City of Cambridge Natural Hazard Mitigation Plan

2025 Update

Acknowledgments

The City of Cambridge's 2023 Natural Hazard Mitigation Plan (NHMP) was adopted by the City Council on December 11, 2023 to update and replace the City of Cambridge's 2015 Natural Hazard Mitigation Plan. The 2023 NHMP was developed through a collaborative planning process that involved city staff across multiple departments, numerous stakeholders, and members of the public. We offer a special thanks to the following individuals and teams who contributed to the NHMP and most of all to the residents and business owners who contributed their knowledge and time.

Steering Committee

- Anthony Tuccinardi, Operations Manager of Cambridge Inspectional Services Department (CISD)
- Brian McLane, Assistant Superintendent of Streets & Sewers, Department of Public Works (DPW)
- Catherine Woodbury, Senior Project Manager DPW
- Colin Walsh, Deputy Chief, Fire Department
- Crystal Rosa, Language Access Manager, Human Rights Commission
- Jacob Lazzara, Manager of Building Inspections CISD
- Jeremiah Hart, Deputy Chief, Fire Department
- Jim Wilcox, Director of Engineering Services, DPW
- John Nardone, Deputy Commissioner DPW
- Julie Greenwood-Torelli, Director of Water Operations, Cambridge Water Department (CWD)
- Leila Mekias, Climate Resilience Project Planner, Community Development Department (CDD)
- Mark Gallagher, Director of Engineering & Distribution Operations, CWD
- Marlees Owayda, Community Engagement Manager, CDD
- Nancy Porter, Manager of Community Resilience, Cambridge Public Health Department (CPHD)
- Nick Stoutt, Assistant Commissioner for Architectural Services, DPW
- Rachel Tanenhaus, Executive Director, Cambridge Commission for Persons with Disabilities (CCPD)
- Sam Lipson, Senior Director of Environmental Health, CPHD
- Deputy Peter Vellucci, Cambridge Police Department
- Susanne Rasmussen, Director, CDD
- David Kaplan, Watershed Manager, Cambridge Water Department
- Vedad Konjic, Director of Facilities, Cambridge Public Schools (CPS) Facilities

Hazard Mitigation Planning Team Participants

- Ali Sorrels, Co-Director of Operations, Cambridge Women's Center
- Barry Keppard, Public Health Director, Metropolitan Area Planning Council (MAPC)
- Bill VanSchalkwyk, Managing Director of Health & Safety, Harvard University
- Brooke Amendola, Director of Planning & Preparedness, Boston Office of Emergency Management
- Catherine Woodbury, Senior Project Manager, City of Cambridge DPW
- Celeste DePalma, Climate Resilience Program Coordinator Department of Conservation & Recreation (DCR)

Hazard Mitigation Planning Team Participants (continued)

