees Fahrenheit (^{o}F).
	Maximum temperature	Maximum annual or seasonal temperature expressed in degrees Fahrenheit (^{o}F).
	Minimum temperature	Minimum annual or seasonal temperature expressed in degrees Fahrenheit (^{o}F).
	Days with Tmax > 90 ^{o}F	Number of days when daily maximum temperature exceeds 90^{o}F.
	Days with Tmax > 95 ^{o}F	Number of days when daily maximum temperature exceeds 95^{o}F.
	Days with Tmax > 100 ^{o}F	Number of days when daily maximum temperature exceeds 100^{o}F.
	Days with Tmin < 32 ^{o}F	Number of days when daily minimum temperature is below 32 ^{o}F.
	Days with Tmin < 0 ^{o}F	Number of days when daily minimum temperature is below 0 ^{o}F.
	Heating degree-days (base 65 ^{o}F)	Heating degree-days (HDD) are a measure of how much and for how long outside air temperature was lower than a specific base temperature. HDD are the difference between the average daily temperature and 65°F. For example, if the mean temperature is 30°F, we subtract the mean from 65 and the result is 30 heating degree-days for that day. HDD serves as a proxy that captures energy consumption required to heat buildings, and is used in utility planning and building design.[5]
	Cooling degree-days (base 65 ^{o}F)	Cooling degree days (CDD) are a measure of how much and for how long outside air temperature was higher than a specific base temperature. CDD are the difference between the average daily temperature and 65°F. For example, if the temperature mean is 90°F, we subtract 65 from the mean and the result is 25 cooling degree-days for that day. CDD serves as a proxy that captures energy consumption required to cool buildings, and is used in utility planning and building design. [6]
	Growing degree-days (base 50 ^{o}F)	Growing degree days (GDD) are a measure of heat accumulation that can be correlated to express crop maturity (plant development). GDD is computed by subtracting a base temperature of 50°F from the average of the maximum and minimum temperatures for the day. Minimum temperatures less than 50°F are set to 50, and maximum temperatures greater than 86°F are set to 86. These substitutions indicate that no appreciable growth is detected with temperatures lower than 50° or greater than 86°.[7]

[5] For seasonal or annual projections, HDD are summed for the period of interest. For example, for winter HDD, one would sum the HDD for December 1 through February 28. Degree-days are not the equivalent of calendar days and thus why it is possible to have more than 365 degree-days.

[6] For seasonal or annual projections, CDD are summed for the period of interest. For example, for summer CDD, one would sum the CDD for June 1 through August 31. Degree-days are not the equivalent of calendar days and thus why it is possible to have more than 365 degree-days.

[7] Definition adapted from National Weather Service. Degree-days are not the equivalent of calendar days and thus why it is possible to have more than 365 degree-days.

Table 4: List and definitions of projected precipitation indicators

Climate Variable	Climate Indicator	Definition
Precipitation	Total precipitation	Total annual or seasonal precipitation expressed in inches.
	Days with precipitation >1 inch	Extreme precipitation events measured in days with precipitation eclipsing one inch.
	Days with precipitation > 2 inch	Extreme precipitation events measured in days with precipitation eclipsing two inches.
	Days with precipitation > 4 inch	Extreme precipitation events measured in days with precipitation eclipsing four inches.
	Consecutive dry days	For a given period, the largest number of consecutive days with precipitation less than 1 mm (0.039 inches).

Impacts from Increasing Temperatures

Warmer temperatures and extended heat waves could have very significant impacts on public health in our state, as well as the health of plants, animals and ecosystems like forests and wetlands. Rising temperatures will also affect important economic sectors like agriculture and tourism, and infrastructure like the electrical grid.

Annual air temperatures in the Northeast have been warming at an average rate of 0.5°F (nearly 0.26°C) per decade since 1970. Winter temperatures have been rising at a faster rate of 0.9°F[8] per decade on average. Even what seems like a very small rise in average temperatures can cause major changes in other factors, such as the relative proportion of precipitation that falls as rain or snow.

In Massachusetts, temperatures are projected to increase significantly over the next century. Winter average temperatures are likely to increase more than those in summer, with major impacts on everything from winter recreation to increased pests and challenges to harvesting for the forestry industry.

Beyond this general warming trend, Massachusetts will experience an increasing number of days with extreme heat in the future (Table 3). Generally, extreme heat is considered to be over 90 degrees F, because at temperatures above that threshold, heat-related illnesses and mortality show a marked increase.

Extreme heat can be especially damaging in urban areas, where there is often a concentration of vulnerable populations, and where more impervious surfaces such as streets and parking lots

[8] NOAA National Centers for Environmental information, Climate at a Glance: U.S. Time Series, Average Temperature, published December 2017, retrieved on December 21, 2017 from http://www.ncdc.noaa.gov/cag/

and less vegetation cause a “heat island” effect that makes them hotter compared to neighboring rural areas.
Urban residents in Massachusetts – especially those who are very young, ill, or elderly, and those who live in older buildings without air conditioning – will face greater risks of serious heat-related illnesses when extreme heat becomes more common. Extreme heat and dry conditions or drought could also be detrimental to crop production, harvest and livestock.

While warmer winters may reduce burdens on energy systems, more heat in the summer may put larger demands on aging systems, creating the potential for power outages. The number of cooling degree days is expected to increase significantly by the end of the century adding to this strain. In addition, heat can directly stress transmission lines, substations, train tracks, roads and bridges, and other critical infrastructure.

Impacts from Changing Precipitation Conditions

Rainfall is expected to increase in spring and winter months in particular in Massachusetts, with increasing consecutive dry days in summer and fall. More total rainfall can have an impact on the frequency of minor but disruptive flooding events, especially in areas where storm water infrastructure has not been adequately sized to accommodate higher levels. Increased total rainfall will also affect agriculture, forestry and natural ecosystems.

More intense downpours often lead to inland flooding as soils become saturated and stop absorbing more water, river flows rise, and the capacity of urban storm water systems is exceeded. Flooding may occur as a result of heavy rainfall, snowmelt, or coastal flooding associated with high wind and wave action, but precipitation is the strongest driver of flooding in Massachusetts. Winter flooding is also common in the state, particularly when the ground is frozen. The Commonwealth experienced 22 flood-related disaster declarations from 1954 to 2017 with many of these falling in winter or early spring, or during recent hurricanes.

The climate projections suggest that the frequency of high-intensity rainfall events will trend upward. Overall, it is anticipated that the severity of flood-inducing weather events and storms will increase, with events that produce sufficient precipitation to present a risk of flooding likely increasing. A single intense downpour can cause flooding and widespread damage to property and critical infrastructure. The coast will experience the greatest increase in high-intensity rainfall days, but some level of increase will occur in every area of Massachusetts.

Intense rainfall in urbanized areas can cause pollutants on roads and parking lots to get washed into nearby rivers and lakes, reducing habitat quality. As rainfall and snowfall patterns change, certain habitats and species that have specific physiological requirements may be affected.

Climate projections for Massachusetts indicate that in future decades, winter precipitation could increase, but by the end of the century most of this precipitation is likely to fall as rain instead of snow due to warmer winters. There are many human and environmental impacts that could result from this change including reduced snow cover for winter recreation and tourism, less spring snow melt to replenish aquifers, higher levels of winter runoff, and lower spring river flows for aquatic ecosystems.

A small projected decrease in average summer precipitation in Massachusetts could combine with higher temperatures to increase the frequency of episodic droughts, like the one experienced across the Commonwealth in the summer of 2016.

Droughts will create challenges for local water supply by reducing surface water storage and the recharge of groundwater supplies, including private wells. More frequent droughts could also exacerbate the impacts of flood events by damaging vegetation that could otherwise help mitigate flooding impacts. Droughts may also weaken tree root systems, making them more susceptible to toppling during high wind events.

Table 5: Statewide projected changes of temperature and precipitation variables by the middle and end of the century, based on climate models and the medium and high pathways of future greenhouse gas emissions. Projected changes for each climate indicator are given as a 30-year mean relative to the 1971-2000 baseline, centered on the 2050s (2040-2069) and the 2090s (2080-2099).[9] The values cited are the range of the most likely scenarios (10-90th percentile).

Climate Indicator		Observed Value 1971-2000 Average	Mid-Century Projected and Percent Change in 2050s (2040-2069)	End of Century Projected and Percent Change in 2090s (2080-2099)
Average Temperature	Annual	47.6 °F	Increase by 2.8 to 6.2 °F Increase by 6 to 13 %	Increase by 3.8 to 10.8 °F Increase by 8 to 23 %
	Winter	26.6 °F	Increase by 2.9 to 7.4 °F Increase by 11 to 28 %	Increase by 4.1 to 10.6 °F Increase by 15 to 40 %
	Spring	45.4 °F	Increase by 2.5 to 5.5 °F Increase by 6 to 12 %	Increase by 3.2 to 9.3 °F Increase by 7 to 20 %
	Summer	67.9 °F	Increase by 2.8 to 6.7 °F Increase by 4 to 10 %	Increase by 3.7 to 12.2 °F Increase by 6 to 18 %
	Fall	50 °F	Increase by 3.6 to 6.6 °F Increase by 7 to 13 %	Increase by 3.9 to 11.5 °F Increase by 8 to 23 %
Maximum Temperature	Annual	58.0 °F	Increase by 2.6 to 6.1 °F Increase by 4 to 11 %	Increase by 3.4 to 10.7 °F Increase by 6 to 18 %
	Winter	36.2 °F	Increase by 2.5 to 6.8 °F Increase by 7 to 19 %	Increase by 3.5 to 9.6 °F Increase by 10 to 27 %
	Spring	56.1 °F	Increase by 2.3 to 5.4 °F Increase by 4 to 10 %	Increase by 3.1 to 9.4 °F Increase by 6 to 17 %
	Summer	78.9 °F	Increase by 2.6 to 6.7 °F Increase by 3 to 8 %	Increase by 3.6 to 12.5 °F Increase by 4 to 16 %
	Fall	60.6 °F	Increase by 3.4 to 6.8 °F Increase by 6 to 11 %	Increase by 3.8 to 11.9 °F Increase by 6 to 20 %
Minimum Temperature	Annual	37.1 °F	Increase 3.2 to 6.4 °F Increase by 9 to 17 %	Increase by 4.1 to 10.9°F Increase by 11 to 29 %
	Winter	17.1 °F	Increase by 3.3 to 8.0 °F Increase by 19 to 47 %	Increase by 4.6 to 11.4 °F Increase by 27 to 66 %
	Spring	34.6 °F	Increase by 2.6 to 5.9 °F Increase by 8 to 17 %	Increase by 3.3 to 9.2 °F Increase by 9 to 26 %
	Summer	56.8 °F	Increase by 3 to 6.9 °F Increase by 5 to 12 %	Increase by 3.9 to 12 °F Increase by 7 to 21 %
	Fall	39.4 °F	Increase by 3.5 to 6.5 °F Increase by 9 to 16 %	Increase by 4.0 to 11.4 °F Increase by 10 to 29 %

[9] A 20-yr mean is used for the 2090s because the climate models end at 2100.

Table 5 Continued

Climate Indicator		Observed Value 1971-2000 Average	Mid-Century Projected and Percent Change in 2050s (2040-2069)	End of Century Projected and Percent Change in 2090s (2080-2099)
Days with Tmax > 90°F	Annual	5 days	Increase by 7 to 26 days	Increase by 11 to 64 days
	Winter	0 days	No change	No change
	Spring	< 1 day[10]	Increase by 0 to 1 days	Increase by 0 to 4 days
	Summer	4 days	Increase by 6 to 22 days	Increase by 9 to 52 days
	Fall	< 1 day[9]	Increase by 0 to 3 days	Increase by 1 to 9 days
Days with Tmax > 95°F	Annual	< 1 day[9]	Increase by 2 to 11 days	Increase by 3 to 35 days
	Winter	0 days	No change	No change
	Spring	< 1 day[9]	No change	Increase by 0 to 1 days Increase by
	Summer	< 1 day[9]	Increase by 2 to 10 days	Increase by 3 to 32 days
	Fall	< 1 day[9]	Increase by 0 to 1 day	Increase by 0 to 3 days
Days with Tmax > 100°F	Annual	< 1 day[9]	Increase by 0 to 3 days	Increase by 0 to 13 days
	Winter	0 days	No change	No change
	Spring	0 days	No change	No change
	Summer	< 1 day[9]	Increase by 0 to 3 days	Increase by 0 to 12 days
	Fall	0 days	No change	Increase by 0 to 1 day
Days with Tmin < 32°F	Annual	146 days	Decrease by 19 to 40 days	Decrease by 24 to 64 days
	Winter	82 days	Decrease by 4 to 12 days	Decrease by 6 to 25 days
	Spring	37 days	Decrease by 6 to 15 days	Decrease by 9 to 20 days
	Summer	< 1 day[9]	No change	No change
	Fall	27 days	Decrease by 8 to 13 days	Decrease by 8 to 20 days
Days with Tmin < 0°F	Annual	8 days	Decrease by 4 to 6 days	Decrease by 4 to 7 days
	Winter	8 days	Decrease by 3 to 6 days	Decrease by 4 to 6 days
	Spring	< 1 day[9]	No change	No change
	Summer	0 days	No change	No change
	Fall	< 1 day[9]	No change	No change

[10] Over the observed period, there were some years with at least 1 day with seasonal Tmax over (or Tmin under) a certain threshold while in all the other years that threshold wasn't crossed seasonally at all.

Table 5 Continued

Climate Indicator		Observed Value 1971-2000 Average	Mid-Century Projected and Percent Change in 2050s (2040-2069)	End of Century Projected and Percent Change in 2090s (2080-2099)
Heating Degree-Days (Base 65°F)	Annual	6839 degree-days	Decrease by 773 to 1627 degree-days Decrease by 11 to 24 %	Decrease by 1033 to 2533 degree-days Decrease by 15 to 37 %
	Winter	3475 degree-days	Decrease by 259 to 681 degree-days Decrease by 7 to 20 %	Decrease by 376 to 973 degree-days Decrease by 11 to 28 %
	Spring	1822 degree-days	Decrease by 213 to 468 degree-days Decrease by 12 to 26 %	Decreases by 283 to 727 degree-days Decrease by 16 to 40 %
	Summer	134 degree-days	Decrease by 63 to 101 degree-days Decrease by 47 to 76 %	Decrease by 76 to 120 degree-days Decrease by 65 to 89 %
	Fall	1407 degree-days	Decrease by 282 to 469 degree-days Decrease by 20 to 33 %	Decrease by 289 to 752 degree-days Decrease by 21 to 53 %
Cooling Degree-Days (Base 65°F)	Annual	457 degree-days	Increase by 261 to 689 degree-days Increase by 57 to 151 %	Increase by 356 to 1417 degree-days Increase by 78 to 310 %
	Winter	0 degree-days	Increase by 0 to 5 degree-days	Increase by 0 to 5 degree-days
	Spring	17 degree-days	Increase by 15 to 48 degree-days Increase by 88 to 277 %	Increase by 18 to 110 degree-days Increase by 103 to 636 %
	Summer	397 degree-days	Increase by 182 to 519 degree-days Increase by 46 to 131 %	Increase by 260 to 1006 degree-days Increase by 65 to 253 %
	Fall	40 degree-days	Increase by 40 to 139 degree-days Increase by 100 to 350 %	Increase by 69 to 297 degree-days Increase by 175 to 750 %
Growing Degree-Days (Base 50°F)	Annual	2344 degree-days	Increase by 531 to 1210 degree-days Increase by 23 to 52 %	Increase by 702 to 2347 degree-days Increase by 30 to 100 %
	Winter	5 degree-days	Increase by 1 to 13 degree-days Increase by 21 to 260 %	Increase by 4 to 27 degree-days Increase by 74 to 563 %
	Spring	259 degree-days	Increase by 88 to 226 degree-days Increase by 34 to 87 %	Increase by 104 to 450 degree-days Increase by 40 to 174 %
	Summer	1644 degree-days	Increase by 253 to 618 degree-days Increase by 15 to 38 %	Increase by 342 to 1124 degree-days Increase by 21 to 68 %
	Fall	429 degree-days	Increase by 172 to 394 degree-days Increase by 40 to 92 %	Increase by 216 to 745 degree-days Increase by 50 to 174 %

Table 5 Continued

Climate Indicator		Observed Value 1971-2000 Average	Mid-Century Projected and Percent Change in 2050s (2040-2069)	End of Century Projected and Percent Change in 2090s (2080-2099)
Days with Precipitation Over 1”	Annual	7 days	Increase by 1 to 3 days	Increase by 1 to 4 days
	Winter	2 days	Increase by 0 to 1 days	Increase by 0 to 2 days
	Spring	2 days	Increase by 0 to 1 days	Increase by 0 to 1 days
	Summer	2 days	Increase by 0 to 1 days	Increase by 0 to 1 days
	Fall	2 days	Increase by 0 to 1 days	Increase by 0 to 1 days
Days with Precipitation Over 2”	Annual	1 day	Increase by 0 to 1 days	Increase by 0 to 1 days
	Winter	< 1 day[11]	Increase by < 1 day[10]	Increase by < 1 day[10]
	Spring	< 1 day[10]	Increase by < 1 day[10]	Increase by < 1 day[10]
	Summer	< 1 day[10]	Increase by < 1 day[10]	Increase by < 1 day[10]
	Fall	< 1 day[10]	Increase by < 1 day[10]	Increase by < 1 day[10]
Days with Precipitation Over 4”	Annual	< 1 day[10]	Increase by < 1 day[10]	Increase by < 1 day[10]
	Winter	0 days	No change	Increase by < 1 day[10]
	Spring	0 days	Increase by < 1 day[10]	Increase by < 1 day[10]
	Summer	< 1 day[10]	Increase by < 1 day[10]	Increase by < 1 day[10]
	Fall	< 1 day[10]	Increase by < 1 day[10]	Increase by < 1 day[10]
Total Precipitation	Annual	47 inches	Increase by 1 to 6 inches Increase by 2 to 13 %	Increase by 1.2 to 7.3 inches Increase by 3 to 16 %
	Winter	11.2 inches	Increase by 0.1 to 2.4 inches Increase by 1 to 21 %	Increase by 0.4 to 3.9 inches Increase by 4 to 35 %
	Spring	12 inches	Increase by 0.1 to 2 inches Increase by 1 to 17 %	Increase by 0.4 to 2.7 inches Increase by 3 to 22 %
	Summer	11.5 inches	Decrease by 0.4 to Increase by 2 inches Decrease by 3 % to Increase by 17 %	Decrease by 1.5 to Increase by 1.9 inches Decrease by 13% to Increase by 16 %
	Fall	12.2 inches	Decrease by 1.1 to Increase by 1.4 inches Decrease by 9 to Increase by 12 %	Decrease by 1.7 to Increase by 1.4 inches Decrease by 14 to Increase by 11 %
Consecutive Dry Days	Annual	17 days	Increase by 0 to 2 days	Increase by 0 to 3 days
	Winter	11 days	Decrease by 1 to Increase by 1 days	Decrease by 1 to Increase by 2 days
	Spring	11 days	Decrease by 1 to Increase by 1 day	Decrease by 1 to Increase by 1 day
	Summer	12 days	Decrease by 1 to Increase by 2 days	Decrease by 1 to Increase by 3 days
	Fall	12 days	Increase by 0 to 3 days	Increase by 0 to 3 days

[11] Over the observed period, there were some years with at least 1 day with seasonal precipitation over a certain threshold while in all the other years that threshold wasn’t crossed seasonally at all.

CONNECTICUT BASIN

MUNICIPALITIES WITHIN CONNECTICUT BASIN:

Agawam, Amherst, Ashfield, Belchertown, Bernardston, Chesterfield, Chicopee, Conway, Deerfield, East Longmeadow, Easthampton, Erving, Gill, Goshen, Granby, Greenfield, Hadley, Hampden, Hatfield, Holyoke, Huntington, Leverett, Leyden, Longmeadow, Ludlow, Monson, Montague, Montgomery, Northampton, Northfield, Pelham, Royalston, Shutesbury, South Hadley, Southampton, Southwick, Springfield, Sunderland, Warwick, Wendell, West Springfield, Westfield, Westhampton, Whately, Wilbraham, and Williamsburg

Many municipalities fall within more than one basin, so it is advised to use the climate projections for the basin that contains the majority of the land area of the municipality.