- Cliff Cook, Senior Planning Information Manager, City of Cambridge, CDD
- Crystal Rosa, Language Access Manager, City of Cambridge Human Rights Commission
- Darrin Korte, Executive Director, Cambridge Community Center
- David Morgan, Environmental Planner & Conservation Agent, Arlington
- Emily Sullivan, Climate Change Program Manager, Somerville
- Eric Grunebaum, Director, Friends of Jerry's Pond, Friends of Alewife Reservation
- Hannah Lyons-Galante, Manager of Climate Change Resiliency, Massachusetts Bay Transportation Authority (MBTA)
- Hillary Monahan, Project Manager, Massachusetts Water Resources Authority (MWRA)
- Jason W Wright, Senior Community Relations Specialist, Eversource
- Jeff Amero, GIS Manager, City of Cambridge GIS
- Jennifer Letourneau, Director, City of Cambridge Conservation Commission
- Jim Wilcox, Director of Engineering Services, City of Cambridge DPW
- Joanne Kossuth, Chief Operations Officer of Information Technology, Lesley University
- Julie Greenwood-Torelli, Director of Water Operations, City of Cambridge, CWD
- Julie Wood, Climate Compact Director, Charles River Watershed Association (CRWA)
- Laurel Schwab, Planner, Watertown
- Leila Mekias, Climate Resilience Project Planner, City of Cambridge, CDD
- Lindsay Diaz, Community Outreach Coordinator, City of Cambridge Community Engagement Team
- Melissa Castillo, Director of Operations, City of Cambridge Department of Human Service Programs
- Michele Scott, Case Manager, City of Cambridge Community Safety Dept.
- Mikayla Criger, Planning Unit Supervisor, Boston Office of Emergency Management (OEM)
- Mike Galvin, Project Manager, DCR
- Mike J Nelson, Director of Ranger Services, DCR
- Michael Johnston, Executive Director, City of Cambridge Housing Authority
- Nahid Chowdhury, City of Cambridge Community Development Dept.
- Nancy Porter, Manager of Community Resilience City of Cambridge, CPHD
- Nikhil Nadkarni, Energy Planner, City of Cambridge, CDD
- Pasang Lhamo, Citizen Scientist, Friend of Jerry's Pond
- Peter Vellucci, Deputy Superintendent, Cambridge Police Department
- Phoebe West, Project Manager, City of Cambridge Office of the Housing Liaison + Multiservice Center
- Rachel Tanenhaus, Executive Director, Cambridge Commission for Persons with Disabilities
- Robert Lowell, Civil Engineer, DCR
- Sam Lipson, Senior Director of Environmental Health, City of Cambridge, CPHD
- Sarah Gyorog, Executive Director, Transition House
- Sarah J White, Director of Climate Resilience, DCR
- Sean Sweeney, Programmer Analyst, City of Cambridge GIS
- Sherry Bernard, Facility Manager, Christian Life Center (Elnora Yard Food Pantry)
- Steven Nutter, Executive Director, Green Cambridge
- Susan Pacheco, Executive Director, Council on Aging, Senior Center

Hazard Mitigation Planning Team Participants (continued)

- Susanne Rasmussen, Director, City of Cambridge, CDD
- Suzanne Blake, Director, Massachusetts Institute of Technology (MIT)
- Tina Alu, Executive Director, Cambridge Economic Opportunity Committee, Inc.
- Vernon Walker, Climate Justice Program Coordinator, Communities Responding to Extreme Weather (CREW)
- William Gode, Project Engineer, DCR

Consultant

Weston & Sampson℠

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Chapter 1:
Introduction

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1. Introduction

1.1. What is a Natural Hazard Mitigation Plan?

Hazard mitigation planning is an iterative process that seeks to reduce the impact of natural hazards on people and property. Cambridge has assessed a variety of natural hazards that pose a risk to the health and welfare of residents, identified specific vulnerabilities associated with those hazards and climate change, and identified local capabilities and specific mitigation actions to protect homes, businesses, and the critical infrastructure that keeps the city running. This process is tailored to address the issues affecting Cambridge residents now and into the future and is crucial to building community resilience.

What are Natural Hazards?
Natural hazards are a source of harm or difficulty created by a meteorological, environmental, or geological event (such as extreme wind events, tornadoes, winter weather as well as earthquakes flooding, and fires).

Vulnerability is a description of which community "assets" (e.g., people, structures, systems, natural resources, cultural resources, historic resources, etc.) are at risk from the effects of a natural hazard.

Hazard Mitigation is the effort to reduce impacts from natural hazards through community planning, policy changes, educational programs, infrastructure projects, and other activities.

Climate change refers to long-term fluctuations in regional temperatures and weather patterns. These fluctuations can be natural, due to events such as solar activity or volcanic eruptions. These fluctuations are also driven by human activities, primarily the burning of fossil fuels like coal, oil, and gas, which have been prominent since the 1800s. Increasing global temperatures have resulted in a multitude of impacts, including but not limited to rising sea levels, shrinking of the polar ice caps, receding glaciers, changes in seasonality, and shifting animal and plant populations (Climate Change Vulnerability Assessment (CCVA), 2015). Climate change has increased the frequency and intensity of many natural hazards creating a greater need for proactive planning. Chapter 3 includes additional information on natural hazard severity and risk.

Resilience is the ability to withstand and swiftly recover from an extreme event. Ideally, resilient systems "bounce forward" to create healthier, greener, and more equitable systems and spaces.

1.2. Benefits of Natural Hazard Mitigation Planning

Completing natural hazard mitigation planning provides benefits to Cambridge:

1. Increasing public awareness of natural hazards that may affect the community reduces overall risk. By providing education and outreach, individuals can understand how natural hazards may affect their lives and what the region, the city, and they as individuals can do and are doing to minimize impacts of those hazards.

2. Proactive planning creates efficiency beyond city limits. Developing a Natural Hazard Mitigation Plan (NHMP) allows state and local governments to work together and combine hazard risk reduction with other community goals and plans.

3. The community's greatest vulnerabilities can be prioritized to receive resources. Developing a plan of hazard mitigation measures considers a prioritization process that reflects the cost and benefit of safety, property protection, technical, political, legal, environmental, economic, social, administrative, and other community objectives, quantitatively and/or qualitatively.

4. The implementation of an NHMP saves taxpayer money. According to FEMA, one dollar spent on federal hazard mitigation grants saves an average of six dollars on disaster response (NIBS, 2019).

5. Maintaining a FEMA compliant NHMP also makes the municipality eligible for federal grant funding (FEMA, 2020). Hazard mitigation funding is available through the Federal Emergency Management Agency (FEMA). To be eligible for FEMA Grants, local governments must prepare an HMP that meets the requirements established in the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by the Disaster Mitigation Act of 2000. The HMP also ensures that federally funded projects reflect a community's priorities and offer solutions to specific threats. Please refer to Chapter 7 for more information on FEMA grants and other potential funding sources.

1.3. Organization of the Natural Hazard Mitigation Plan

The report presents the results of the NHMP planning process, which was informed by data review and analysis, input received from the Steering Committee during and outside of the Steering Committee meetings, input from the NHMP stakeholder workshops, and input from public engagement activities. This report is organized as visualized in the diagram on the following page.