CONNECTICUT BASIN

Connecticut Basin		Observed Baseline 1971-2000 (°F)	Projected Change in 2030s (°F)	Mid-Century Projected Change in 2050s (°F)	Projected Change in 2070s (°F)	End of Century Projected Change in 2090s (°F)
Average Temperature	Annual	46.98	+2.18 to +4.46	+3.00 to +6.43	+3.57 to +9.00	+4.04 to +10.94
	Winter	25.01	+2.36 to +5.37	+3.02 to +7.99	+3.95 to +9.54	+4.18 to +10.83
	Spring	45.35	+1.51 to +3.30	+2.26 to +5.21	+2.76 to +7.23	+3.11 to +8.81
	Summer	67.93	+2.19 to +4.54	+3.05 to +7.24	+3.44 to +10.52	+3.91 to +12.94
	Fall	49.24	+2.27 to +5.23	+3.81 to +6.81	+3.75 to +9.57	+4.21 to +11.69
Maximum Temperature	Annual	58.45	+2.03 to +4.24	+2.65 to +6.56	+3.18 to +9.13	+3.63 to +11.03
	Winter	35.23	+1.96 to +4.66	+2.61 to +7.11	+3.19 to +8.53	+3.43 to +9.63
	Spring	57.16	+1.38 to +3.23	+2.13 to +5.16	+2.66 to +7.53	+3.17 to +8.99
	Summer	80.18	+1.89 to +4.67	+2.75 to +7.45	+3.25 to +10.93	+3.76 to +13.41
	Fall	60.8	+2.47 to +5.04	+3.65 to +7.16	+3.54 to +9.91	+4.21 to +12.20
Minimum Temperature	Annual	35.51	+2.38 to +4.81	+3.35 to +6.64	+3.93 to +8.89	+4.37 to +10.89
	Winter	14.8	+2.63 to +6.03	+3.56 to +8.76	+4.51 to +10.54	+4.94 to +11.83
	Spring	33.53	+1.62 to +3.63	+2.38 to +5.64	+2.96 to +7.07	+3.29 to +8.59
	Summer	55.67	+2.34 to +4.62	+3.21 to +7.33	+3.63 to +10.13	+4.07 to +12.49
	Fall	37.68	+1.97 to +5.33	+3.58 to +6.64	+3.82 to +9.22	+4.21 to +11.37

- The Connecticut basin is expected to experience increased average temperatures throughout the 21st century. Maximum and minimum temperatures are also expected to increase throughout the end of the century. These increased temperature trends are expected for annual and seasonal projections.
- Seasonally, maximum summer and fall temperatures are expected to see the highest projected increase throughout the 21st century.
    - Summer mid-century increase of 2.8 °F to 7.5 °F (3-9% increase); end of century increase of 3.8 °F to 13.4 °F (5-17% increase).
    - Fall mid-century increase of 3.7°F to 7.2°F (6-12% increase); end of century increase by and 4.2 °F to 12.2 °F (7-20% increase).
- Seasonally, minimum winter and fall temperatures are expected to see increases throughout the 21st century.
    - Winter mid-century increase of 3.6 °F to 8.8 °F (24-59% increase); end of century increase by 4.9 °F to 11.8 °F (33-80% increase).
    - Fall mid-century of 3.6 °F to 6.6 °F (10-18% increase); end of century increase of 4.2°F to 11.4 °F (11-30% increase).

CONNECTICUT BASIN

Connecticut Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Maximum Temperature Over 90°F	Annual	6.41	+6.36 to +19.72	+9.87 to +35.35	+11.98 to +57.07	+14.50 to +76.01
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.39	+0.14 to +0.91	+0.30 to +1.76	+0.37 to +3.31	+0.28 to +5.00
	Summer	5.73	+5.53 to +16.97	+8.31 to +29.50	10.37 to +46.30	+12.47 to +60.30
	Fall	0.29	+0.44 to +2.09	+0.51 to +4.58	+0.61 to +8.80	+1.02 to +11.94
Days with Maximum Temperature Over 95°F	Annual	0.46	+1.74 to +7.34	+2.77 to +16.31	+3.55 to +32.96	+4.56 to +49.67
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.00	+0.00 to +0.26	+0.02 to +0.49	+0.04 to +1.03	+0.03 to +1.93
	Summer	0.45	+1.71 to +6.53	+2.54 to +14.84	+3.05 to +28.97	+4.16 to +43.03
	Fall	0.01	+0.06 to +0.63	+0.09 to +1.19	+0.13 to +3.23	+0.20 to +4.87
Days with Maximum Temperature Over 100°F	Annual	0.00	+0.14 to +1.54	+0.22 to +4.35	+0.41 to +11.64	+0.38 to +23.33
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.00	+0.00 to +0.03	+0.00 to +0.06	+0.00 to +0.21	+0.00 to +0.45
	Summer	0.00	+0.13 to +1.45	+0.20 to +4.17	+0.36 to +10.72	+0.33 to +21.46
	Fall	0.00	+0.00 to +0.14	+0.00 to +0.37	+0.01 to +0.75	+0.00 to +1.29

- Due to projected increases in average and maximum temperatures throughout the end of the century, the Connecticut basin is also expected to experience an increase in days with daily maximum temperatures over 90 °F, 95 °F, and 100 °F.
    - Annually, the Connecticut basin is expected to see days with daily maximum temperatures over 90 °F increase by 10 to 35 more days by mid-century, and 15 to 76 more days by the end of the century.
    - Seasonally, summer is expected to see an increase of 8 to 30 more days with daily maximums over 90 °F by mid-century.
    - By end of century, the Connecticut basin is expected to have 12 to 60 more days.

CONNECTICUT BASIN

Connecticut Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Minimum Temperature Below 0°F	Annual	11.33	-4.01 to -7.02	-4.88 to -8.3	-5.42 to -8.76	-5.53 to -9.57
	Winter	11	-3.84 to -6.82	-4.67 to -7.96	-5.11 to -8.52	-5.33 to -9.1
	Spring	0.38	-0.08 to -0.44	-0.12 to -0.44	-0.18 to -0.49	-0.18 to -0.55
	Summer	0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00	-0.00 to -0.00
	Fall	0.01	-0.02 to -0.00	-0.02 to -0.00	-0.02 to -0.00	-0.02 to -0.00
Days with Minimum Temperature Below 32°F	Annual	158.63	-10.58 to -28.13	-18.57 to -37.28	-22.18 to -50.76	-22.88 to -59.79
	Winter	85.33	-1.15 to -5.9	-2.37 to -8.5	-3.50 to -15.82	-4.26 to -19.49
	Spring	41.52	-3.47 to -9.56	-6.03 to -13.97	-6.70 to -17.87	-8.82 to -19.42
	Summer	0.02	-0.01 to -0.17	-0.01 to -0.27	-0.01 to -0.23	-0.01 to -0.26
	Fall	31.7	-4.87 to -12.57	-9.60 to -15.50	-8.89 to -19.96	-9.36 to -22.29

- Due to projected increases in average and minimum temperatures throughout the end of the century, the Connecticut basin is expected to experience a decrease in days with daily minimum temperatures below 32 °F and 0 °F.
- Seasonally, winter, spring and fall are expected to see the largest decreases in days with daily minimum temperatures below 32 °F.
    - Winter is expected to have 2 to 9 fewer days by mid-century, and 4 to 19 fewer by end of century.
    - Spring is expected to have 6 to 14 fewer days by mid-century, and 9 to 19 fewer by end of century.
    - Fall is expected to have 10 to 16 fewer days by mid-century, and 9 to 22 fewer days by end of century.

CONNECTICUT BASIN

Connecticut Basin		Observed Baseline 1971-2000 (Degree-Days)	Projected Change in 2030s (Degree-Days)	Mid-Century Projected Change in 2050s (Degree-Days)	Projected Change in 2070s (Degree-Days)	End of Century Projected Change in 2090s (Degree-Days)
Heating Degree-Days (Base 65°F)	Annual	7038.04	-579.08 to -1220.89	-807.65 to -1696.71	-932.31 to -2213.81	-1061.27 to -2563.22
	Winter	3617.34	-196.64 to -492.19	-267.53 to -731.67	-348.79 to -867.16	-385.45 to -997.60
	Spring	1827.32	-122.30 to -279.16	-188.81 to -436.93	-225.95 to -566.74	-272.18 to -666.52
	Summer	127	-45.72 to -80.45	-63.18 to -101.77	-66.76 to -116.60	-72.74 to -119.29
	Fall	1471.22	-176.19 to -404.39	-298.62 to -486.71	-283.22 to -674.74	-306.64 to -768.06
Cooling Degree-Days (Base 65°F)	Annual	459.27	+200.92 to +430.52	+272.64 to +749.47	+326.52 to +1142.40	+379.72 to +1504.58
	Winter	nan	-0.39 to +2.36	+0.05 to +6.58	-0.14 to +3.38	-0.29 to +7.15
	Spring	20.23	+10.02 to +28.89	+17.52 to +55.39	+21.11 to +92.67	+20.81 to +121.55
	Summer	396.24	+162.41 to +335.42	+204.13 to +564.51	+235.28 to +853.52	+270.64 to +1075.43
	Fall	37.72	+25.68 to +84.68	+40.57 to +136.51	+49.64 to +225.83	+63.95 to +304.46
Growing Degree-Days (Base 50°F)	Annual	2348.43	+392.37 to +801.41	+536.06 to +1252.31	+652.08 to +1894.77	+739.11 to +2379.52
	Winter	3.8	-0.26 to +8.95	+0.09 to +9.32	+0.51 to +14.24	+1.70 to +19.27
	Spring	278.98	+59.68 to +130.77	+91.58 to +225.48	+117.65 to +331.37	+117.61 to +434.70
	Summer	1649.87	+201.11 to +416.74	+279.05 to +664.79	+315.32 to +966.48	+358.57 to +1190.01
	Fall	403.13	+105.14 to +284.19	+169.55 to +395.11	+166.52 to +591.21	+211.39 to +734.09

- Due to projected increases in average, maximum, and minimum temperatures throughout the end of the century, the Connecticut basin is expected to experience a decrease in heating degree-days, and increases in both cooling degree-days and growing degree-days.
- Seasonally, winter historically exhibits the highest number of heating degree-days and is expected to see the largest decrease of any season, but spring and fall are also expected to see significant change.
    - The winter season is expected to see a decrease of 7-20% (268-732 degree-days) by mid-century, and a decrease of 11-28% (385-998 degree-days) by the end of century.
    - The spring season is expected to decrease in heating degree-days by 10-24% (189-437 degree-days) by mid-century, and by 15-36% (272-667 degree-days) by the end of century.
    - The fall season is expected to decreases in heating degree-days by 20-33% (299-487 degree-days) by mid-century, and by and 21-52% (307-768 degree-days) by the end of century.
- Conversely, due to projected increasing temperatures, summer cooling degree-days are expected to increase by 52-142% (204-565 degree-days) by mid-century, and by 68-271% (271-1075 degree-days) by end of century.

- Seasonally, summer historically exhibits the highest number of growing degree-days and is expected to see the largest decrease of any season, but the shoulder seasons of spring and fall are also expected to see an increase in growing degree-days.
    - The summer season is projected to increase by 17-40% (279-665 degree-days) by mid-century, and by 22-72% (359-1190 degree-days) by end of century.
    - Spring is expected to see an increase by 33-81% (92-225 degree-days) by mid-century and 42-156% (118-435 degree-days) by end of century.
    - Fall is expected to see an increase by 42-98% (170-395 degree-days) by mid-century and 52-182% (211-734 degree-days) by end of century.

CONNECTICUT BASIN

Connecticut Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century: Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century: Projected Change in 2090s (Days)
Days with Precipitation Over 1"	Annual	6.5	+0.05 to +2.22	+0.52 to +3.15	+0.80 to +2.82	+0.67 to +4.35
	Winter	1.04	-0.04 to +0.74	+0.05 to +1.01	+0.06 to +1.30	+0.22 to +1.64
	Spring	1.56	-0.08 to +0.62	+0.08 to +0.81	+0.17 to +1.20	+0.21 to +1.62
	Summer	1.98	-0.37 to +0.57	-0.19 to +0.97	-0.34 to +0.66	-0.38 to +0.74
	Fall	1.89	-0.28 to +0.70	-0.17 to +0.82	-0.27 to +1.00	-0.40 to +1.17
Days with Precipitation Over 2"	Annual	0.55	-0.05 to +0.40	-0.01 to +0.39	+0.00 to +0.45	+0.04 to +0.58
	Winter	0.03	-0.02 to +0.05	-0.02 to +0.07	-0.01 to +0.08	-0.01 to +0.09
	Spring	0.1	-0.03 to +0.10	-0.03 to +0.09	-0.02 to +0.17	+0.00 to +0.25
	Summer	0.26	-0.06 to +0.16	-0.07 to +0.17	-0.06 to +0.17	-0.09 to +0.19
	Fall	0.16	-0.06 to +0.17	-0.06 to +0.16	-0.04 to +0.18	-0.05 to +0.19
Days with Precipitation Over 4"	Annual	0.00	-0.03 to +0.03	-0.02 to +0.03	-0.01 to +0.05	-0.01 to +0.05
	Winter	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Spring	0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00	+0.00 to +0.00
	Summer	0.00	-0.02 to +0.02	-0.02 to +0.02	-0.02 to +0.03	-0.02 to +0.03
	Fall	0.00	-0.02 to +0.03	-0.01 to +0.03	-0.01 to +0.04	-0.01 to +0.04

- The projections for expected number of days receiving precipitation over one inch are variable for the Connecticut basin, fluctuating between loss and gain of days.
    - Seasonally, the winter season is generally expected to see the highest projected increase.
    - The winter season is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and of 0-2 days by the end of century.
    - The spring season is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and of 0-2 days by the end of century.

CONNECTICUT BASIN

Connecticut Basin		Observed Baseline 1971-2000 (Inches)	Projected Change in 2030s (Inches)	Mid-Century Projected Change in 2050s (Inches)	Projected Change in 2070s (Inches)	End of Century Projected Change in 2090s (Inches)
Total Precipitation	Annual	46.39	-0.40 to +4.99	+1.25 to +6.22	+1.95 to +7.26	+1.68 to +8.30
	Winter	10.34	-0.39 to +2.08	+0.07 to +2.59	+0.30 to +3.03	+0.73 to +3.87
	Spring	12.12	-0.05 to +2.09	+0.32 to +2.13	+0.57 to +2.80	+0.45 to +2.87
	Summer	11.98	-0.37 to +1.76	-0.17 to +2.13	-0.34 to +1.85	-1.03 to +1.90
	Fall	11.94	-1.20 to +1.48	-1.26 to +1.65	-1.50 to +1.78	-1.73 to +1.49

- Similar to projections for number of days receiving precipitation over a specified threshold, seasonal projections for total precipitation are also variable for the Connecticut basin.
    - The winter season is expected to experience the greatest change with an increase of 1-25% by mid-century, and of 7-37% by end of century.
    - Projections for the summer and fall seasons are more variable, and could see either a drop or increase in total precipitation throughout the 21st century.
        - The summer season projections for the Connecticut or basin could see a decrease of 0.2 to an increase of 2.1 inches by mid-century (decrease of 1% to increase of 18%), and a decrease of 1.0 to an increase of 1.9 inches by the end of the century (decrease of 9% to increase of 16%).
        - The fall season projections for the Connecticut basin could see a decrease of 1.3 to an increase of 1.7 inches by mid-century (decrease of 11% 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%).

Connecticut Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Consecutive Dry Days	Annual	16.41	-0.18 to +1.34	-0.42 to +1.75	-0.73 to +2.26	-0.35 to +2.44
	Winter	11.4	-0.77 to +1.14	-0.57 to +1.30	-0.80 to +1.18	-1.21 to +1.47
	Spring	11.95	-1.05 to +0.50	-0.91 to +1.05	-1.24 to +1.13	-1.24 to +0.76
	Summer	11.57	-0.70 to +1.46	-0.61 to +1.07	-0.91 to +1.61	-1.37 to +1.87
	Fall	12.03	-0.12 to +1.72	-0.21 to +2.35	-0.61 to +2.61	-0.13 to +2.78

- 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.
    - For all the temporal parameters, the Connecticut basin is expected to see a slight decrease to an increase in consecutive dry days throughout this 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.

Appendix D: Holyoke MVP Risk Matrix

Community Resilience Building **Summary of Team Matrices** www.CommunityResilienceBuilding.org

Holyoke, MA

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

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

Features	Location	Ownership	V or S	Flooding (F)	Extreme Heat (H)	Wind (W)	Disease (D)	Priority H - M - L	Time S hort L ong O ngoing
Infrastructural									
Municipal Utility/Dams/Renewable Energy	Citywide	Public	S/V			Make Holyoke's generation more diverse - prefer state policies to support renewable energy	Bury more utility lines	H	S
Power Grid / Wireless	Citywide	City/3rd Party	S	Power low flow relaxing of environmental controls (to increase generation) (F)				L	L
				More active tree trimming program (W)				H	O
				Add more generation (peaker stations) and towers (H)				L	L
				Alternate power supplies at critical facilities (H, W)				H	S
Dams/Small Canal/Levees/Flood Walls	Citywide	HG&E	V/S	See Environmental category (CT River, canals)					
SW/Sewer/Water	Citywide	City/3rd Party	V	Sewer separation project – LTCP in 2019 (Jackson St. Separation?) (F)				M	L
				Repair of Whiting Reservoir dam (preventative) (F)				M	S
				Day Brook separation (F)				M	L
				Tannery Brook project (flooding prevention) (F)				H	S
				Markers replaced on PS1&2 (F)				H	S
				Green infrastructure project in the urban core (F)				H	O
Stormwater (CSO, Undersized, Culverts, Roadways, Underpasses)	Citywide	DPW	V			Upgrade undersized culverts to accomdate increased flow and conduct a study to prioritize these upgrades (F)			
						Deploy green infrastructure in concert with CSO eliminations (F)			
CSOs	Citywide	Public	V	Implement Separation Study				L	O
Roadways/Travel (PVTA)	Citywide	City/State	S/V	*		*			
Evacuation Routes (lack of back-up power)	Citywide	HPD/DPW/DOT	V			Identify culverts and trees that could block routes and			
						Identify alternate routes (F, W)			
						Develop evaculation route signage (F, W)			
More Walkable City	Citywide	Public	V/S					M	O
Housing	Citywide	Private/City	V/S	Accessibility for War Memorial					
Fire/Police/AMB	Citywide	City	V/S	*	*	*	*		
DPW	63 Canal Street	City	V	Phone list for city staff – City Gov't Emergency Contact Plan					
				Communication plan					
				Evaluate location for an alternative DPW Yard (F)				H	S
				Clear evacuation plan & crisis plans					

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Holyoke, MA

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

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

Features	Location	Ownership	V or S	Flooding (F)	Extreme Heat (H)	Wind (W)	Disease (D)	Priority H - M - L	Time Short Long Ongoing
Infrastructural (con't)									
HMP - New Communication System	Citywide	Public	S	Through MVP applying climate change lens to HMP				H	S
Telecommunication Holyoke G&E: Transmission Lines/ Grid/Hydro-electric	Citywide	HG&E	V/S				Preventative maintenance for trees near utility in Ahsley Reservoir to preserve transmissions lines (W)		
				Ensure plans between HG&E and telecommunications match					
Communication (MT. Tom, towers, etc.)	Citywide	Regional	V/S				Back-up power at communication towers (W)		
Older Buildings (disrepair, vacant)	Citywide	Public/Private	V	Insulate older buildings (H, C)					
				Adopt PACE program (H, C)					
				Education strategy around PACE (H, C)					
						Procure and demolish abandoned older buildigs in high risk flood areas - convert to parks with flood storage (F)		H	O
				Retrofit to make less susecpible to heat swings (H, C)					
				Install green roofs on older buildings (F, H)	See heat action.				
				Install green walls on older buildings (H)					
							Demolish dangerous buildings (W)		
				Determine which buildings to keep					
Age of building & infrastructure	Citywide	Public/Private	V/S						
Cultural/aesthetic value									

Community Resilience Building **Summary of Team Matrices** www.CommunityResilienceBuilding.org

Holyoke, MA

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

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

Features	Location	Ownership	V or S	Flooding (F)	Extreme Heat (H)	Wind (W)	Disease (D)	Priority H - M - L	Time S Long O Ongoing
Societal									
Daily day population not prepared	Multiple	Private	V	Reach out to NPOs agencies to ensure they have plans in place					
				Educate public on availability of resources (Public Ed)					
				Educate on preparedness					
				More resources for code enforcement & legal support					
				Targeted education on successful codes					
Vacant Buildings	Urban Core	Private/City	V						
Food Scarcity	Urban Core	Private	V	Increase local urban food production					
				Expand farmer's market					
Underfunded Gov't	Citywide	City	V						
Dependent Population (systems)	Urban Core	Private/City/State	V						
Isolated Population	Urban Core	Private/City	V						
Vulnerable Neighborhoods (Springdale, W. Holyoke, S. Holyoke)	Specific Neighborhoods	Public/Private	V			Create a neighborhood level marketing engagement & training program		H	S/O
Multi-layered vulnerable (income, language) population honesty, ect.	Downtown	Citywide	V	Education program and resources to increase sense of agency and create communication line to these individuals. These may include: move in pakcets from landlord/HHA and realtors on climate resiliency and local resources.				H	L
Diverse population	Citywide	Citywide	S						
Self-affiliating social networks	Citywide	Citywide	S						
Shelter Management Plan - Red Cross	Citywide	Public	S/V	Distribute and/or update shelter Management Plan & tensive use of backup generation				H	S
Medically Vulnerable (Dialysis, Resp., IEP Students)	Citywide		V	Coordination w/ community Medical focused on resilience - social cohesion assets for deployment of critical treatments Neighborhood Captain/Ambassador.				H	L/O
Aging Population	Citywide		S/V	Educate teenage able seniors to volunteer for emergency volunteer corp.			Chains of command - link to Neighbor watch - black parties	M	S/O
Low-income population (close knit)	Citywide		S/V						