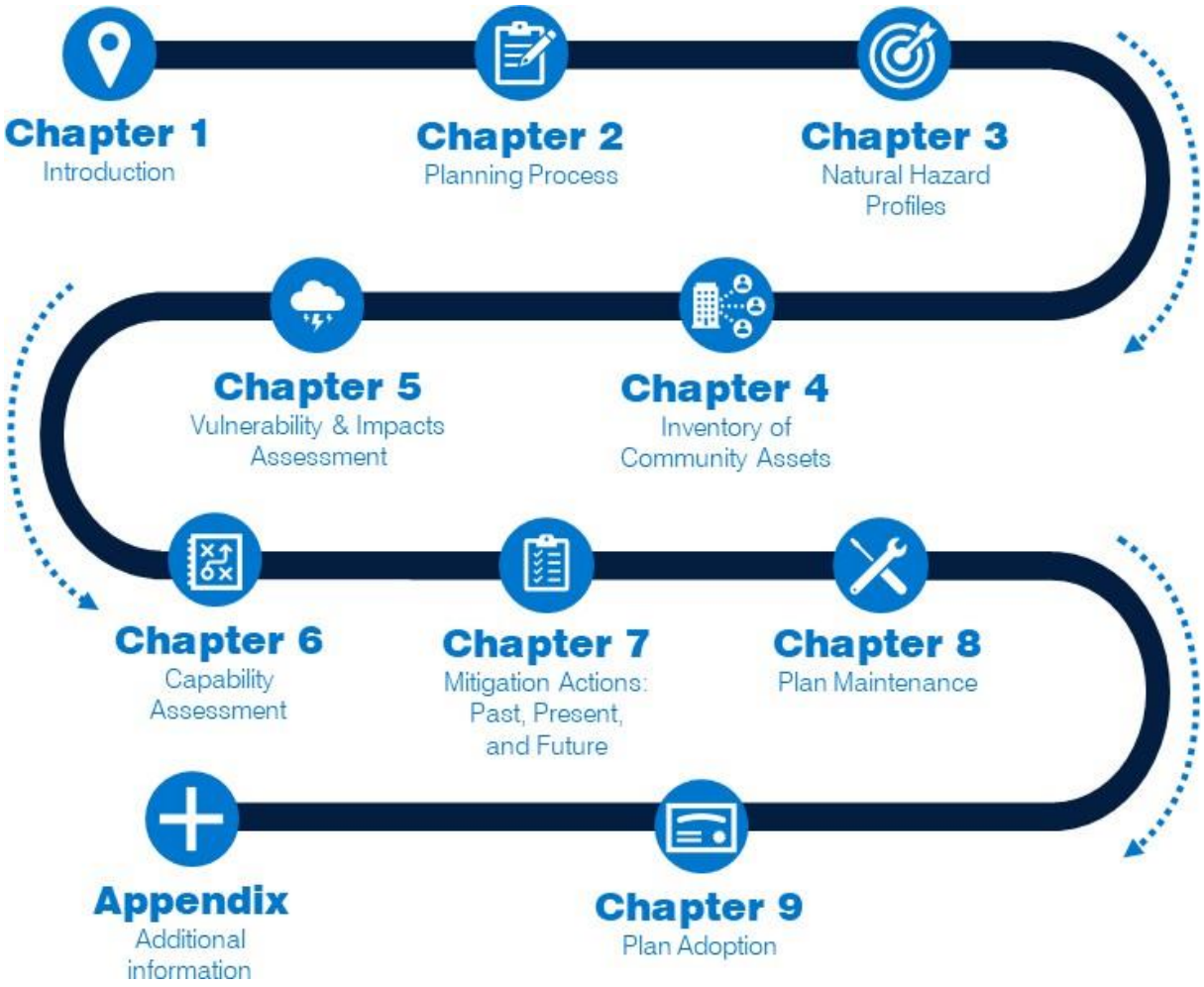


Figure 1.1: A diagram of NHMP report chapters

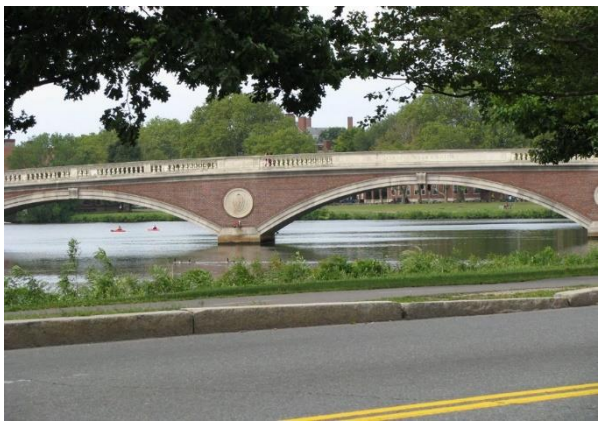


Figure 1.2: The Charles River, photo by Weston & Sampson

Figure 1.3: Danehy Park Universal Playground, photo by Weston & Sampson

1.4. Natural Hazard Mitigation & Climate Adaptation Goals

On April 24, 2023, the Cambridge Hazard Mitigation Steering Committee established the goals and objectives for natural hazard mitigation planning in Cambridge. The committee reviewed and endorsed the goals at their subsequent meeting on May 22, 2023. This effort included a review and update of the goals listed in the 2015 Hazard Mitigation Plan. The goals were restructured to better represent the current hazard mitigation efforts in Cambridge, create consistency with other climate resilience planning processes, and provide simplified messaging to the public. The following presents the goal, on the left, and the supporting objectives, on the right. Goals are broad, long- term policy and vision statements that explain what is to be achieved by implementing the natural hazard mitigation strategy described in Chapter 7. Objectives are more specific and are indicators that a community uses to understand if the goal is being addressed. Objectives are not meant to be specific mitigation actions. Objectives will be evaluated and tracked as part of the plan maintenance process described in Chapter 8.

1. Equitably *Protect* Health and Safety of the Community

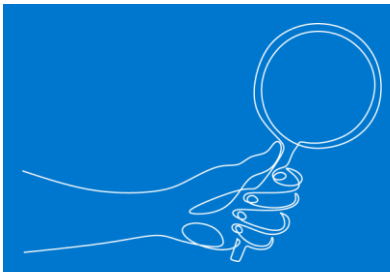
- Identify and reduce impacts to the health and safety of vulnerable populations from natural hazards.
- Provide resources for residents and businesses to make their buildings and properties more disaster resistant.
- Ensure critical infrastructure, facilities, and services are protected from natural hazards and incorporate resiliency, to facilitate efficient recovery, evacuation, public health, and safety.
- Ensure that future development/ redevelopment does not make existing properties more vulnerable to hazards.
- Identify mitigation strategies that preserve and restore the function of natural systems and minimize secondary impacts from hazards.

2. Promote Public Preparedness and Resilience Through *Communication*

- Improve outreach to non-English speakers and other vulnerable populations before, during and after hazard events.
- Encourage people to be prepared before, during, and after hazard events.
- Increase awareness and provide information for hazard mitigation and climate resilience to businesses and residents through outreach and education, including promoting community-based mitigation strategies.

3. *Coordinate and Collaborate* among City Departments and with Community Partners on Hazard Mitigation Planning and Climate Adaptation

- Develop internal strategies to review and update current emergency preparedness, outreach, and response activities to anticipate future changes in vulnerabilities.
- Encourage private property-owners, institutions, and local businesses to implement measures to protect their own property.
- Work regionally with state, regional and federal agencies as well as surrounding communities to mitigate impacts from natural hazards and to respond and recover from hazard events.



4. *Plan for and Sustainably Invest in* Priority Hazard Mitigation Implementation

- Continue to program mitigation projects in the Cambridge capital improvement planning.
- Identify and seek funding for priority measures to mitigate or eliminate significant hazards and impacts.

5. Improve Capacity to *Monitor* Natural Hazards and *Respond* to Changes

- Continue to identify and understand how climate change may alter where and how Cambridge is vulnerable to natural hazards.
- Ensure City departments, committees, and boards have adequate data, guidance, staff, training, and equipment to respond to natural hazard events, maintain preparedness, and anticipate future changes in vulnerabilities.

Chapter 2:
Planning Process

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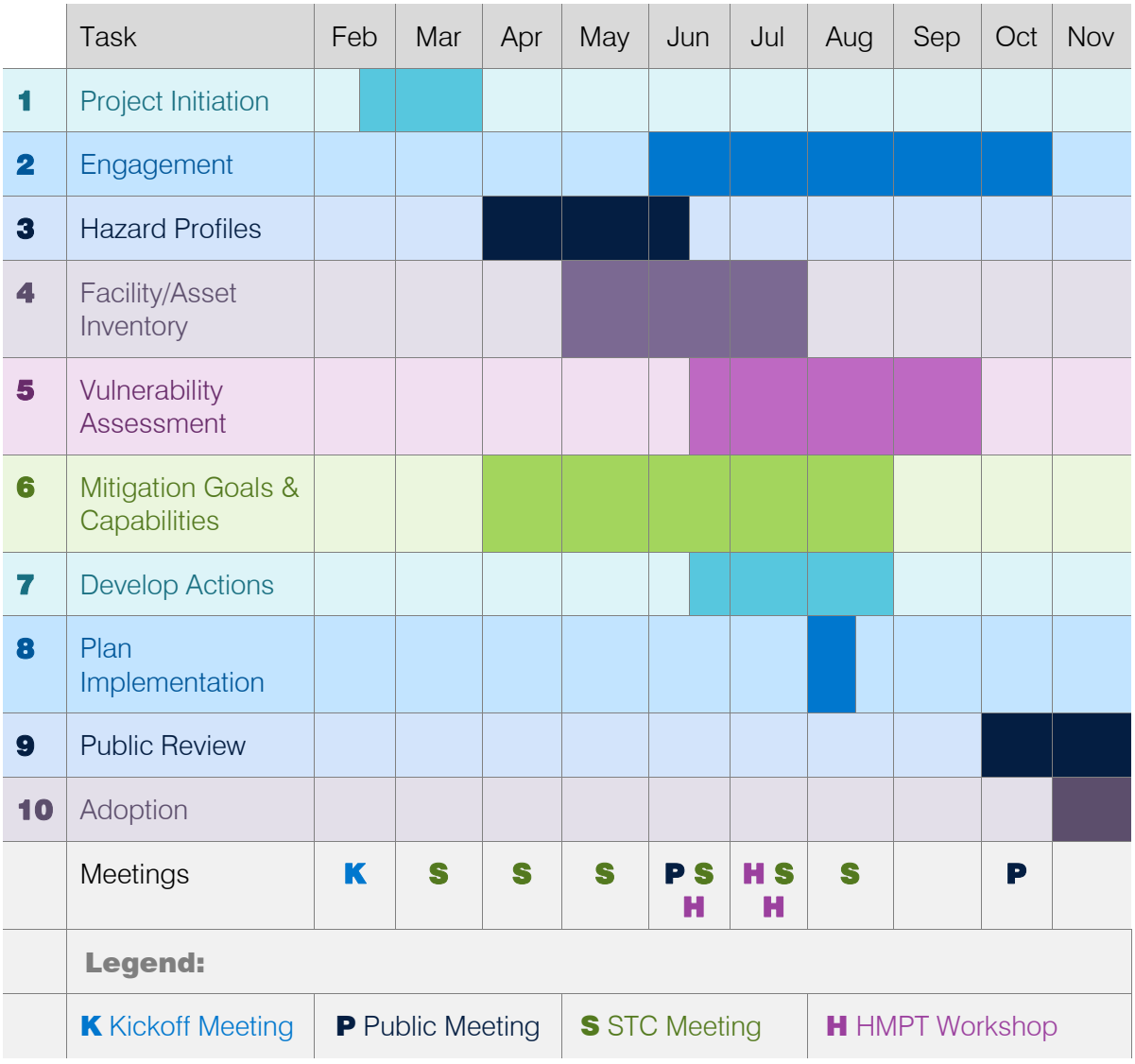
2. Planning Process