Community Resilience Building **Summary of Team Matrices** www.CommunityResilienceBuilding.org

Holyoke, MA

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

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

Features	Location	Ownership	V or S	Flooding (F)	Extreme Heat (H)	Wind (W)	Disease (D)	Priority H - M - L	Time S Short L Long O Ongoing
Societal (con't)									
Communication, Language, Technology	Citywide	Public/Private	V/S	Training & Ongoing engagement of Municipal Dept. Heads on the "plan" and their role.				H	S/O
Outward Communication	Citywide/Localized	City/State	V/S	Identify and train community/trusted social network leaders as climate ambassadors (for all groups/neighborhoods) to				H	
				Create a plan to get the climate message out					
				Expand reverse 911 program to mobil devices					
				Create outreach programs in the schools					
				Communitate climate change hazards and sustainability at community events, including existing block parties					
Emergency Planning Processes	Citywide	Fire Dept/emd	S	Create the EMD/LEPC Director as a paid position to integrate climate preparedness into the local planning process					
				Link climate-related planning with disaster management					
Emergency shelter network exists, (Staffing amount of shelters, and lack & back-up power are issues)	Citywide	BOH	V/S	Install back-up power at shelters, including the War Memorial				H	
				Identify the people responsible for running shelters 24/7 a needed					
				Identify, create, and formalize cooling shelters (H)					
				Investigate and install battery storage as a generator at high priority locations (including the fire station)				H	
Overarching actions in the society category:				Two-way education event to tap into knowiddge of people that fled from Hurricane Maria with case studies, oral histories, lessons and prioritzations of the greatest needs for the populations in transition				H	S
				Evaluate reverse call registration and increase registration				H	S
				Evaluate shelter staffing at War Memorial				H	S
				Leverage use of Mobile City Hall				L	O
				Coordinate local NPO leaders as ambassador to help spread the word					
				How can we build upon lessons learned from Hurricane Maria?					
				It could happen here Campaign				H	S
				Investigate creation another "stressed person" list					
				Leverage Facebook page to communicate (part of an education campaign)					

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Holyoke, MA

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

Features	Location	Ownership	V or S	Flooding (F)	Extreme Heat (H)	Wind (W)	Disease (D)	Priority H - M - L	Time S Short L Long O Ongoing
Environmental									
Forests	MT. Tom, West Holyoke	Waterworks, DCR & State	V/S	See forest related activities in open space/urban tree canopy					
Tree Canopy	Citywide	Public/Private	S/V	Develop & fund a proper tree planting & maintenance program - engage citizens Right Species					
Urban tree canopy	Downtown	DPW	V/S	Develop a tree watering program / water the trees downtown(H)					
				Plant drought resistant species (H)					
				Increase tree planting (H)					
				Fund urban tree maintence program, including a rig that anyone could use (rather than need a specialized license) (H)					
						Integrate urban trees into green instructure (F)			
						Educate/train staff on how to maintain green instructure (F)			
Open Space/Forest	West of 91	City/State	S	Plan for forest protection room invasive species					
				Expand urban forest					
Open space (watershed, Mt. Tom, Conservation land)	Citywide	Mixed Ownership	S	Manage forest to reduce risk of fire (H)					
				Plant drought resistant species (H)					
				Manage invasive pests to preserve tree canopy (H, C, F)					
							Allow forest to recover after events (W)		
				Stay alert to fire risk (H)					
				Create fire breaks in forest (H)					
Conservation (Pervious Surfaces & Open Space)	Citywide	Public/Private	S						

Community Resilience Building **Summary of Team Matrices** www.CommunityResilienceBuilding.org

Holyoke, MA

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

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

Features	Location	Ownership	V or S	Flooding (F)	Extreme Heat (H)	Wind (W)	Disease (D)	Priority H - M - L	Time S Short L Long O Ongoing
Environmental (con't)									
Downtown parks/open space	Downtown	Parks & Rec	S	Install water parks/features (H)					
				Restore public pools (H)					
				Increase tree shade/canopy at parks (H)					
				Install ice skating rinks and sledding areas (C)					
Parks/Fields	Citywide	City	S	Potential to investigate open space for stormwater controls					
Parks & Recreational Areas	Citywide	Public	S		Add more shader water features			M	O
Urban blight/Industrial Legacy	Urban Core	Private/City	V	Leverage open brownfield, to solar fields					
Impervious Surfaces	Urban Core	City/Private	V	Look for a creative way to balance development & stormwater control (F)					
				Stronger education on value of stormwater controls (F)				H	S
				Investigate green infrastructure inclusion for stormwater & CSO control				H	S
Floodplains	Citywide	City/Private	S						
CT River Watershed	Citywide	Public	S/V	Ensure current flood control activities can meet increases in flooding				M	L
			S/V	Ensure current flood control activities can meet increases in flooding/ Review zoning codes & ensure take into account climate change impacts.				L	L
Water Supply	Citywide	City	S/V						

Community Resilience Building **Summary of Team Matrices** www.CommunityResilienceBuilding.org

Holyoke, MA

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

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

Features	Location	Ownership	V or S	Flooding (F)	Extreme Heat (H)	Wind (W)	Disease (D)	Priority	Time
								H - **M** - **L**	**S**hort **L**ong **O**ngoing
Environmental (con't)									
CT River/Canals	Holyoke up to turners fall	HG&E	V/S	Increase renewable energy and storage (batteries) to make-up for reduced power genrator from river (H)				H	O
				Install more hydrowheels in canals (H)					L
						Conduct worst-case scenario planning study to determine risks to during flood event and flood control system failure. This includes determining the future x% chance floodplains, impacts to pump stations, people, how to evacuate, how to communicate the risk. (F)			
						Create a line of communication to communicate flooding event			
						Conduct a table-top, multi-agency, flooding scenevent ario exerciseto prepare for events (F)		H	O
Pests/disease	Citywide	BOH	V	Treat areas as needed to eliminate the vector (H, F)		See heat action.			
				Conduct an education campaign around vectors (H, F)		See heat action.			
				Encourage behavior changes					
Air Quality	Citywide	Public/Private	V	Continue to implement complete streets				H	O S
				Continue to implement electrical vehicles incentives				M	S

Community Resilience Building Risk Matrix **RED TEAM** www.CommunityResilienceBuilding.org

Holyoke, MA

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

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	Flooding (F)	Extreme Heat (H)	Wind (W)	Disease (D)	Priority H - M - L	Time S Long O ngoing
Infrastructural									
Power Grid / Wireless	Citywide	City/3rd Party	S	Power low flow relaxing of environmental controls (to increase generation) (F)				L	L
				More active tree trimming program (W)				H	O
				Add more generation (peaker stations) and towers (H)				L	L
				Alternate power supplies at critical facilities (H, W)				H	S
SW/Sewer/Water	Citywide	City/3rd Party	V	Sewer separation project – LTCP in 2019 (Jackson St. Separation) (F)				M	L
				Repair of Whiting Reservoir dam (preventative) (F)				M	S
				Day Brook separation (F)				M	L
				Tannery Brook project (flooding prevention) (F)				H	S
				Motors replaced on PS1&2 (F)				H	S
				Green infrastructure project in the urban core (F)				H	O
Roadways/Travel (PVTA)	Citywide	City/State	S/V	*		*			
Housing	Citywide	Private/City	V/S	Accessibility for War Memorial					
Fire/Police/AMB	Citywide	City	V/S	*	*	*	*		
DPW	63 Canal Street	City	V	Phone list for city staff – City Gov't Emergency Contact Plan					
				Communication plan					
				Evaluate location for an alternative DPW Yard (F)				H	S
				Clear evacuation plan & crisis plans					
Societal									
Daily day population not prepared	Multiple	Private	V	Reach out to NPO agencies to ensure they have plans in place					
				Educate public on availability of resources (Public Ed)					
				Educate on preparedness					
				More resources for code enforcement & legal support					
				Targeted education on successful codes					
Food Scarcity	Urban Core	Private	V	Increase local urban food production					
				Expand farmer's market					
Vacant Buildings	Urban Core	Private/City	V						
Underfunded Gov't	Citywide	City	V						
Dependent Population (systems)	Urban Core	Private/City/State	V						
Isolated Population	Urban Core	Private/City	V						
	Overarching actions in the society category:			Evaluate reverse 911 call registration and increase registration				H	S
				Evaluate shelter staffing at War Memorial				H	S
				Leverage use of Mobile City Hall				L	O
				Coordinate local NPO leaders as ambassadors to help spread the word					
				How can we build upon lessons learned from Hurricane Maria?					
				It could happen here Campaign				H	S
				Investigate creation of another "stressed person" list					
				Leverage Facebook page to communicate (part of an education campaign)					
Environmental Public Safety	Citywide	C	V/S						
Open Space/Forest	West of 91	City/State	S	Plan for forest protection from invasive species					
				Expand urban forest					
Parks/Fields	Citywide	City	S	Potential to investigate open space for stormwater controls					
Urban blight/Industrial Legacy	Urban Core	Private/City	V	Leverage open brownfield, to solar fields					
Water Supply	Citywide	City	S/V						
Impervious Surfaces	Urban Core	City/Private	V	Look for a creative way to balance development & stormwater control (F)					
				Stronger education on value of stormwater controls (F)				H	S
				Investigate green infrastructure inclusion for stormwater & CSO control				H	S
Floodplains	Citywide	City/Private	S						

Community Resilience Building Risk Matrix

Holyoke, MA

BLUE TEAM

www.CommunityResilienceBuilding.org

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

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

Features	Location	Ownership	V or S	Extreme Precipitation (Rain, Snow)	Heat	Drought	Wind	Priority H - M - L	Time S hort L ong O ngoing
Infrastructural									
Municipal Utility/Dams/Renewable Energy	Citywide	Public	S/V			Make Holyoke's generation more diverse - push for state policies to support new renewable energy	Bury more utility lines	H	S
CSOs	Citywide	Public	V	Implement Separation Study				L	O
Age of building & infrastructure	Citywide	Public/Private	V/S				continue to identify aging vulnerable bldgs and retrofit to higher standards	M	O
HMP - New Communication System	Citywide	Public	S	Through MVP applying climate change lens to HMP				H	S
Societal									
Communication, Language, Technology	Citywide	Public/Private	V/S	Training & Ongoing engagement of Municipal Dept. Heads and Emergency Response related stakeholders on the "plan" and their role.				H	S/O
Shelter Management Plan - Red Cross	Citywide	Public	S/V	Distribute and/or update Shelter Management Plan & ensure use of backup generation				H	S
Medically Vulnerable (Dialysis, Resp., IEP Students)	Citywide		V	Coordination w/ community Medical Assets for deployment of critical treatments				H	L/O
Aging Population	Citywide		S/V	Educate and engage able seniors to volunteer for emergency volunteer corp. and ensure there are clear chains of command- link to Neighborhood Watch and Block Parties				M	S/O
Vulnerable Neighborhoods (Springdale, W. Holyoke, S. Holyoke)	Specific Neighborhoods	Public/Private	V	Create a neighborhood level marketing engagement & training program focused on resilience and social cohesion Neighborhood Captain/Ambassador.				H	S/O
Low-income population (close knit)	Citywide		S/V						
Environmental									
CT River Watershed	Citywide	Public	S/V	Ensure current flood control activities can meet increases in flooding				M	L
			S/V	Review zoning codes & ensure take into account climate change impacts.				L	L
Reservoirs	Specific Locations	Public	S	Ensure current water management plan is sufficient to meet potential future needs and climate change impacts				H	L/O
Tree Canopy	Citywide	Public/Private	S/V	Develop & fund a proper tree planting & maintenance program - engage citizens, use the right species for the right climate				M	O
Parks & Recreational Areas	Citywide	Public	S		Add more shade and water features			M	O
Conservation (Previous Surfaces & Open Space)	Citywide	Public/Private	S						
Air Quality	Citywide	Public/Private	V	Continue to implement complete streets				H	O
				Continue to implement electrical vehicles incentives				M	S

Community Resilience Building Risk Matrix

Holyoke, MA

GREEN TEAM www.CommunityResilienceBuilding.org

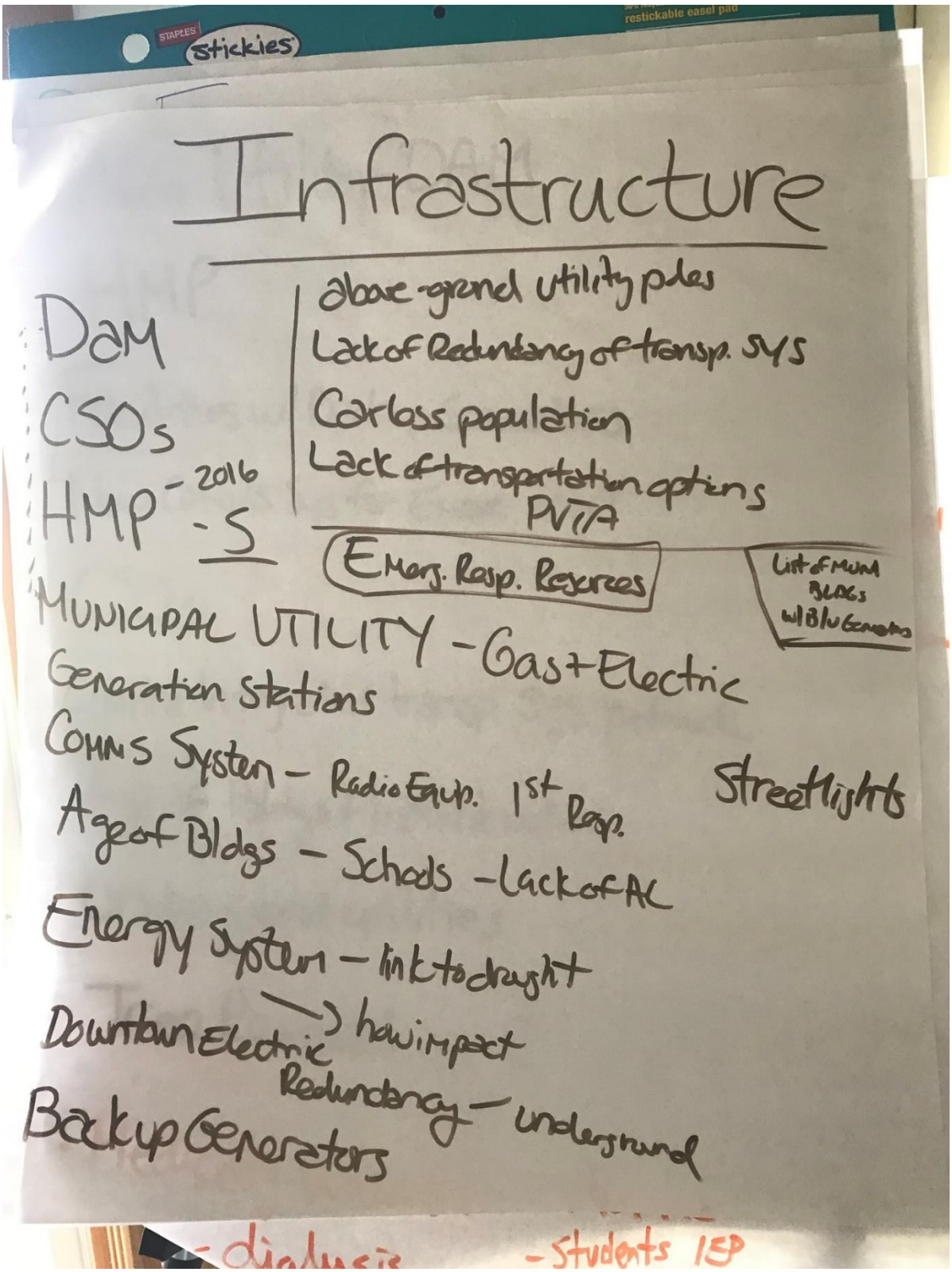
H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

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

Features	Location	Ownership	V or S	Extreme Heat (H)	Extreme Cold (C)	Flooding (localized) / Extreme Precipitation (F)	Wind Events (W)	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Dams/Small Canal/Levees/Flood Walls	Citywide	HG&E	V/S	See Environmental category (CT River, canals)					
Stormwater (CSO, Undersized, Culverts, Roadways, Underpasses)	Citywide	DPW	V			Upgrade undersized culverts to accomdate increased flow and conduct a study to prioritize these upgrades (F)			
						Deploy green infrastructure in concert with CSO eliminations (F)			
Telecommunication Holyoke G&E: Transmission Lines/ Grid/Hydro-electric	Citywide	HG&E	V/S				Preventative maintenance for trees near utility in Ahsley Reservoir to preserve transmissions lines (W)		
				Ensure plans between HG&E and ??? Match					
Communication (MT. Tom, towers, etc.)	Citywide	Regional	V/S				Back-up power at communication towers (W)		
Older Buildings (disrepair, vacant)	Citywide	Public/Private	V	Insulate older buildings (H, C)					
				Adopt PACE program (H, C)					
				Education strategy around PACE (H, C)					
						Procure and demolish abandoned older buildigs in high risk flood areas - convert to parks with flood storage (F)		H	O
				Retrofit to make less susecpible to heat swings (H, C)					
				Install green roofs on older buildings (F, H)	See heat action.				
				Install green walls on older buildings (H)					
							Demolish dangerous buildings (W)		
				Determine which buildings to keep					
Evacuation Routes (lack of back-up power)	Citywide	HPD/DPW/DOT	V			Identify culverts and trees that could block routes and upgrade/maintain (F, W)			
						Identify alternate routes (F, W)			
						Develop evaculation route signage (F, W)			
Societal									
Outward Communication	Citywide/Localized	City/State	V/S	Identify and train community/trusted social network leaders as climate ambassadors (for all groups/neighborhoods) to spread				H	
				Create a plan to get the climate message out					
				Expand reverse 911 program to mobil devices					
				Create outreach programs in the schools					
				Communitate climate change hazards and sustainability at community events, including existing block parties					
Emergency Planning Processes	Citywide	Fire Dept/emd	S	Create the EMD/LEPC Director as a paid position to integrate climate preparedness into the local planning process					
				Link climate-related planning with disaster management					
Emergency shelter network exists, (Staffing amount of shelters, and lack & back-up power are issues)	Citywide	BOH	V/S	Install back-up power at shelters, including the War Memorial				H	
				Identify the people responsible for running shelters 24/7 a needed					
				Identify, create, and formalize cooling shelters (H)					
				Investigate and install battery storage as a generator at high priority locations (including the fire station)				H	
Multi-layered vulnerable (income, language) population honesty, ect.	Downtown	Citywide	V	Education program and resources to increase sense of agency and create communication line to these individuals. These may include: move in pakcets from landlord/HHA and realtors on climate resiliency and local resources.				H	L
Diverse population	Citywide	Citywide	S						
Self-affiliating social networks	Citywide	Citywide	S						
	Overarching actions in the society category:			Two-way education event to tap into knowlddge of people that fled from Hurricane Maria with case studies, oral histories, lessons and prioritzations of the greatest needs for the populations in transition.				H	S
Environmental									
CT River/Canals	Holyoke up to turners fall	HG&E	V/S	Increase renewable energy and storage (batteries) to make-up for reduced power genrator from river (H)				H	O
				Install more hydrowheels in canals (H)					L
						Conduct worst-case scenario planning study to determine risks to during flood event and flood control system failure. This includes determining the future x% chance floodplains, impacts to pump stations, people, how to evacuate, how to communicate the risk. (F)			
						Create a line of communication to communicate flooding event			
						Conduct a table-top, multi-agency, flooding scenevent ario exerciseto prepare for events (F)		H	O
Open space (watershed, Mt. Tom, Conservation land)	Citywide	Mixed Ownership	S	Manage forest to reduce risk of fire (H)					
				Plant drought resistant species (H)					
				Manage invasive pests to preserve tree canopy (H, C, F)					
							Allow forest to recover after events (W)		
				Stay alert to fire risk (H)					
				Create fire breaks in forest (H)					
Urban tree canopy	Downtown	DPW	V/S	Develop a tree watering program / water the trees downtown(H)					
				Plant drought resistant species (H)					
				Increase tree planting (H)					
				Fund urban tree maintence program, including a rig that anyone could use (rather than need a specialized license) (H)					
						Integrate urban trees into green instructure (F)			
						Educate/train staff on how to maintain green instructure (F)			
Forests	MT. Tom, West Holyoke	Waterworks, DCR & State	V/S	See forest related activities in open space/urban tree canopy					
Downtown parks/open space	Downtown	Parks & Rec	S	Install water parks/features (H)					
				Restore public pools (H)					
				Increase tree shade/canopy at parks (H)					
				Install ice skating rinks and sledding areas (C)					
Pests/disease	Citywide	BOH	V	Treat areas as needed to eliminate the vector (H, F)		See heat action.			
				Conduct an education campaign around vectors (H, F)		See heat action.			
				Encourage behavior changes					