The Cambridge NHMP Update was informed by data review and analysis, input received from the Steering Committee during and outside of the Steering Committee meetings, input from the Natural Hazard Mitigation Plan Workshops held with targeted stakeholders, and input from public engagement activities. The NHMP planning process proceeded according to the timeline below. The subsequent pages describe the involvement of the Steering Committee, Natural Hazard Mitigation Planning Team, and the public in the NHMP planning process in more detail.

Figure 2.1: NHMP Planning Timeline during 2023



2.1. Plan Updates to Reflect Community Priorities

Cambridge is a hub for innovation and research that is constantly evolving. The city's technology market is thriving, leading to an increase in population and invigorating the economy. The community in Cambridge is becoming more vibrant and diverse with a growing immigrant population. However, Cambridge is also facing challenges such as economic disparities and a shortage of affordable housing. Additionally, the changing climate and stresses on aging infrastructure and natural systems add complexity to the situation. To address these challenges, the city has undertaken several planning processes and programs that consider economic disparities, affordable housing, climate change, and the diverse needs of the community.

Since the last update of the Hazard Mitigation Plan, Cambridge released its first climate change resilience plan in June 2021 called Resilient Cambridge. The plan provided a solid foundation for the city government and all sectors of the community to do the necessary work to create closer neighborhoods, better buildings, stronger infrastructure, and a greener city. This NHMP reflects these considerations and Resilient Cambridge.

2.2. Community Engagement Approach

The goal of public engagement for this NHMP process was to center the experiences of those who are most vulnerable to natural hazards in Cambridge. To truly mitigate hazards, the city must develop strategies for protecting and supporting those who are most exposed. In 2023, the Massachusetts Executive Office of Energy and Environmental Affairs (EEA) edited the terminology and definition of “climate vulnerable populations” to “priority populations.”

In the Commonwealth, EJ populations (or EJ neighborhoods) have been identified as census block groups (divisions of larger census tracts that are made up of about 600 to 3000 people) that meet one or more of the following criteria:

- The annual median household income is not more than 65% of the statewide annual median household income.
- Individuals who identify themselves as Latino/Hispanic, Black/ African American, Asian, Indigenous people, and people who otherwise identify as non-white comprise 40% or more of the population.
- 25% or more of households lack English language proficiency.
- Individuals who identify themselves as Latino, Hispanic, Black, African American, Asian, or Indigenous, and people who otherwise identify as non-white comprise 25% or more of the population and the annual median household income of the municipality in which the neighborhood is located does not exceed 150% of the statewide annual median household income; or
- A geographic portion of a neighborhood designated by the Secretary as an Environmental Justice population in accordance with law (An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy, Chapter 8 of the Acts of 2021).

According to EEA, priority populations also include people or communities who may be disproportionately impacted by climate change due to life circumstances that systematically increase their exposure to climate hazards or make it harder to respond. In addition to factors that contribute to EJ status (i.e., income, race, and language), other factors like disability status, access to transportation, health status, and age shape whether someone or their community will be disproportionately affected by climate change. This is because of underlying contributors such as racial inequality, financial insecurity, or accessibility barriers that create vulnerability. The term priority populations acknowledges that the needs of people with these experiences and expertise must take precedence when developing resilience solutions to reduce vulnerability to climate change and natural hazards. All communities have priority populations even if they do not have a mapped EJ neighborhood. To better understand the experiences of the residents and businesses of Cambridge, the engagement strategy included a multitude of approaches including:

The Steering Committee: A group of City staff whose work focuses on specific related groups and issues and who met regularly to consult on the NHMP

The Hazard Mitigation Planning Team: A team of representatives of a wide variety of groups and experiences

Public Engagement: Outreach, public surveys, and public meetings open to all community members and neighbors

Within these activities, some engagement strategies include:

- Being intentional about participants in the HMPT so that the group's participants are more representative of Cambridge's neighborhoods, community knowledge, and more.
- Tracking information about demographics in public surveys to inform gaps in reach to the community and use information to inform engagement approach.
- Identifying approaches to engage residents with the understanding that already limited time and resources have been stressed post COVID-19. The team worked with STC and HMPT to respectfully and meaningfully ask for community input through existing channels and partnership with the Community Engagement Team.
- The team worked to address barriers to participation through translation of surveys and printed materials, offering interpretation for meetings, and conducting accessibility reviews of language and visuals.
- Understanding the community context and local initiatives through interactive engagement techniques focused on listening and collecting stories, ideas, and input from residents, businesses, and other stakeholders.

- Avoid "planning fatigue" by building on previous and ongoing efforts as well as considering ways to continue natural hazard preparedness beyond this project.

These engagement activities and the input gathered from the community were invaluable to the development of the NHMP. The STC, HMPT, and community members helped shape the asset inventory, vulnerability assessment, mitigation actions, and other elements of the plan.

For the Asset Inventory, community members gave input on assets that are critical to them or their community. For the Vulnerability Assessment, community members gave feedback on specific experiences they or others have had in a variety of hazards. They also brought attention to potential vulnerabilities in the face of a changing climate. Additionally, community members helped develop specific mitigation actions to address these vulnerabilities and strengthen the resilience of the community. These assets, vulnerabilities, and actions have all been incorporated into the NHMP.

Bringing as many people, particularly vulnerable people, as possible into the hazard mitigation process and implementation will help Cambridge be more equitable and resilient in the future.

2.3. Steering Committee

The City of Cambridge convened a Steering Committee (STC) for the development of the NHMP. The STC met six times to guide the planning process and make final planning decisions. More information on these meetings and a list of STC members is included in Appendix A. The STC played a key role in identifying critical infrastructure, involving key stakeholders, and documenting the City's capacity to mitigate hazards alongside ongoing operations. To assist in drafting the plan, the STC also suggested or made available reports, maps, and other pertinent information related to natural hazards in Cambridge.

Table 2.1: Steering Committee Meeting Schedule

Meeting	Date	Meeting Topics
Kickoff Meeting	February 27, 2023	• Overview of Natural Hazard Mitigation Planning • Scope and Schedule • Engagement • Questions/ Discussion/ Action Items
Steering Committee Meeting #1	March 27, 2023	• Overview of work in progress • Chapter 3 Hazard Profiles • Stakeholder Outreach and Engagement Plan • Capabilities Assessment • Next Steps
Steering Committee Meeting #2	April 24, 2023	• Overview of work in progress • Mitigation Goals

Meeting	Date	Meeting Topics
		• Mitigation Actions: Past • Outreach and HMPT Meetings • Next Steps
Steering Committee Meeting #3	May 22, 2023	• Overview of Work in progress • Hazard Mitigation Goals • Capabilities Assessment • Asset Inventory • Outreach and HMPT Meetings • Next Steps
Steering Committee Meeting #4	June 26, 2023	• Overview of work in progress • Outreach and HMPT Meetings • Mitigation Actions • Plan Evaluation and Maintenance • Next Steps
Steering Committee Meeting #5	July 24, 2023	• Overview of work in progress • Prioritization Criteria and Process for Prioritizing Mitigation Actions • Asset Inventory Discussion • Draft Report Template • Next Steps
Steering Committee Meeting #6	August 8, 2023	• Results of Asset Inventory • Results of Vulnerability Assessment • Targeted Review of Draft NHMP • Next Steps

2.4. Natural Hazard Mitigation Planning Team (HMPT)

Stakeholders with subject matter expertise and local knowledge and experience were invited to join the Natural Hazard Mitigation Planning Team (HMPT) and attend a series of three workshops. These stakeholders included City of Cambridge affiliates, state and regional agencies, representatives of business/academia/private organizations, nonprofit organizations, community groups, and neighboring communities.