Appendix E: Notes from the MVP Workshop

Blue Team - Day 1



Muni Utility-DAM

HMP

- Facilities w/ Backup Generators
- New Comms Sys for Emer Resp

CSOs

Limited Integrated transp. Sys network

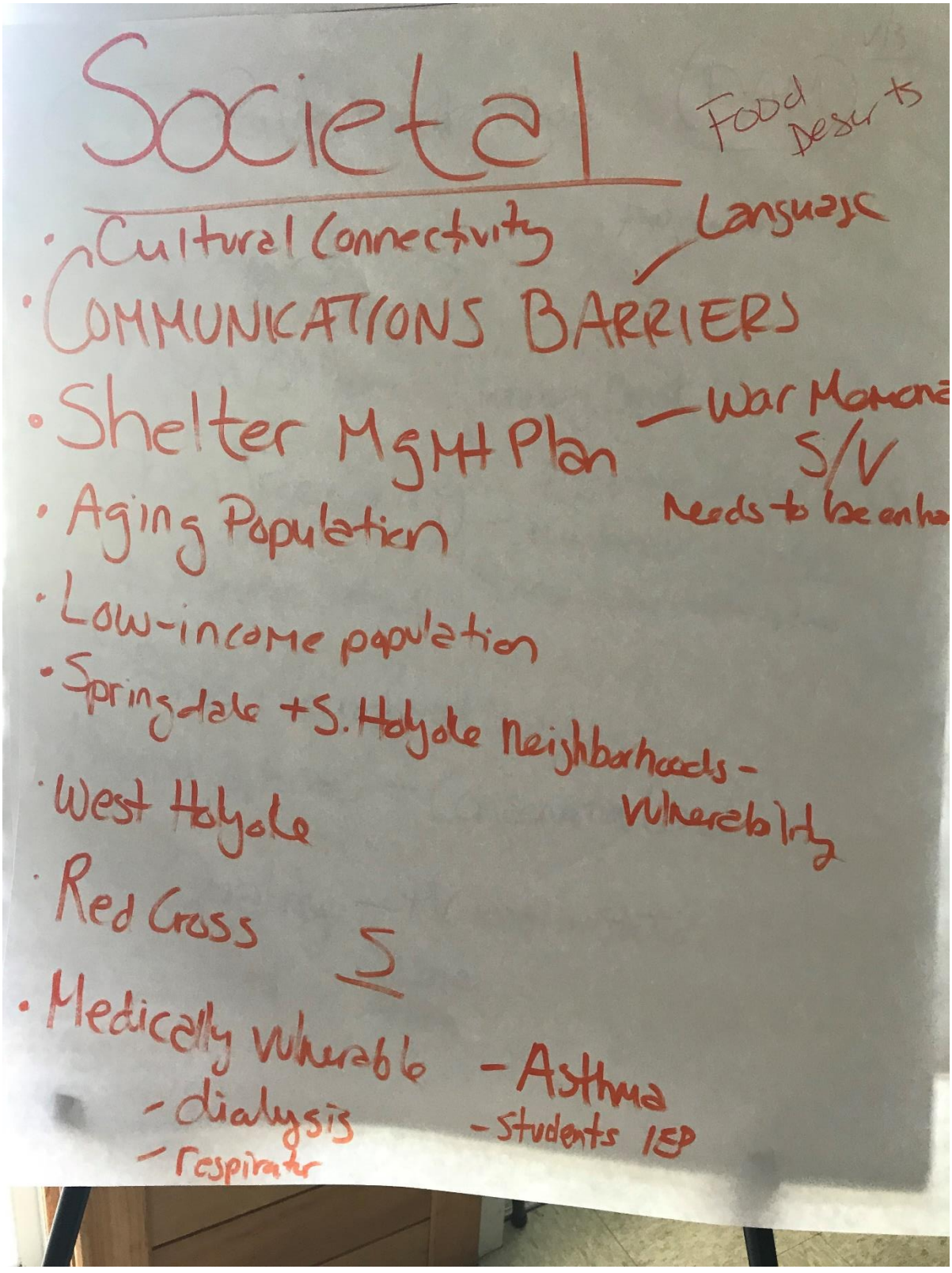
Age of Bldgs + Infrastructure

Underground utilities

Tree Removal – E

- Medically

- students IEP


Societal
Food Deserts
Cultural Connectivity
Language
COMMUNICATIONS BARRIERS
Shelter MgMt Plan
War Mamora
S/V
Needs to be enha
Aging Population
Low-income population
Springdale + S. Holyoke Neighborhoods -
West Holyoke
Vulnerability
Red Cross
Medically Vulnerable
- Asthma
- dialysis
- students IEP
- respirator

Environmental

CT River watershed (DAM) v/s

Agricultural

Reservoirs 5

Wetland/Stream – Tannery Brook

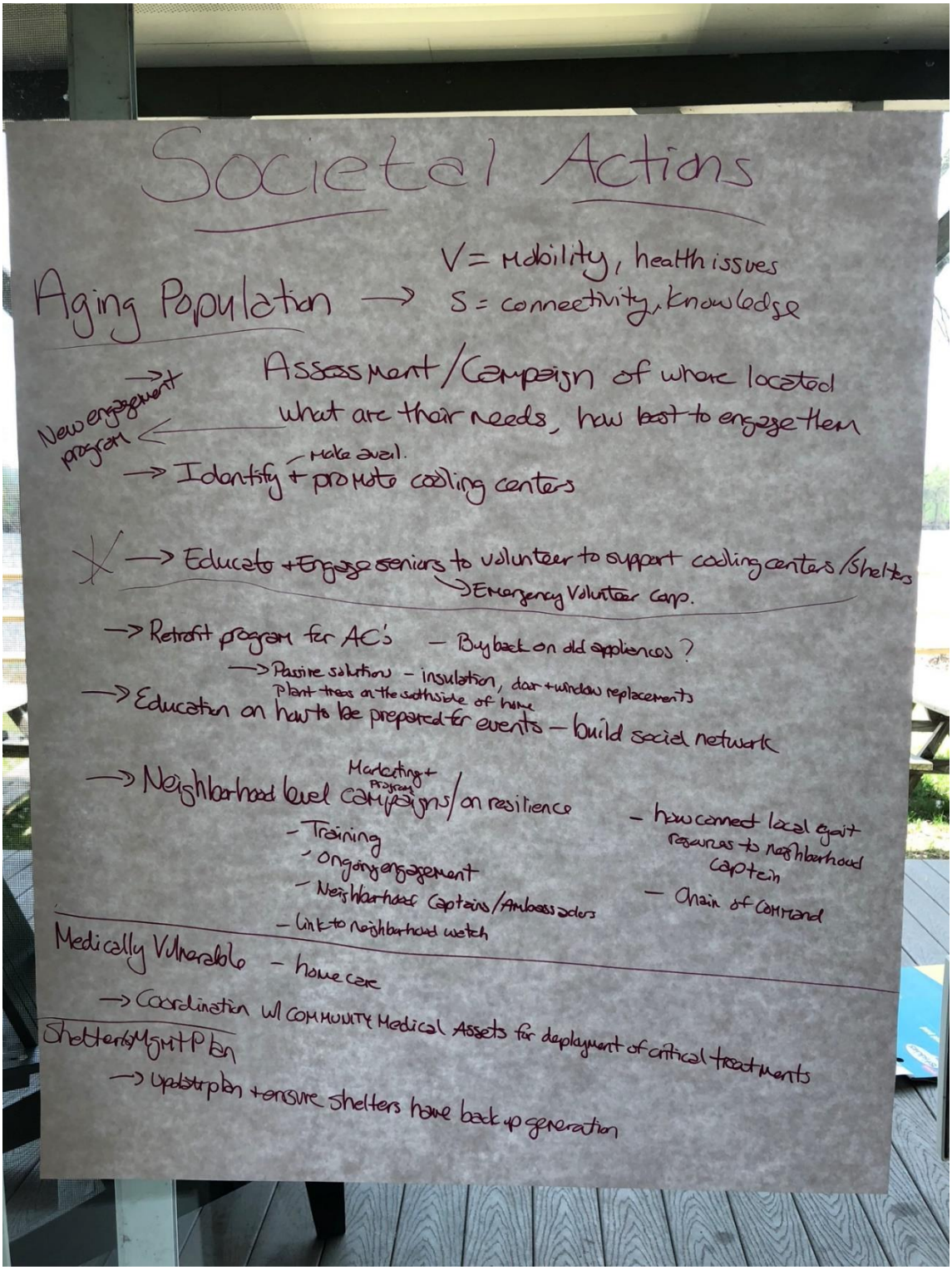
Urban Tree Canopy – 4,000 trees planted v/s
– Maintenance – City + Public
→ assess current + future species

Grass/Pervious Surfaces
↳ Parks + Recreational Spaces

Migratory species – Conservation Land

Air Quality – PV worst in State
MT. TOM Ozone
Asthma

Blue Team – Day 2



Enviroactions Actions

CT River

- Ensure current flood mitigation activities can meet potential increases in flooding

- Implement Tannery Brook Eng. study
- Review zoning codes + ensure tatas into account climate change impacts
- Bray Lake as flood Mitigation (control) resource

reservoirs

- Ensure water quality is not compromised due to flooding or drought ~~current~~ development in watersheds
  - testing
  - analysis
  - studies

H S/O

- Confirm current water Mgmt plan is sufficient to meet potential future needs + climate change impacts

Tree Canopy

- Develop a proper (+fund) tree planting + maintenance program
  - engage / "deputize" citizens to assist
  - "right tree for the right place"
  - look @ species that are more resilient
  - look @ feasibility of tree removal equipment for emergencies

urban mostly

Parks + Rec Areas

M O – Identify + install water features / pools ~~@~~ @ parks in urban heat island areas

M O – Add more shade features / plant trees to create shade where applicable

Air Quality

H/M O – Continue to implement ~~complete~~ complete streets + aim toward walkability / bikeability

M S – EV incentives from MUNI UTILITY

H – Educational Campaigns – WALK + BIKE HAS RIGHT OF WAY

Vulnerable Neighborhoods

Scenario: Dam breaks - S. Holyoke floods

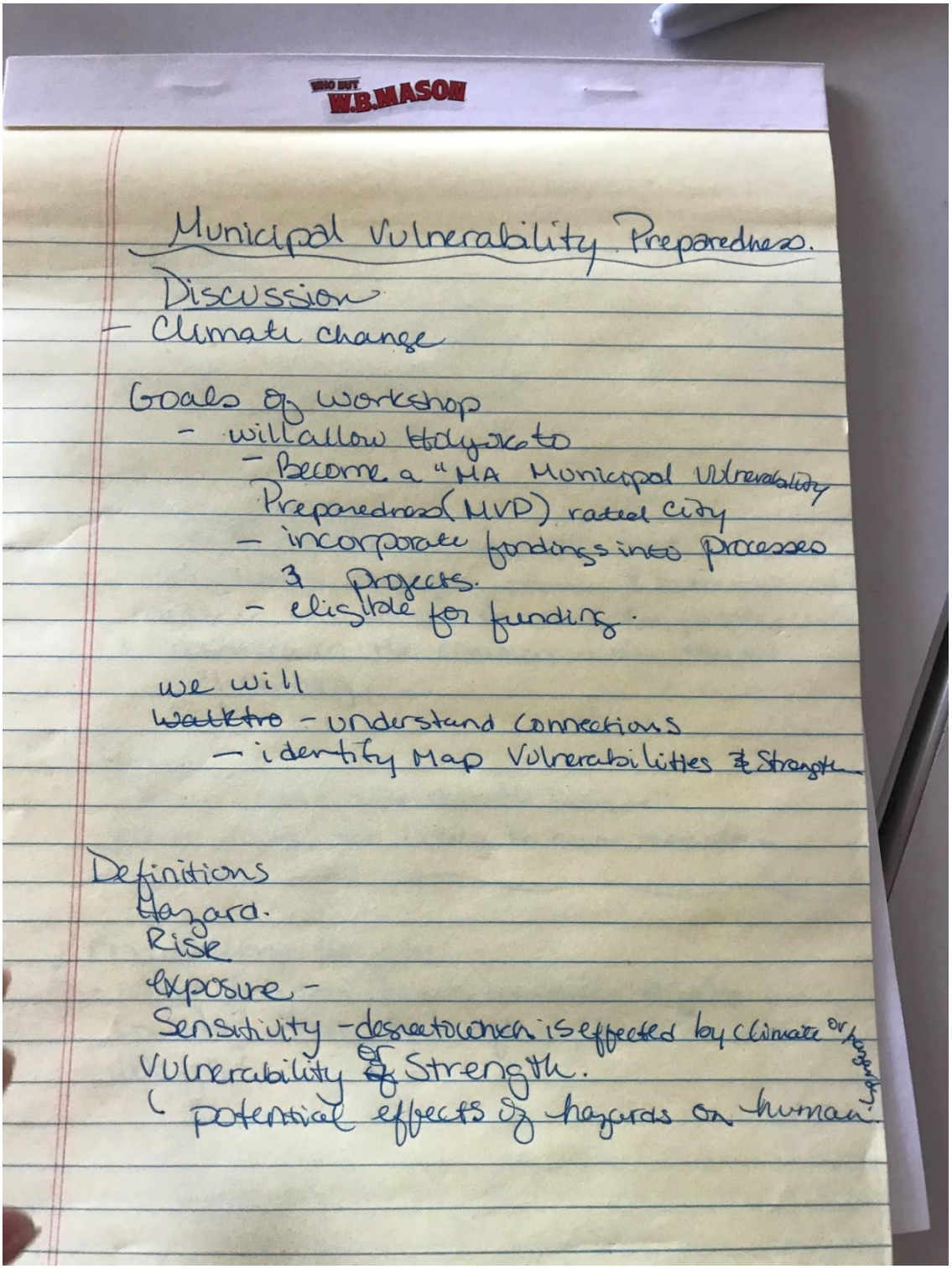
- acknowledge people are looking for leadership
  - Give specific steps/actions

☆ All Municipal dept heads must be educated + trained on emergency response on an annual basis. → ongoing
- incorporated into protocols
  new hire orientation

Food deserts – Partnership w/ Stop+Shop (PeaPod) to deliver during Emergency situations

COMMUNICATION

Green Team – Day 1



- Strength
  - trees - help reduce
    - provide shading
    - quality of life
    - Air quality.

Climate change
- & Regardless of geographic Scale.
rising temps, changing precip, & extreme weather will continue to affect the people.
& resources in the Commonwealth thru out 21 Century.

Precip.
Precip will be more variable "Extreme" precip events are likely to occur more often.

Characterize Hazards
- What hazards have impacted Holyoke in Past? where, how often, and in what ways?

Issues in Holyoke

- Extreme heat
- weak infrastructure
- flash floods
- Old bldg Stock.
- Unprepared pop.
- Aging pop.
- Communication barriers / [illegible]
- technology
- [illegible] language.

& Young People. (Kids)
- Amount of housing ((Available housing Stock)
- Snow storms
  - unexpected timing
  - microburst.
  - tornadoes
  - Wildfire
  - extreme wind event.
  - food insecurity.
  - heat mortality ↑ Risk.
  - Vector borne disease
    - Ticks
    - Mosquitoes.
- drought
- power Supply
- people & environment

- Crime w/ heat.
- Community to public.
- Available resources for response & aid.
- Complicated population.
  - living in most vulnerable part of city.
- Self Sufficiency of Pop. →
- homelessness - housing insecurity.

Top 4 Hazards - Greendeam

identify vulnerabilities & Strength -

① environment.

Hazards - Pond.
- infrastructure - water.
- Population Density (no sprinklers)
- extreme cold...
  extreme heat - first (homeless & elderly)
  where do they go.

Environment
MT TOM...
CT River -
(CANALS
Reservoirs)

DAM - Provides 2/3 of Power in Holyoke.

Private property
DAMS (where are they)

100 year flood event.

** 1940 Sargeant Street flood.

how to keep open cell towers?

(DCS)
Distribution Communication Systems
- boost Signals for
- DCS Program

MEFA warning
- Send out Emergency info to residents in Area

verizon out can provide power to boost cell

CSO events

Shelters in Holyoke.
- no one to run Shelters
- no Personnel.

Mall & HCC

Emergency Plans - each place has its own plan.

~~when emergency - how does info get out.~~

- media
  - facebook page
  - City Hall website

- lack of communication between

Schools assests.
Social ~~assests~~.

Infra

Old blds
Small DAMS
CT Rivers
DAMS
levees.
Roads
bridges.

(Green team)

income vulnerable

vulnerable pop.

& housing

lack of agency.

Push notification - strengths

green ideas

- cultural comm.
- emergency planning Processes.
- emerg. shelter network

- urban tree canopy.
- forest.

today - Hazards & vulnerability

tom - revisit goal
- action

(Green team)

income vulnerable

Vulnerable pop.
& housing
lack of agency.

Push notification - strengths

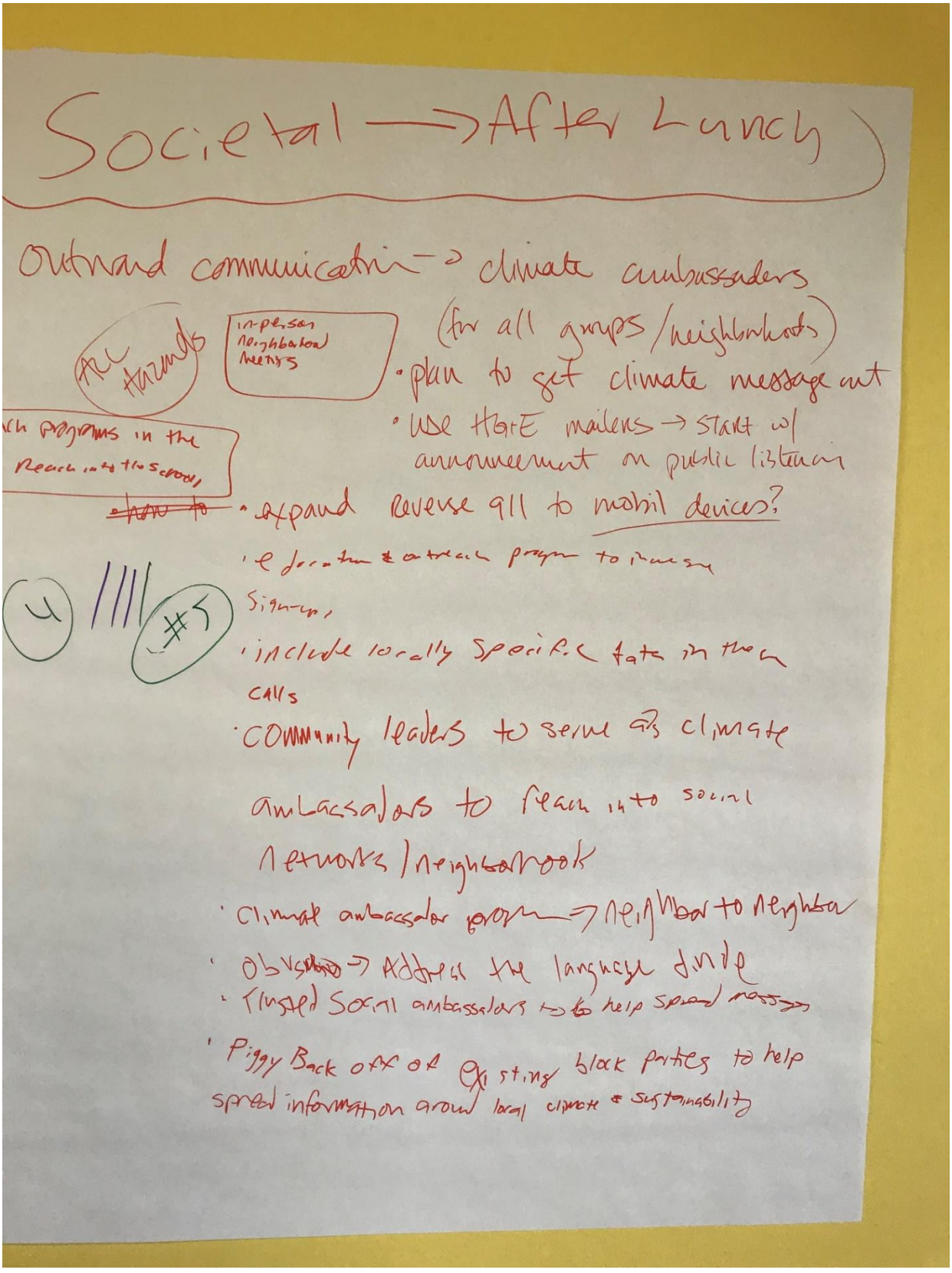
green ideas
- cultural comm.
- emergency planning Processes.
- emerg. shelter network -

- Urban tree Canopy.
- forest.

Today - Hazards & vulnerability

tom - revisit goal
- action

Green Team – Day 2



Emergency Planning Process

L.E.P.C. → EMD/LEPC director as a paid position to integrate climate preparedness into the local planning process; pay so to get all the different threads together *

plan; wrap together climate-related planning w/ disaster management

- Set funding

Shelters | There is not a group of people to run a shelter 24 hours a/g

All need Back-up Power → cooling shelters i.e. (W) senior and family development

get back-up power family development

→ All fire calls → War Memorial → Back-up pow

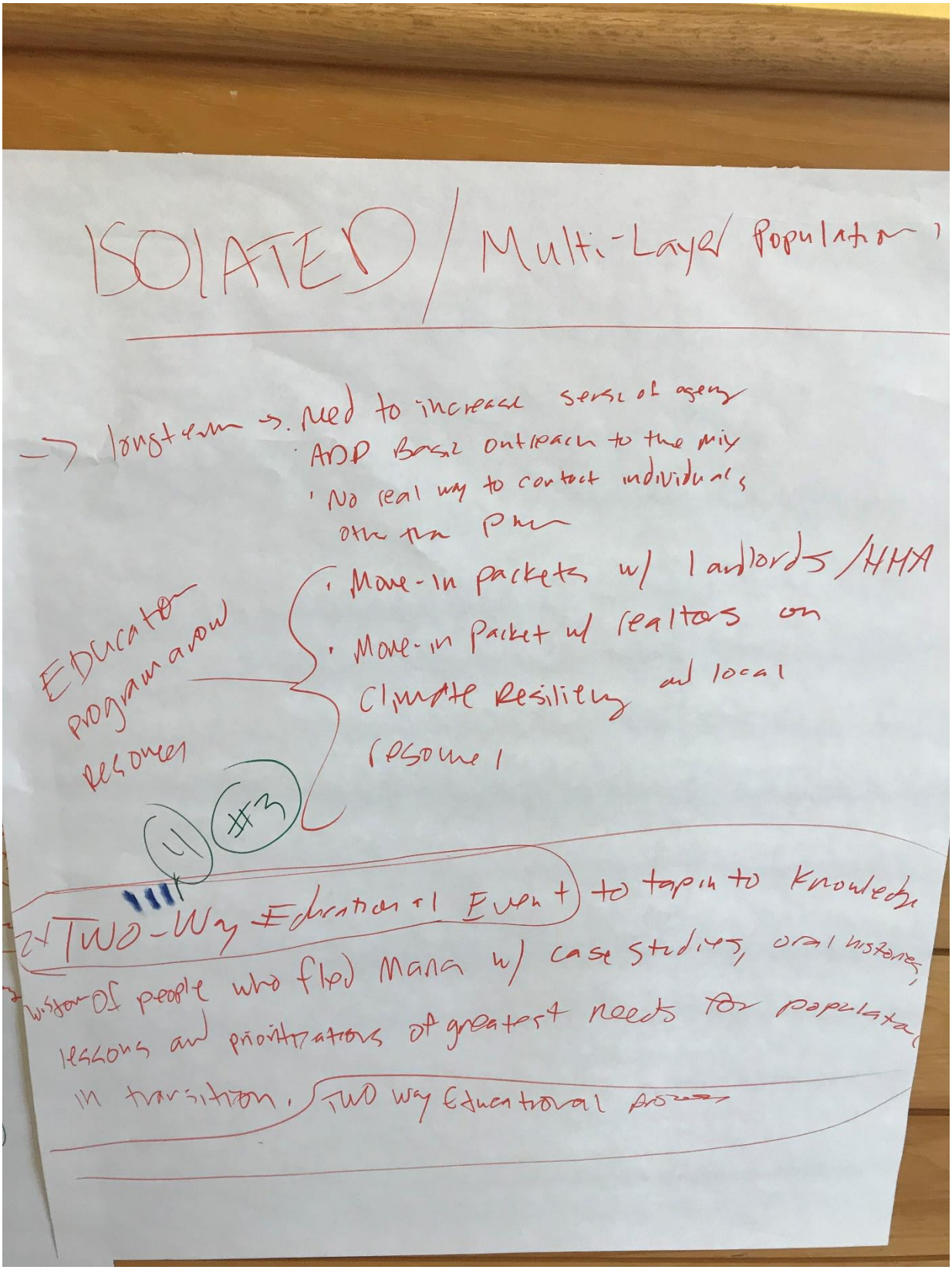
Absolutely necessary

→ Battery/Storage generator (W)

high-priority locations | · Dean tech · War Memorial

→ Battery (W) HHA proposed

Battery (W) the fire station #1 Building


ISOLATED / Multi-Layer Population
→ long term → need to increase sense of agency
ADD Basic outreach to the mix
No real way to contact individuals other than Phone
Move-in packets w/ landlords / HHA
Move-in Packet w/ realtors on Climate Resiliency and local resources
Education programs now
#3
TWO-Way Educational Event to tap in to knowledge
history of people who fled Mana w/ case studies, oral histories, lessons and prioritizations of greatest needs for populations in transition.
TWO way Educational process

Environment

CT River – Heat

River Down
Power Down
Buying Power from Market

Rooftops & canopies (get incentives for Munis)

Increase Renewables &
Battery Storage; increase energy storage (5)

#4

Increase Renewable Energy + Storage (Battery) to Make up for Reduced Power generation from River

ongoing

4

more Hydrowheels in Canals; Long-term

Extreme Cold

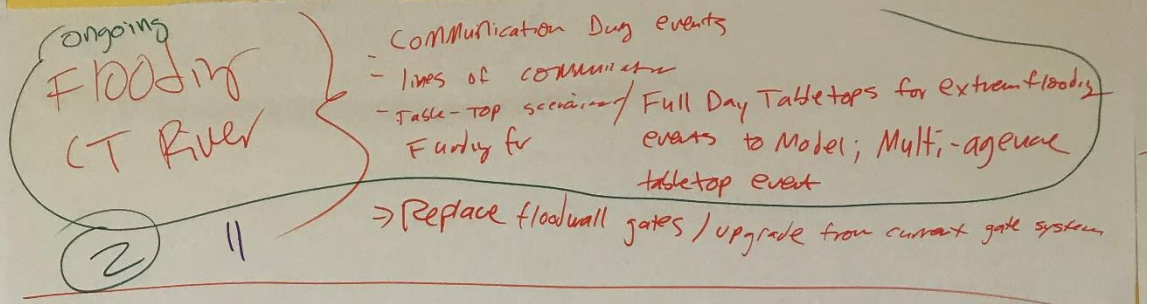
Ice jams
no effect on Dam/canal
But effects on flooding

Flooding

CT River

~~Medium~~ Short
- Worst-case flooding scenario ~~RAO~~ Study to determine risks to people & flood control systems

Study
Understand future floodrisks,
to 0.2% floodplain / zone "X"
in future climate scenarios
- impacts to pump station
- impacts to people
- How to evac
- How to communicate



(5)

@ CT River/coast -> wind = No Action

Open Space

Extreme heat -> Forest fires / Manage forests to support Drought resistant species
. Manage invasive pests to preserve this canopy
. keep the forests b/c they're cool on hot days

Extreme cold -> no worries

Flood -> no worries / just keep it "build on" existing / expand
forested floodplains to preserve that "space"

wind -> let forest Recover after wind events
-> Stay alert for fire risk
-> Fire breaks in forest

URBAN Forestry

Extreme Heat → - Water the trees downtown
- Plant trees that are drought resis
- Develop a watering program
- Plant More trees & water them
- Fund Maintenance activities
- Fund a water Rig that anyone could u of a specialized license

Extreme cold - Mulch non priority >

Flooding - integrate urban trees into green infrastructure
- Educate & train staff in maintaining green infrastructure

Parks / Urban Parks

~~Add~~

Install water parks for extreme heat

$ green infrastructure

Parks / Urban Parks

~~Mosq~~

- Install water parks for extreme heat
- Restore public pools
-> * Make sure there are good, shady trees
-> Ice skating rinks * sledding hills not chocolate

~~Pests~~

- Treat w/ ~~Pesticides~~ pesticides
to eliminate the vector (i.e. EEE)
- Education campaigns around vectors
(i.e. Public outreach)
- behavior changes

OLDER Buildings

① Retrofit Buildings we are going to keep to make them less susceptible to temperature swings
-> green roofs on older buildings
-> "Green walls"

wind -> Demolish Dangerous ones
- figure out which to keep & which to ditch

Evacuation Routes -> Identify culverts & trees that are going to block Routes in either wind or flooding events
-> upgrade those culverts
-> Identify alternate routes
-> Develop signage

Stormwater

① Undersized culverts throughout the city → upgrade & study to prioritize the upgrades to accomodate ↑ flows

② Replay green infrastructure in connect w/ CSO eliminations

- Preventative Maintenance for trees near utilities (HG&E)
In Ashley Reservoir to preserve transmission l
→ Make sure plans blurred HG&E and flow mater
→ communication towers → Back-up power ④ comms towers 100 hr/yr max

OLDER Buildings

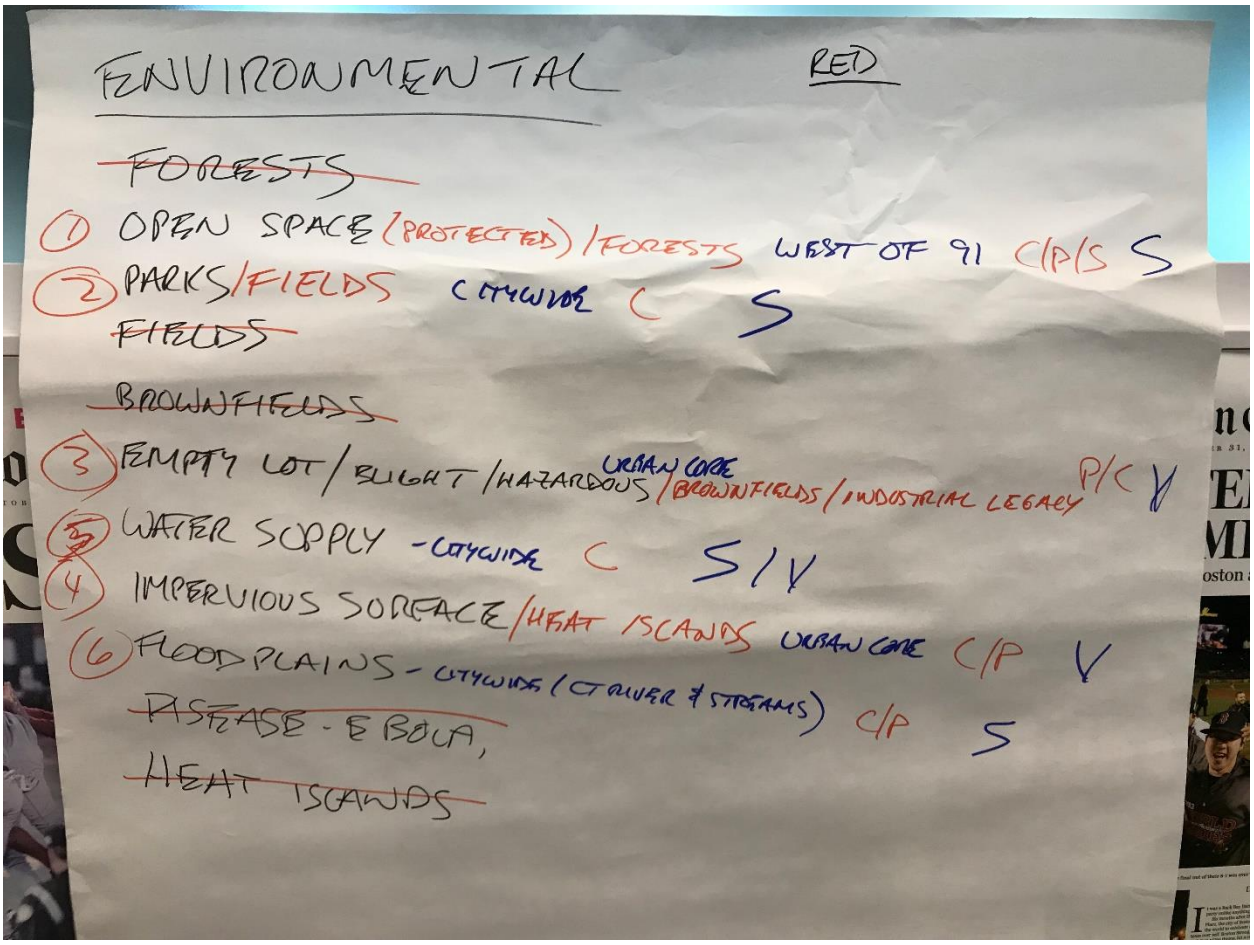
Extreme Heat & cold → · Insulation of older buildings
· Adopt R.A.C.E. Program
· Education strategy around RACE

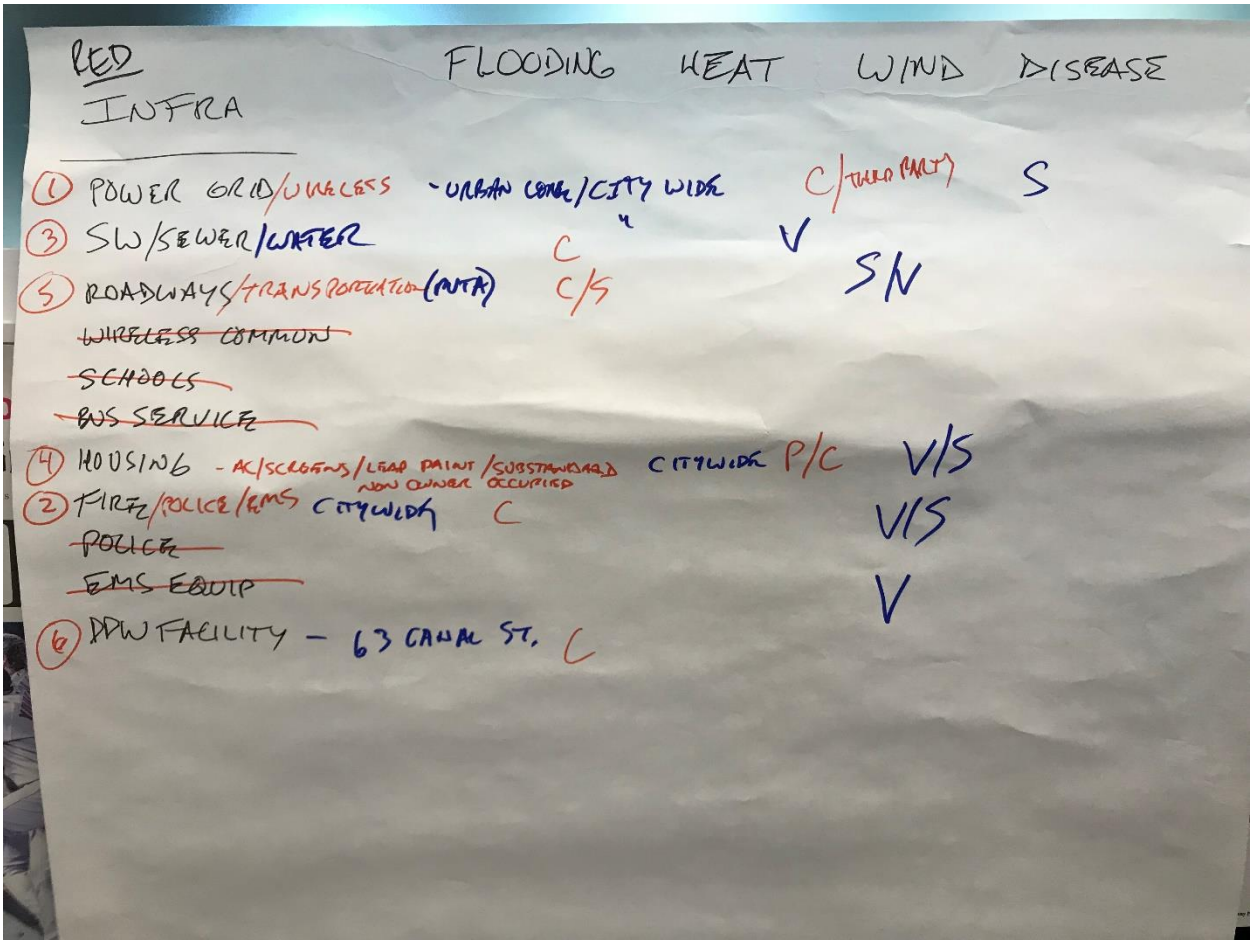
ongoing High

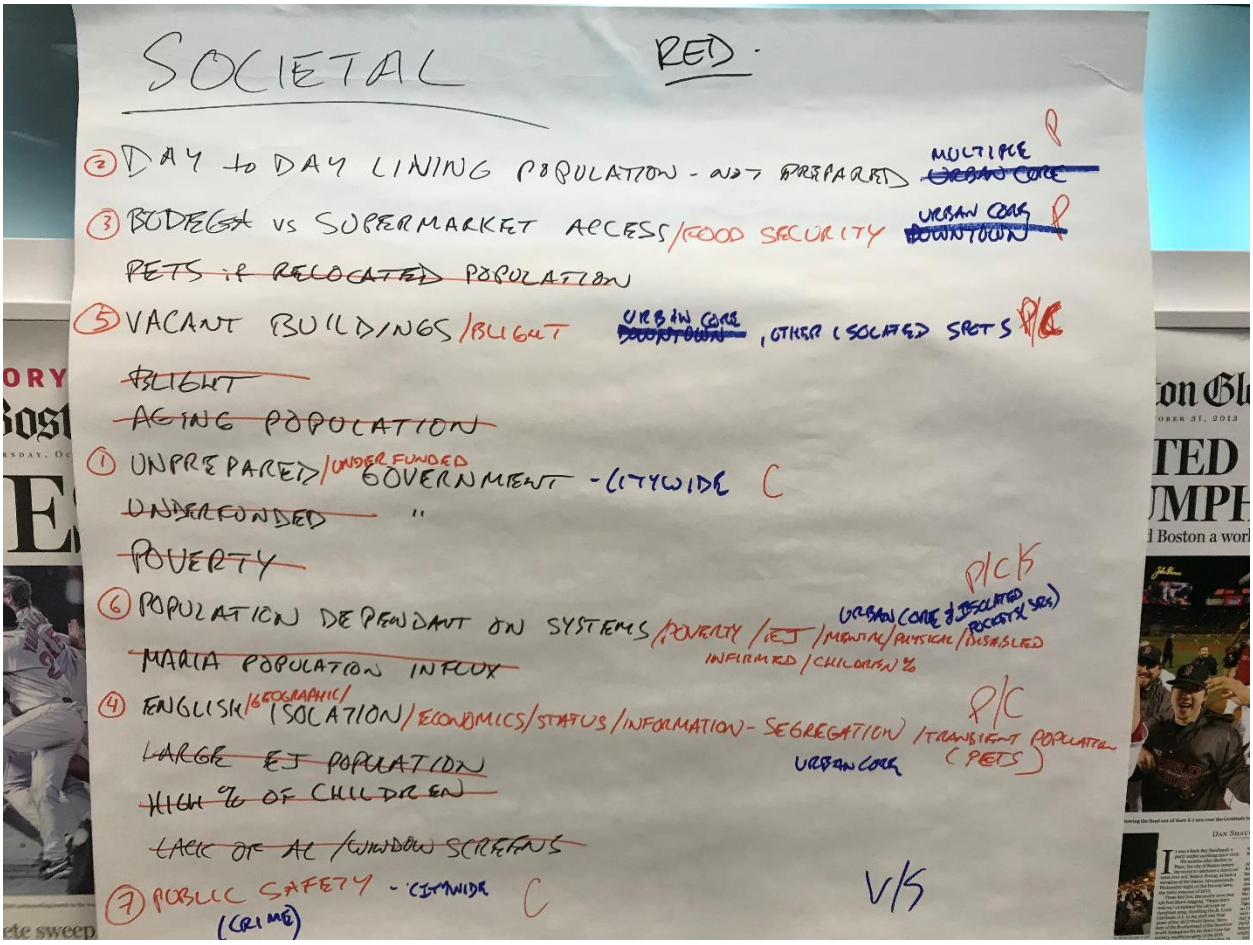
Floodplain → Process
↑ Demolish & Abandon older buildings in high-risk flood areas; convert to parks w/ flood storage &

⑥ #1

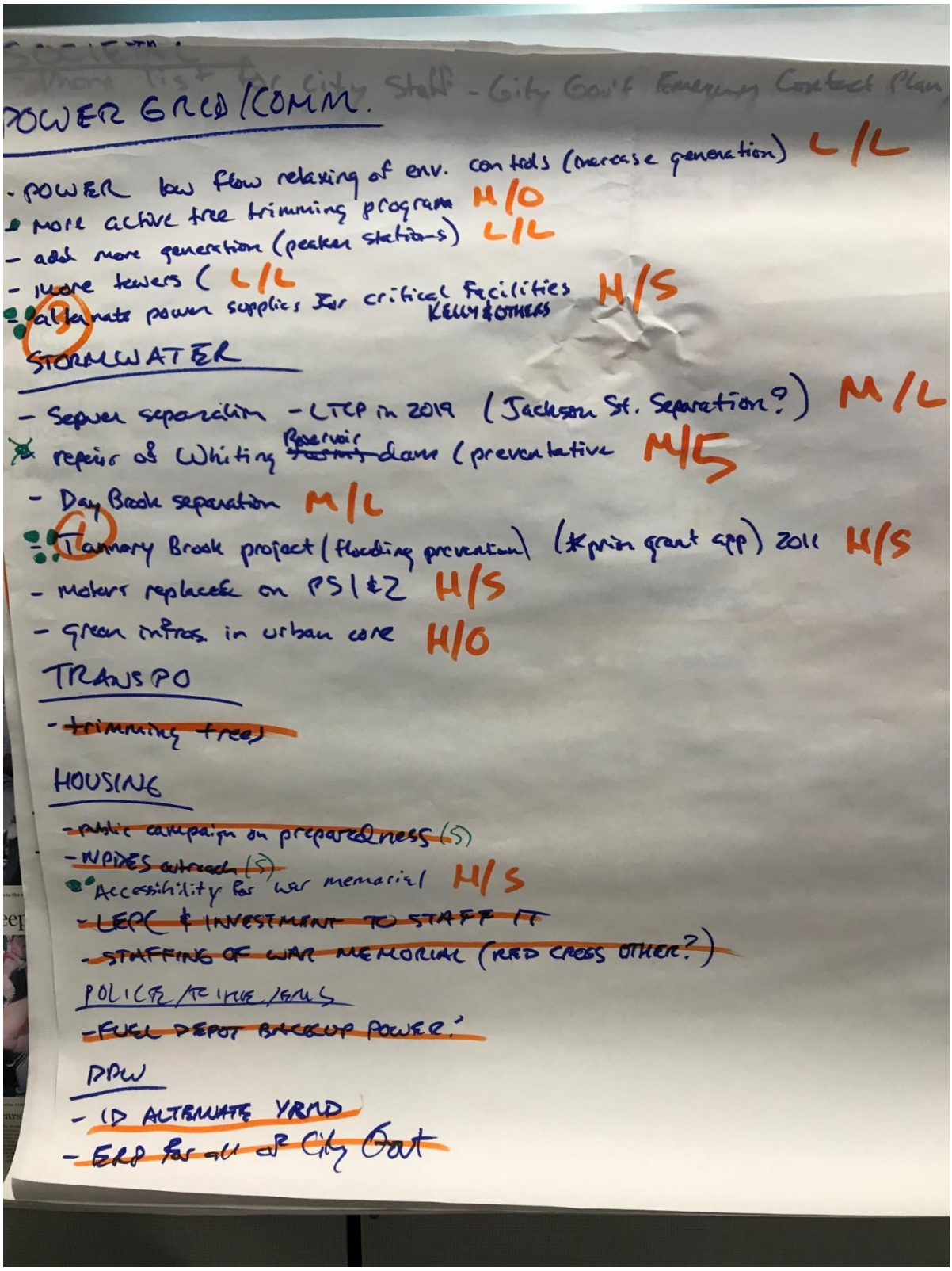
Red Team – Day 1




RED
INFRA
FLOODING
HEAT
WIND
DISEASE
1 POWER GRID/WIRELESS - URBAN CORE/CITY WIDE C/ S
3 SW/SEWER/WATER C V
5 ROADWAYS/TRANSPORTATION (MTA) C/S SN
WIRELESS COMMON
SCHOOLS
BUS SERVICE
4 HOUSING - AC/SCREENS/LEAD PAINT/SUBSTANDARD NON OWNER OCCUPIED CITYWIDE P/C V/S
2 FIRE/POLICE/EMS CITYWIDE C V/S
POLICE
EMS EQUIP V
6 DPW FACILITY - 63 CANAL ST. C


SOCIETAL
RED.
② DAY to DAY LIVING POPULATION - NOT PREPARED
MULTIPLE
③ BODEGA vs SUPERMARKET ACCESS / FOOD SECURITY
URBAN CORE
PETS if RELOCATED POPULATION
⑤ VACANT BUILDINGS / BLIGHT
URBAN CORE, OTHER ISOLATED SPOTS
BLIGHT
AGING POPULATION
① UNPREPARED / UNDER FUNDED GOVERNMENT - CITYWIDE C
UNDERFUNDED "
POVERTY
pick
⑥ POPULATION DEPENDANT ON SYSTEMS / POVERTY / EJ / MENTAL / PHYSICAL / DISABLED
URBAN CORE & ISOLATED POCKETS
INFIRMED / CHILDREN %
MARIA POPULATION INFLUX
④ ENGLISH / GEOGRAPHIC / ISOLATION / ECONOMICS / STATUS / INFORMATION - SEGREGATION / TRANSIENT POPULATION (PETS)
P/C
URBAN CORE
LARGE EJ POPULATION
HIGH % OF CHILDREN
LACK OF AC / WINDOW SCREENS
⑦ PUBLIC SAFETY - CITYWIDE C
(CRIME)
V/S

Read Team – Day 2



SOCIETAL

~~- Phone list for city staff~~ - City Gov't Emergency Contact Plan

- Communication plan
- clear evacuation plan + crisis plans

Day to Day

- reach out to NPOs agencies to ensure they have plans in place H/O
- educate public on availability of resources → Public Ed H/O
- ~~educate on preparedness~~
- ~~Katy backup power | A&E~~
- increase local urban food production L/L
- expand farmers market L/L
- more resources for code enforcement & legal support H/O
  - targeted education on successful tools

CITY WIDE COORD/NATED ERP & FREQ. LEPC MTGS H/O

- evaluate reverse 911 registration (increase registration) H/S
  - STAFFING WAR MEM
  - ALT DPW YARD
- leverage use of Mdsik City Hall L/O
- coordinate local NPO leaders as ambassador to help spread the word
- how can we build upon lessons learned from hurricane Maria
- ~~investigate creating another stressed person list?~~ - IT COULD HAPPEN HERE CAMPAIGN H/S
- leverage facebook page to communicate (part of ecf campaign)

ENV

- plan for forest protection from invasive species
- urban forest => expand use of the
- potential to investigate open space for SW controls
- leverage open brownfields to solar fields
- look for a creative way to balance development & SW control
- stronger education on value of SW controls H / S
- investigate GI inclusion for SW & CSO control H / S

MARIA LESSONS LEARNED
REACH OUT TO AGENCIES & PUBLIC ED

ACCESSIBILITY FOR WAR MEM

TREE TRIMMING

Appendix F: Holyoke MVP Meeting Materials

Holyoke, Massachusetts

Municipal Vulnerability Preparedness Program

Agenda: Community Resilience Building Workshop #1

May 2, 2018

10:00 – 10:10	Registration, Welcome, and Introductions
10:10 – 10:20	Workshop goals and Community Resilience in Holyoke
10:20 – 10:45	Science and resources: Climate change projections in Holyoke
10:45 – 1:00	Small Team Exercise (Led by the table facilitators)

- Team introductions / identify a spokesperson
- Characterize the hazards
- Identify community vulnerability and strengths for infrastructure, society, and environment

11:45 – 12:00	*Collect lunch*
1:00– 1:30	Small Team report out – present findings to the full group
1:30 – 1:45	Summary Discussion / Wrap up
1:45 - 2:00	Introduce Workshop #2 on May 3rd

Customized Solutions for the Community You Want

Holyoke, Massachusetts

Municipal Vulnerability Preparedness Program

Community Resilience Building Workshop #1: May 2, 2018

Small Team Exercise Instructions

1. Team introductions: Name, organization/department
2. Identify the spokesperson (not the facilitator or scribe)
3. Characterize the **TOP 4** the hazards in Holyoke. **20 minutes**
    - Climate change projections
    - GIS maps (flooding, heat)
    - Your experience
4. Identify Community Vulnerabilities and Strengths
    - "Features" in each category of infrastructure, society, and environment. Includes mapping and identifying ownership where possible. **1 hour (20 minutes on each feature)**
    - Identify each "Features" as a Vulnerability or Strength. **20 minutes**

Definitions

- **Hazard:** A physical process or event (hydro-meteorological or oceanographic variables or phenomena) that can harm human health, livelihoods, or natural resources.
- **Risk:** The potential for consequences where something is at stake and where the outcome is uncertain.
- **Exposure**: The presence of people, livelihoods, species or ecosystems, environmental services and resources, infrastructure, or economic, social, or cultural assets in places that could be adversely affected by a hazard.
- **Sensitivity**: The degree to which a system, asset, or species may be affected, either adversely or beneficially, when exposed to climate variability or change or geophysical hazards.
- **Vulnerability or Strength:** The potential effects of hazards on human or natural assets and systems. These potential effects, which are determined by both exposure and sensitivity, may be beneficial or harmful.

A *hazard* is like the sun. The *risk* is sunburn. The *vulnerability* includes the length of *exposure* to the sun, how *sensitive* the skin is to it.

CDM Smith

KLA KIM LUNDGREN ASSOCIATES, INC.
Customized Solutions for the Community You Want

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.com

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.)

Step 1. 20 minutes

Features	Location	Ownership	V or S					Priority H-M-L	Time Short Long Ongoing
Infrastructural									
Step 2. 20 minutes on each section (1 hour total)				Step 3. 30 minutes					
Societal									
Environmental									

Holyoke Municipal Vulnerability Preparedness

Workshop #1

May 2, 2018

City of Holyoke
Climate & Sustainability Program

City of Holyoke
Climate & Sustainability
Program

Welcome and Introductions

Agenda

- 10:00 – 10:10 Welcome and Introductions
- 10:10 – 10:20 Workshop goals and Community Resilience in Holyoke
- 10:20 – 10:45 Science and resources: Climate change projections in Holyoke
- 10:45 – 1:00 Small Team Exercise (Led by the table facilitators)
  - *Team introductions / identify a spokesperson*
  - *Characterize the hazards*
  - *Identify community vulnerability and strengths for infrastructure, society, and environment*

11:45 – 12:00 *Collect lunch*

- 1:00– 1:30 Small Team report out
- 1:30 – 1:45 Summary Discussion / Wrap up
- 1:45 – 2:00 Introduce Workshop #2 on May 3 (tomorrow)

City of Holyoke
Climate & Sustainability
Program

Workshop Goals and Community Resilience in Holyoke

GOAL of the MVP Workshops:

"The Workshops are a new initiative to immediately identify actions and community-derived priorities that will build resilience in the community."

<u>This will allow Holyoke to:</u>

1. Become a "Massachusetts Municipal Vulnerability Preparedness (MVP)" rated City
2. Incorporate findings into processes and projects
3. Eligible for funding

At these Workshops we will:

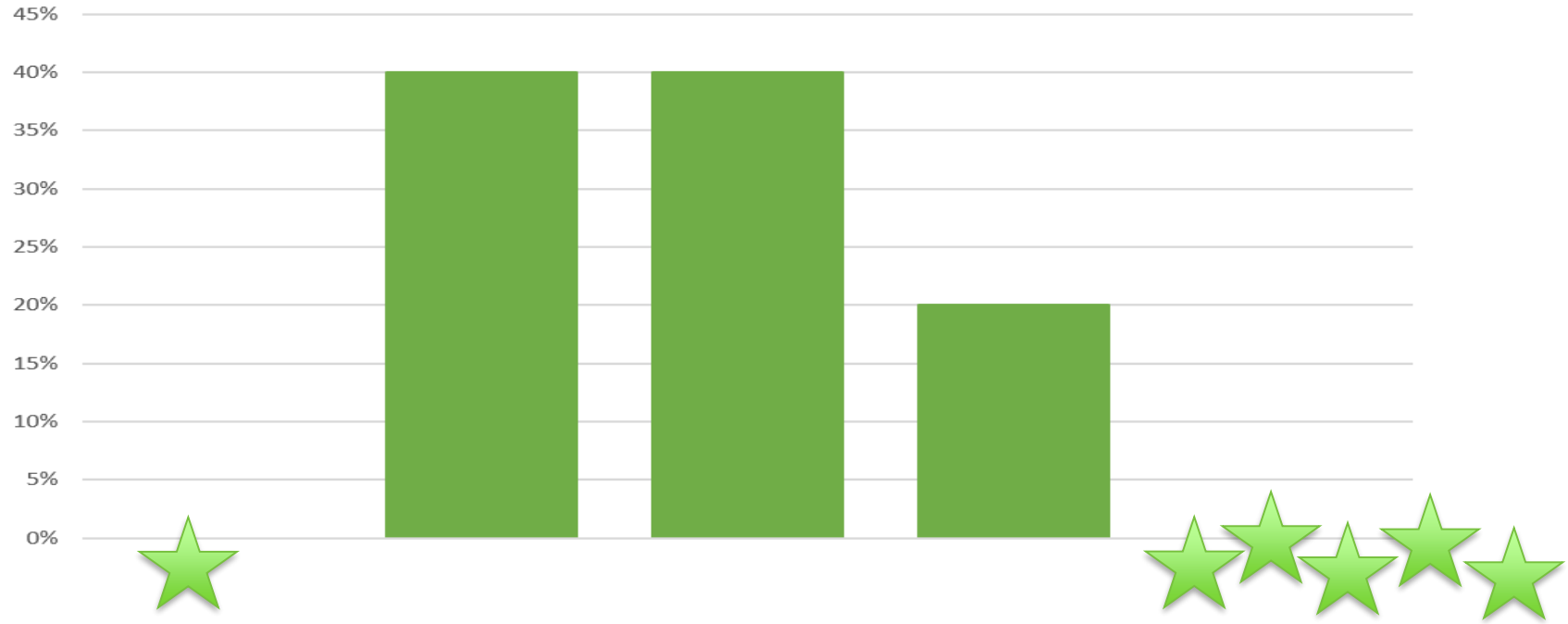
Workshop #1 (today):

- Understand connections between ongoing community issues, **hazards**, and local planning and actions in Holyoke.
- Identify and map **vulnerabilities and strengths** to develop infrastructure, societal, and environmental **risk** profiles for Holyoke.

Workshop #2 (tomorrow):

- Develop and prioritize actions and clearly delineated next steps.
- Identify opportunities to advance **actions** that further reduce the impact of hazards and increase resilience across and within Holyoke.

Survey Result: How prepared is your department / organization to address climate change vulnerabilities?



NOT PREPARED:

We expect operations would be significantly impacted by climate change hazards

PREPARED:

We have plans, tools, and resources in place to be resilient to climate change hazards

Definitions

- **Hazard:** A physical process or event (hydro-meteorological or oceanographic variables or phenomena) that can harm human health, livelihoods, or natural resources.
- **Risk:** The potential for consequences where something is at stake and where the outcome is uncertain.
- **Exposure**: The presence of people, livelihoods, species or ecosystems, environmental services and resources, infrastructure, or economic, social, or cultural assets in places that could be adversely affected by a hazard.
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Source: World Bank: https://climatescreeningtools.worldbank.org/content/key-terms-0

City of Holyoke
Climate & Sustainability
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Climate Change Projections in Holyoke

Background on Climate Data

- Summarized by the MA Executive Office of Energy and Environmental Affairs
- Based on the latest Global Climate Models (GCM) from the International Panel on Climate Change (IPCC)
  - Medium and high greenhouse gas emission scenarios
  - Bracket the "most likely" scenarios
- "Downscaled" to major watershed basin (majority of Holyoke is in the Connecticut Basin watershed)
  - Temperature (e.g. average/maximum/minimum temperatures annual/seasonal days over 90, 95, 100^{o}F)
  - Precipitation (e.g. total annual, seasonal, days over 1, 2, 4 inches)
  - Temperature projections are more certain than precipitation

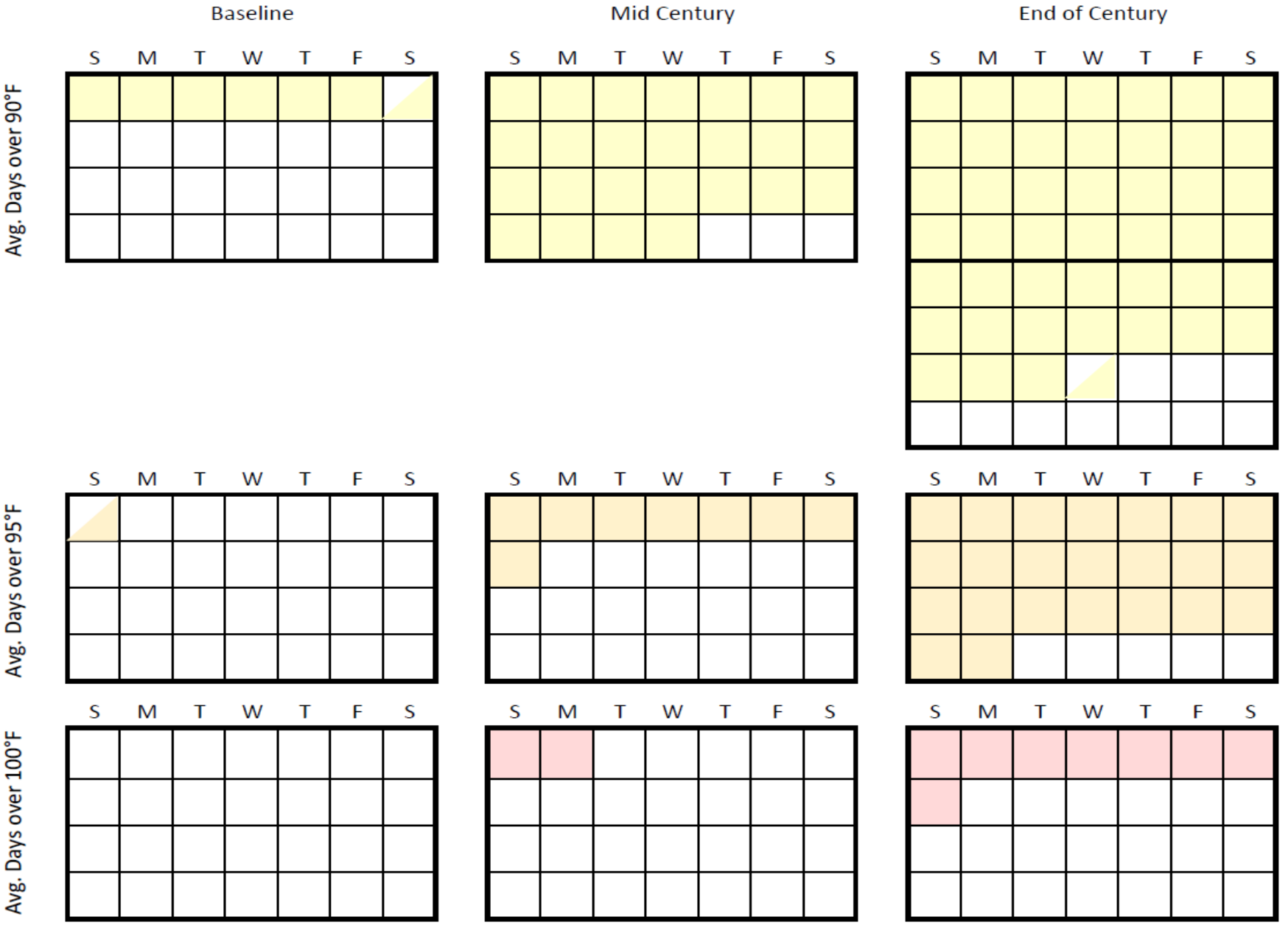
Regardless of geographic scale, rising temperatures, changing precipitation, and extreme weather will continue to affect the people and resources of the Commonwealth throughout the 21st century.

Temperature Impacts in Holyoke

- Average, maximum, and minimum temperatures are expected to increase
- Seasonally, maximum summer and fall temperatures are expected to see the highest projected increase
- Seasonally, minimum winter and fall temperatures are expected to increase throughout the 21st century.

Connecticut Basin		Observed Baseline 1971-2000 (°F)	Mid-Century 2050 (°F)			End of Century 2090's (°F)		
Average	Annual	46.98	49.98	to	53.41	51.02	to	57.92
Maximum Temperature	Summer	80.18	82.93	to	87.63	83.94	to	93.59
	Fall	60.8	64.45	to	67.96	65.01	to	73.00
Minimum Temperature	Annual	35.51	38.86	to	42.15	39.88	to	46.40
	Winter	14.8	18.36	to	23.56	19.74	to	26.63
	Fall	37.68	41.26	to	44.32	41.89	to	49.05

Representation of Hot Days



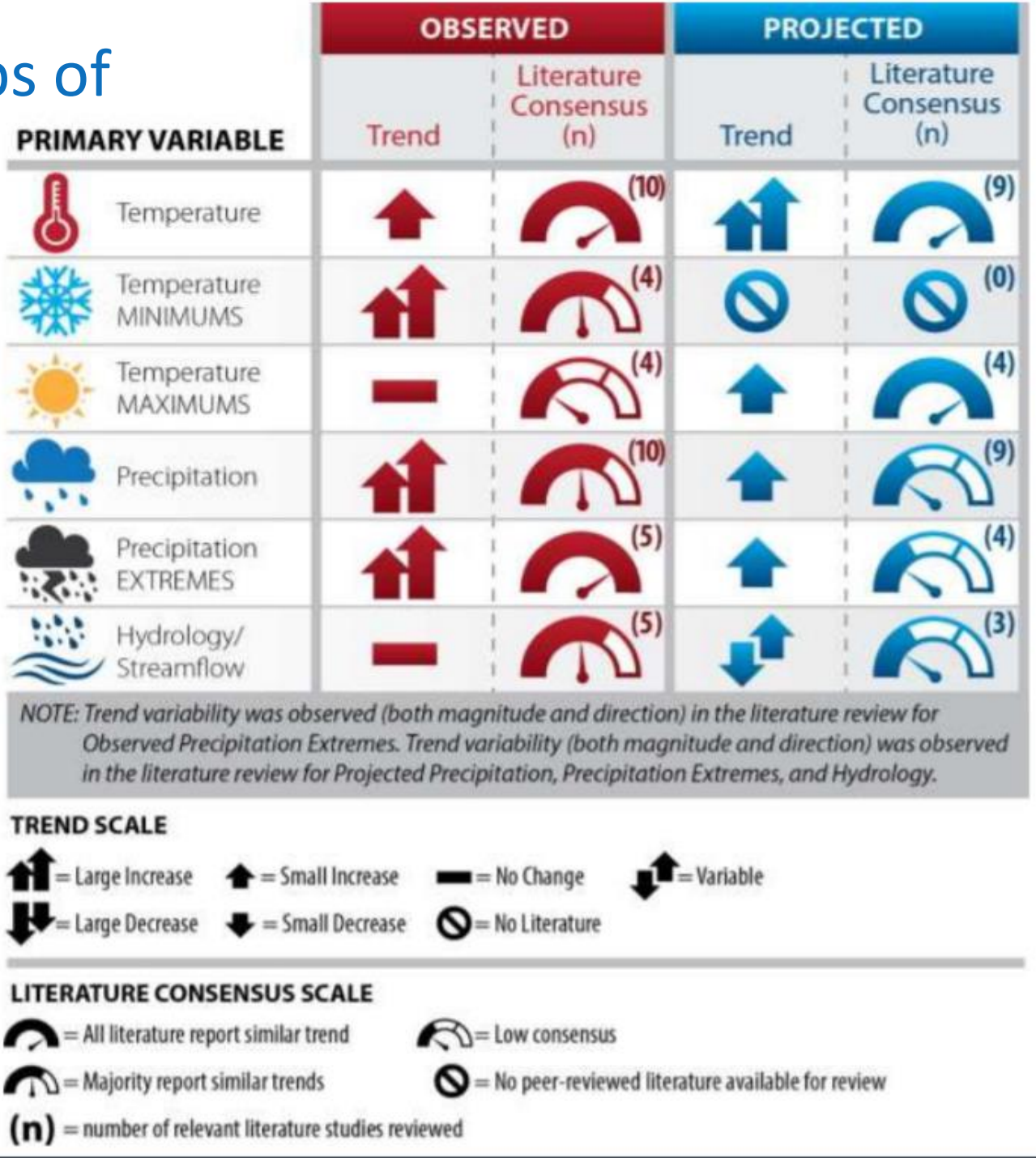
Precipitation Impacts in Holyoke

- Number of days receiving precipitation over one inch are variable, fluctuating between loss and gain of days.
- Seasonal projections for total precipitation are also variable for the Connecticut Basin.
  - The winter season is expected to experience the greatest change with an increase of < 1 - 25% by mid-century, and 7 - 37% by end of century.
- Annual and seasonal projections for consecutive dry days, or for a given period, are variable throughout the 21st century.

Take away: Precipitation will be more variable. "Extreme" precipitation events are likely to occur more often.

U.S. Army Corps of Engineers

- Temperatures are rising
- Precipitation is increasing, especially extreme precipitation
- Hydrology and streamflow

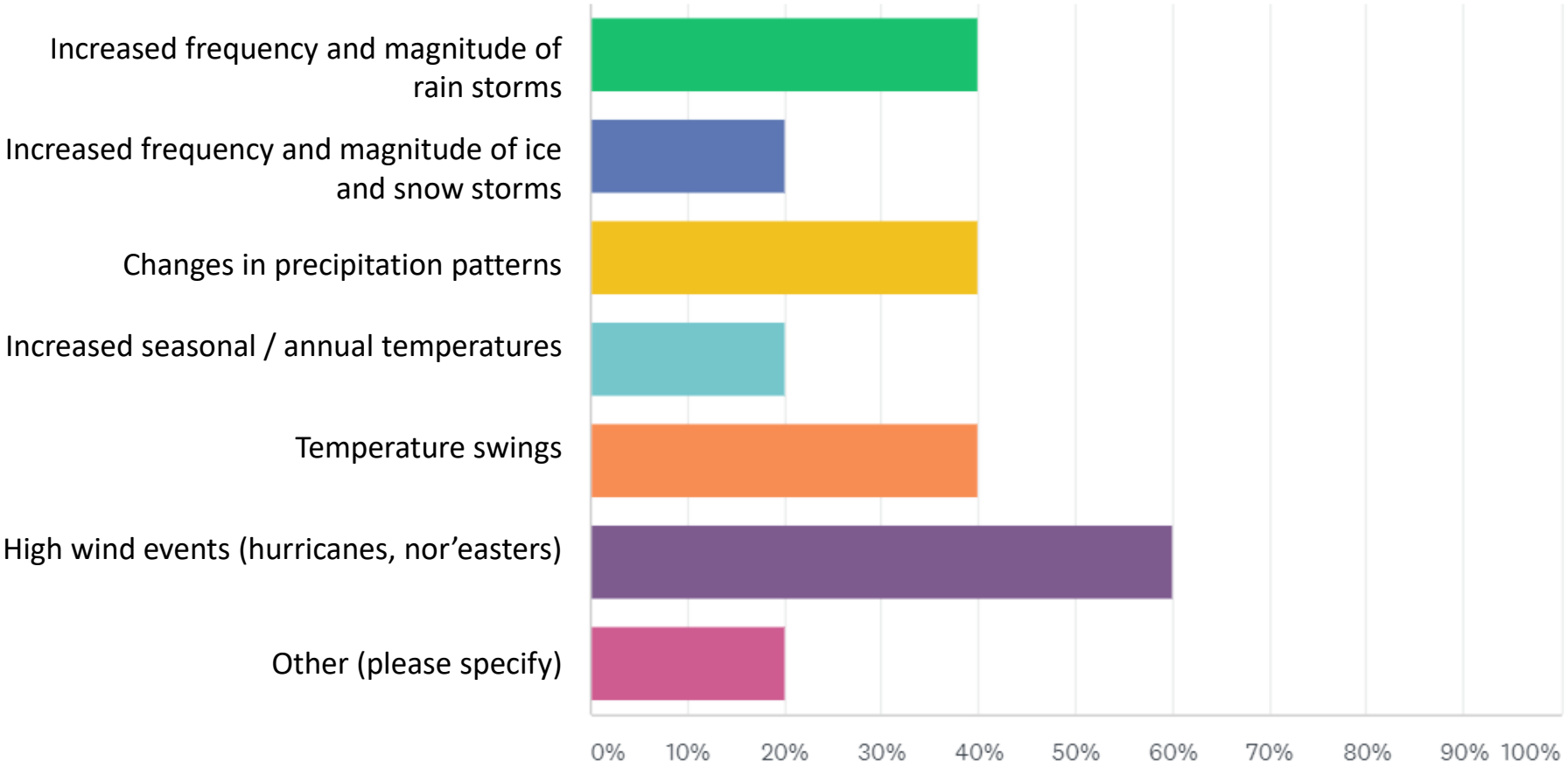


Source: USACE IWR: http://www.corpsclimate.us/docs/rccvarreports/USACE_REGION_01_Climate_Change_Report_CWTS-2015-20_Lo.pdf

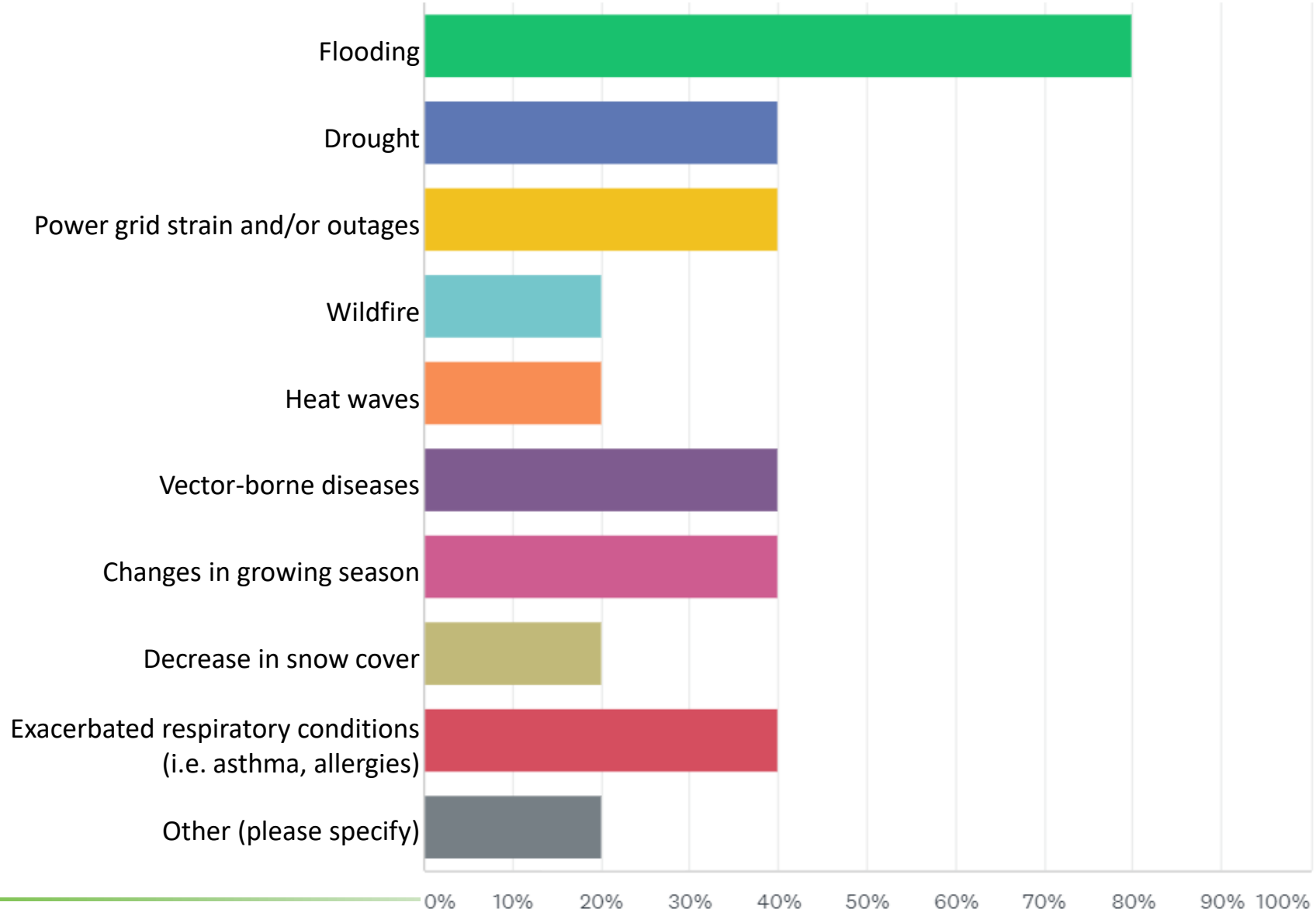
Characterize Hazards

- What hazards have impacted Holyoke in the past? Where, how often, and in what ways?
- What hazards are impacting your community currently?
- What effects will these hazards/changes have on Holyoke in the future (5, 10, 25, years?)
- What is exposed to hazards and climate threats within your community?
- Other concerns or considerations?

Which observed climate change impacts have already impacted your department/organization?



What climate-related hazards is your department / organization most concerned about experiencing?



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Small Team Exercise Instructions

Small Team Exercise Instructions

1. Team introductions: Name, organization/department
2. Identify the spokesperson (not the facilitator or scribe)
3. Characterize the **TOP 4** the hazards in Holyoke. **20 minutes**
   - Climate change projections
   - GIS maps
   - Your experience
4. Identify Community Vulnerabilities and Strengths
   - "Features" in each category of infrastructure, society, and environment. Includes mapping and identifying ownership where possible. **1 hour (20 minutes on each feature)**
   - Identify each "Features" as a Vulnerability or Strength. **20 minutes**

Community Resilience Building Risk Matrix www.CommunityResilienceBuilding.com

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.)

Step 1. 20 minutes

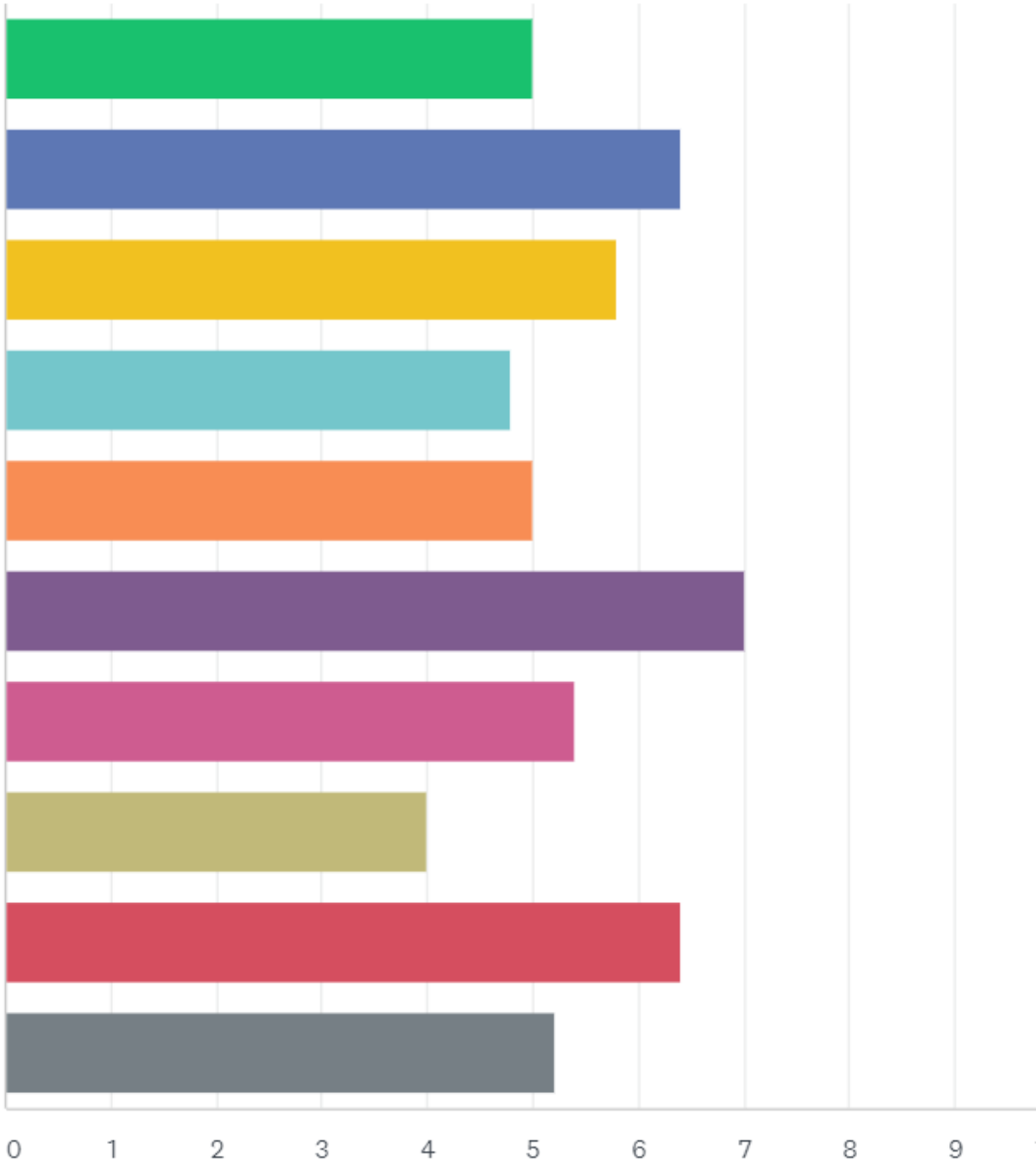
Features	Location	Ownership	V or S					Priority H-M-L	Time Short Long Ongoing
Infrastructural									
Societal									
Environmental									

Step 2. 20 minutes on each section (1 hour total)

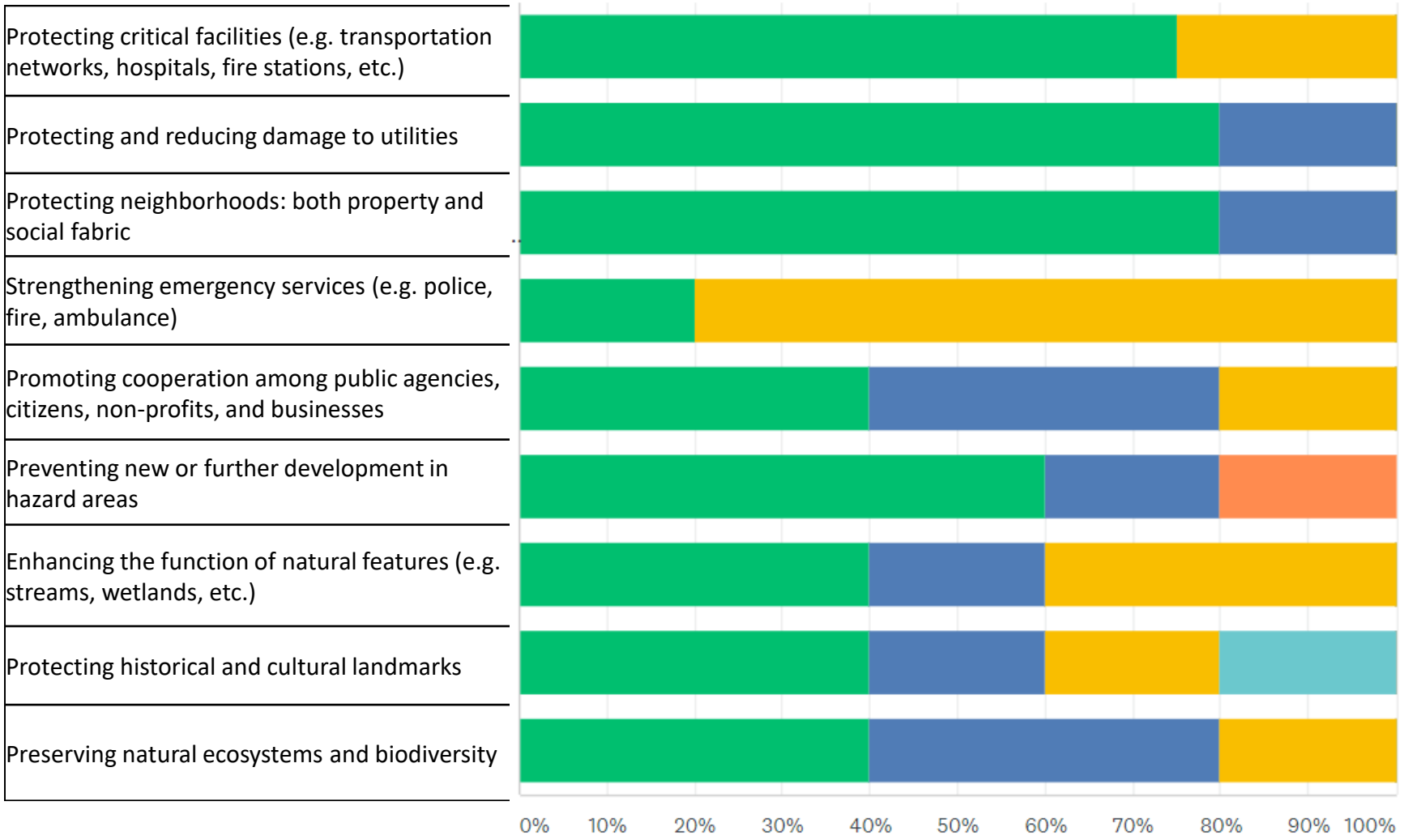
Step 3. 30 minutes

Which of the following is Holyoke most vulnerable to as the result of climate change?

Compromises to transportation infrastructure (roads, rail, bridges, trails, etc.)	5
Availability of utilities (water, wastewater, energy, communications, etc.)	6.4
Access to critical facilities (schools, libraries, emergency shelters, medical facilities, etc.)	5.8
Human injury, illness, or loss of life	4.8
Business interruptions (closures, economic losses, etc.)	5
Ability to maintain order and/or provide public amenities	7
Damage, contamination, or loss of ecosystems and natural resources (forests, wetlands, waterways, etc.)	5.4
Damage or loss of cultural resources (i.e. museums, historic properties, etc.)	4
Government closures and interruptions	6.4
School closures and interruptions	5.2



Collective priorities: rank the importance of each statement to your department / organization



Community Resilience Building Workshop Risk Matrix

H-M-L priority for action over the **S**hort or **L**ong term (and **O**ngoing)
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
Infrastructural									
Town Campus	Specific	Town	V						
Evacuation Routes - Roads	Town-wide	Town/State	V						
Electrical Distribution System	Multiple	CL&P/Town	V						
Dams (inland and coastal)	Multiple	Private	V						
Railway and State Bridges	Multiple	Amtrak/State	V						
Societal									
Elderly Citizens (facilities)	Multiple	Private	V						
Neighborhood Cooperation	Town-wide	Private	V						
Faith-based Organizations	Multiple	Private	V						
Homeless Population	Town-wide	Town	V						
Vulnerable Neighborhoods	South side	Town/Private	V						
Coordinated Evacuation Plan	Town-wide	Town/State	V						
Sheltering Facility (upgrades)	Town/Region	Town/State	V						
Shelter Management Plan	Town-wide	Town	S						
Lower Household Expenses (flood insurance)	Town-wide	Town	S						
Environmental									
Beaches & Dunes	Multiple	State-Town-Private	V/S						
Forest (uniform age structure)	Town-wide	Town/State	V						
Salt Marsh	Multiple	State/Private	V/S						
Open Space Acquisition (for flood impact reduction)	Town-wide	Town-State-Private	V						
State Parks	Specific	State	V						
Rippowam River	Specific	State/Town	V						
Drinking Water Reservoir	Multiple	State-Private	V						
Protected Open Space	Multiple	State-Town-Private	S						

City of Holyoke
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Small Team Report Out

City of Holyoke
Climate & Sustainability
Program

Introduction to Workshop #2

Workshop #2 Agenda

Tomorrow – May 3, 2018

- Workshop goals and desired outcomes
- Review Findings from Workshop #1
- Small Team Exercise (Led by the table facilitators)
  - Identify actions to address community vulnerabilities and reinforce strengths for infrastructure, society, and environment
  - Prioritize actions
  - Report out to the full group
- Finalize top priorities
- Wrap up and Next Steps

Holyoke, Massachusetts

Municipal Vulnerability Preparedness Program

Agenda: Community Resilience Building Workshop #2

May 3, 2018

10:00 – 10:05 Registration, Welcome, and Introductions

10:05 – 10:15 Workshop goals and desired outcomes

10:15 – 10:30 Review Findings from Workshop #1

10:30 – 1:00 Small Team Exercise (Led by the table facilitators)

- Team introductions / identify a spokesperson
- Revisit Small Team hazards, vulnerability, and strengths from Workshop #1
- Identify actions to address community vulnerabilities and reinforce strengths for infrastructure, society, and environment
- Prioritize actions

11:45 – 12:00 Collect lunch

1:00– 1:30 Small Team report out – present findings to the full group

1:30 – 1:50 Finalize top priorities

1:50 –2:00 Wrap up and Next Steps

Customized Solutions for the Community You Want

Holyoke, Massachusetts

Municipal Vulnerability Preparedness Program

Community Resilience Building Workshop #2: May 3, 2018

Small Team Exercise Instructions

1. Identify the spokesperson (not the facilitator or scribe)
2. Revisit team findings from Workshop #1 **15 minutes**
    - TOP 4 the hazards in Holyoke
    - Community Vulnerabilities and Strengths" for infrastructure, society, and environment
3. Identify actions to address community vulnerabilities and reinforce strengths for in each category of infrastructure, society, and environment. **1 hour (20 minutes on each category)**
4. Prioritize actions for each feature; Includes mapping and identifying timeframe (Short, Long, Ongoing). **30 minutes (10 minutes on each category)**
5. Identify the top 3-4 priority actions for the Report Out **15 minutes**

New defintions:

- **Actions** reduce vulnerability or reinforce strengths.
- **Prioritized actions** take into account the importance of addressing the vulnerability / reinforcing the strength to the community

A *hazard* is like the sun. The *risk* is sunburn. The *vulnerability* includes the length of *exposure* to the sun, how *sensitive* the skin is to it.

The *actions* to address vulnerability of a sunburn include staying in the shade or wearing sunblock.

Prioritizing Considerations

- Funding availability and terms
- Agreement on outstanding impacts from recent hazard events
- Necessity for advancing longer-term outcomes
- Contribution towards meeting existing local/regional planning objectives

Timeframe/Urgency Examples

- Current projects to reduce flooding = **ongoing (O)**
- Update the Hazard Mitigation Plan = **short term (S)**
- Reducing housing stock in high-risk areas = **long term (L)**

CDM Smith

KLA KIM LUNDGREN ASSOCIATES, INC.
Customized Solutions for the Community You Want

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.com

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.)

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

Step 1 (Review). 15 minutes

Step 2. 20 minutes on each section (1 hour total)

Step 3. 45 minutes

Holyoke Municipal Vulnerability Preparedness

Workshop #2

May 3, 2018

City of Holyoke
Climate & Sustainability Program

KLA

CDM Smith

City of Holyoke
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Welcome and Introductions

Agenda

- 10:00 – 10:05 Welcome and Introductions
- 10:05 – 10:15 Workshop goals and desired outcomes
- 10:15 – 10:30 Review Findings from Workshop #1
- 10:30 – 1:00 Small Team Exercise (Led by the table facilitators)
  - *Team introductions / identify a spokesperson*
  - *Revisit team findings from Workshop #1*
  - *Identify actions to address community vulnerabilities and reinforce strengths*
  - *Prioritize actions and identify timeframes*

11:45 – 12:00 Collect lunch

- 1:00 – 1:30 Small Team report out
- 1:30 – 1:50 Finalize top priorities
- 1:50 - 2:00 Wrap up / Next Steps

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Workshop Goals and Desired Outcomes

GOAL of the MVP Workshops:

"The Workshops are a new initiative to immediately identify actions and community-derived priorities that will build resilience in the community."

<u>This will allow Holyoke to:</u>

1. Become a "Massachusetts Municipal Vulnerability Preparedness (MVP)" rated City
2. Incorporate findings into processes and projects
3. Eligible for funding

MVP Action Grant Funding: (RFR) ENV 18 POL 03

- Funding is to advance priority climate adaptation actions identified by "MVP Communities"
- **Eligible projects:** Climate change adaptation actions - advanced vulnerability assessments, education and outreach, changes to local policies, plans or management strategies, redesigns and retrofits, nature-based solutions designed to increase resiliency within the community, or ecological restoration and habitat management.
- **$10K - $400K** per project to advance MVP Actions
- Match requirement: **25% match** - cash or in-kind contributions or a combination of the two

- **Application requirements:**
  - Problem and Climate Change Adaptation
  - Need for Assistance
  - Project Description
  - Transferability
  - Incorporation of Nature-based Solutions and Strategies
  - Timeline
  - Budget
  - Project Management and Partners
  - Attach MVP (draft) report
  - Statement of Match
- **Due: Fri 5/18** (more funding rounds coming!)
- Duration: Through June 30, 2019 (break the projects up)
- May submit more than 1 project

At Today's Workshop, we will:

- **Develop and prioritize actions** and clearly delineated next steps.
- **Identify opportunities to advance actions** that further reduce the impact of hazards and increase resilience across and within Holyoke.
- **Finalize top priorities**

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Review Findings from Workshop #1

Definitions

- **Hazard:** A physical process or event (hydro-meteorological or oceanographic variables or phenomena) that can harm human health, livelihoods, or natural resources.
- **Risk:** The potential for consequences where something is at stake and where the outcome is uncertain.
- **Exposure**: The presence of people, livelihoods, species or ecosystems, environmental services and resources, infrastructure, or economic, social, or cultural assets in places that could be adversely affected by a hazard.
- **Sensitivity**: The degree to which a system, asset, or species may be affected, either adversely or beneficially, when exposed to climate variability or change or geophysical hazards.
- **Vulnerability or Strength:** The potential effects of hazards on human or natural assets and systems. These potential effects, which are determined by both exposure and sensitivity, may be beneficial or harmful.

Source: World Bank: https://climatescreeningtools.worldbank.org/content/key-terms-0

- **Actions** reduce vulnerability or reinforce strengths.
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Review of Climate Data

- Summarized by the MA Executive Office of Energy and Environmental Affairs
- Regardless of geographic scale, rising temperatures, changing precipitation, and extreme weather will continue to affect the people and resources of the Commonwealth throughout the 21st century.

TEMPERATURE KEY TAKE-AWAY

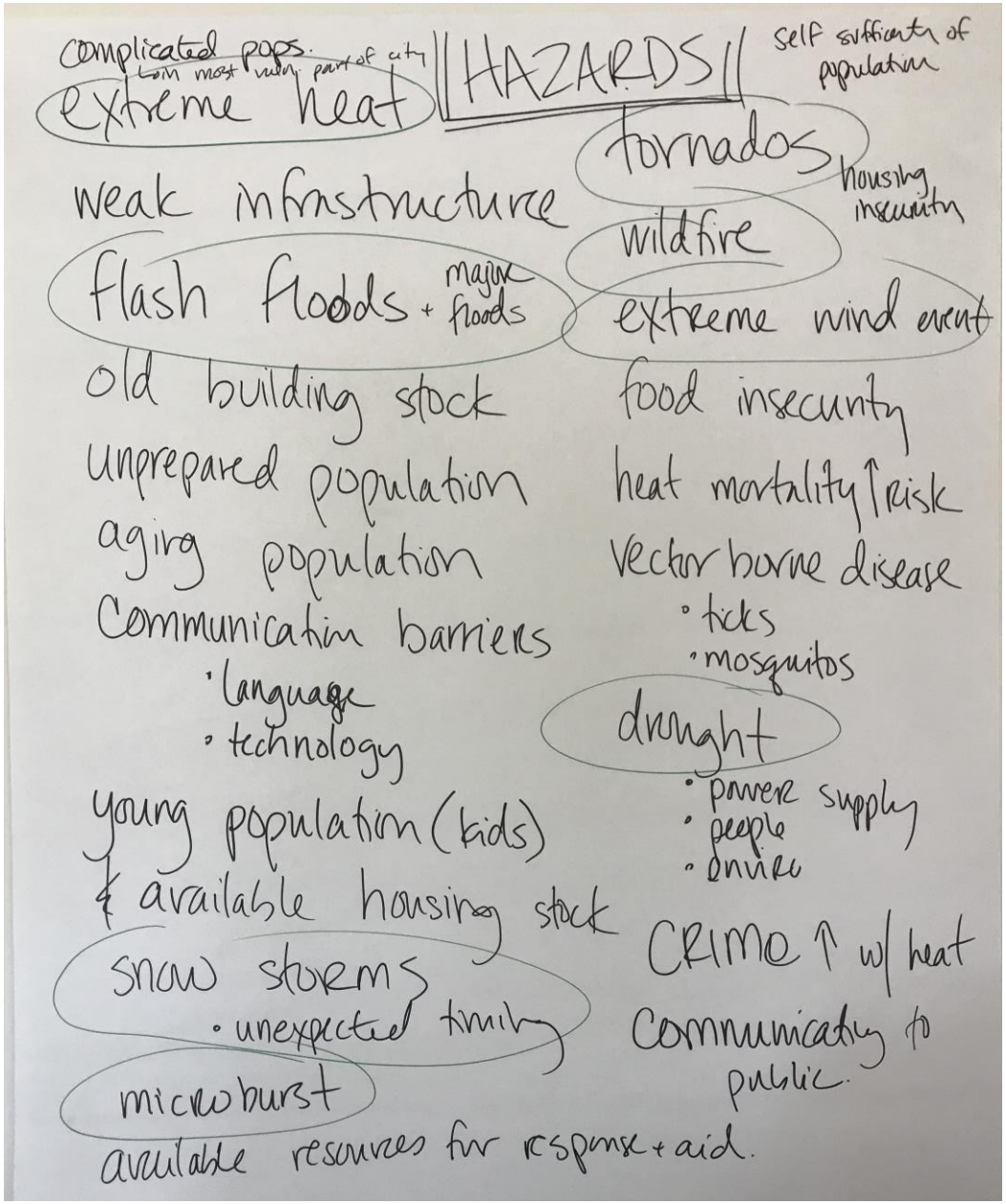
- Average, maximum, and minimum temperatures are expected to increase
- Seasonally, maximum summer and fall temperatures are expected to see the highest projected increase

PRECIPITATION KEY TAKE-AWAY

- Precipitation will be more variable. "Extreme" precipitation events are likely to occur more often.

Hazards in Holyoke

- Extreme precipitation / flooding (all)
- Heat (all)
- Wind (all)
- Drought
- Extreme cold
- Disease



Vulnerabilities and Strengths in Holyoke

Infrastructure	V or S
Power grid/wireless/transmission lines	V/S
Stormwater/sewer/water/CSOs/undersized culverts	V
Roadways/transportation/limited integrated transportation system	V/S
Housing	V/S
Fire/Police/EMS	V/S
DPW	V
Age of infrastructure	V
Ability to remove downed trees	V
HMP	S
Facilities with back-up generators	V
Dams (canal, levees, floodwalls)	V/S
Communication (Mt. Tom infrastructure, towers, etc.)	V/S
Age of buildings	V
Evacuation Routs	V

Society	V or S
Outward communications	V/S
Emergency planning process	S
Emergency shelter network / management plan	V/S
Multi-layered vulnerable populations	V/S
Diverse population	S
Self- affiliating social networks	S
Food deserts/food scarcity	V
Communications (language, technology)	V/S
Vulnerable neighborhoods	V
Medically vulnerable	V
Aging population	V/S
Low income population	V/S
Day to day population not prepared	V
Vacant buildings	V
Underfunded government	V
Dependant population (systems)	V
Isolated population	V
Public safety	V

Vulnerabilities and Strengths in Holyoke

Environment	V or S
Connecticut River: watershed, river, canals	V/S
Reservoirs	S
Urban tree canopy	V/S
Forests	V/S
Parks and recreational areas (including downtown)	S
Conservation land and open space (pervious surfaces)	S
Air quality	V
Pests / disease	V

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Small Team Exercise Instructions

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Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.com

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.)

Features	Location	Ownership	V or S	Top Priority Hazards				Priority H-M-L	Time Short Long Ongoing
Infrastructural									
Societal									
Environmental									

Step 1 (Review). 15 minutes

Step 2. 20 minutes on each section (1 hour total)

Step 3. 45 minutes

Prioritizing and Timeframes

Prioritizing Considerations

- Funding availability and terms
- Agreement on outstanding impacts from recent hazard events
- Necessity for advancing longer-term outcomes
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Timeframe/Urgency Examples

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Community Resilience Building Risk Matrix

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

Features	Location	Ownership	V or S	Top Priority Hazards: Flooding	Top Priority Hazards: ALL (Flooding/Extreme temps/wind)	Top Priority Hazards: Heat	Priority H - M - L	Time Short Long Ongoing
Infrastructural								
Stormwater/sewer/ water	Citywide	City/ State	V	-Install "green infrastructure" features -Designate and design specific areas/parks for stormwater storage			M	L
Societal								
Outward communication	Citywide/ Localized	City/ State	V/S		-Expand two-way preparedness communication to citizens -Engage and train climate ambassadors		H	O/S
Environmental								
Air quality	Citywide	Public/ Private	V			-Increase the tree canpoy near vulnerable populations -Create an anti-idling campaign	M	S/L

Community Resilience Building Workshop Risk Matrix

H-M-L priority for action over the **S**hort or **L**ong term (and **O**ngoing)
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
Infrastructural									
Town Campus	Specific	Town	V	Verify risk from flooding events; Identify alternative locations during peak flooding; Verify maintenance plan annually				H	S
Evacuation Routes - Roads	Town-wide	Town/State	V	Install highly visible signage for evacuation routes; Develop and implement communication program				H	S
Electrical Distribution System	Multiple	CL&P/Town	V	Within floodplain area, establish plan to address protection and long-term relocation of equipment		Upgrade transformers; Maintain power line protection zone (tree trimming)		H	O-L
Dams (inland and coastal)	Multiple	Private	V	Prevent possibility of catastrophic dam failure; Identify and remove dams to minimize downstream flooding due to failure				H	L
Railway and State Bridges	Multiple	Amtrak/State	V	Improve communications between parties; Expand green/gray infrastructure and improve bridge structures; Assess vulnerability and prioritize infrastructure improvement list				M	S
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
Homeless Population	Town-wide	Town	V	Extreme weather flyers and communications about available services				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
Sheltering Facility (upgrades)	Town/Region	Town/State	V	Conduct feasibility analysis for regional sheltering facility; Seek to construct over next 15 years.				L	L
Shelter Management Plan	Town-wide	Town	S	Review and update as needed on annual basis; More resources required (cots, shampoo, etc.)					Ongoing
Lower Household Expenses (flood insurance)	Town-wide	Town	S	Continue enrollment in FEMA Community Rating System (CRS);Reduced number flood insurance rate payers through volunteer buyouts/relocation					Ongoing
Environmental									
Beaches & Dunes	Multiple	State-Town-Private	V/S	Maintain existing beaches & dunes; Assess values and key locations relative to people and property				H	S
Forest (uniform age structure)	Town-wide	Town/State	V	Seeks management that diversifies the age structure of forests in Town; Assess and identify key vulnerabilities from tree fall				H	S
Salt Marsh	Multiple	State/Private	V/S	Maintain existing marsh; Consider additional regulatory protection (increased setbacks) to prevent impacts to resource; Assess risk reduction potential from existing and future wetlands				H	S
Open Space Acquisition (for flood impact reduction)	Town-wide	Town-State-Private	V	Secure state funding; Salt marsh advancement zones	Secure state/federal funding	Include land protection needs Master Plan		H	S-L
State Parks	Specific	State	V	Encourage the State to work more closely with Town to comprehensively maintain town-wide natural resources, amenities, and water quality; Coordinate with state regarding evacuation procedures				M	S
Rippowam River	Specific	State/Town	V		Improve risk reduction characteristics of waterway through natural infrastructure & riparian buffer enhancements			M	S-L
Drinking Water Reservoir	Multiple	State-Private	V	Conduct assessment to comprehensively identify vulnerabilities and develop action plans to increase resilience of natural resources and long term water quality/quantity; Implement improvements				L	L
Protected Open Space	Multiple	State-Town-Private	S	Maintain existing open space to help reduce risk to Town; Seek to increase open space with the highest risk reduction characteristics					Ongoing

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Report Out / Final Priority Actions

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Next Steps

Next Steps

- Master Risk Matrix
- MVP Findings Report
- Apply for MVP Action Grant to fund one of the top priority actions
- MVP listening session – scheduled by June
- Continued progress towards a Resilient Holyoke

GREAT JOB!
THANK YOU!