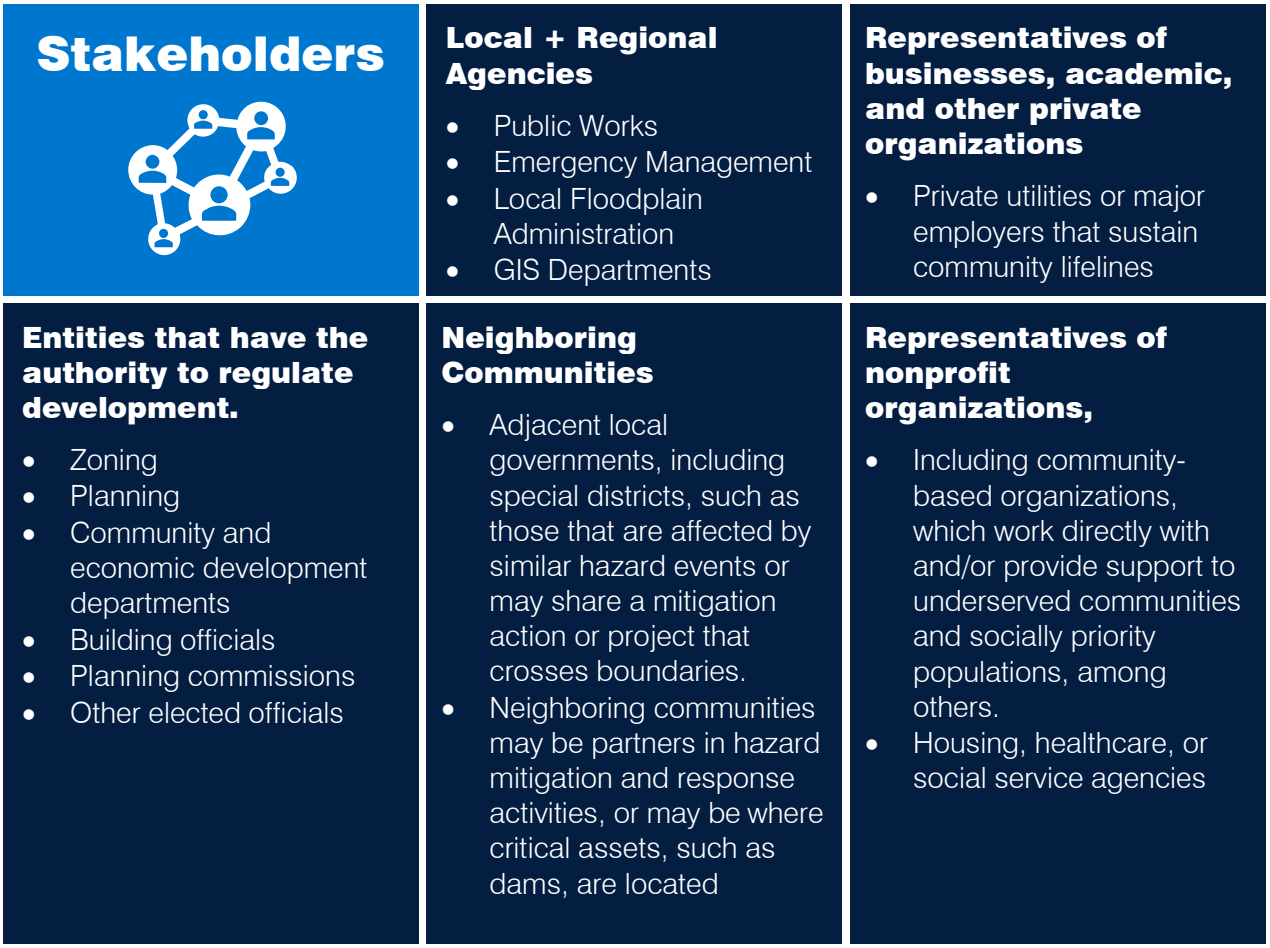


Figure 2.2: Example List of Categories of NHMP Update Stakeholders

During the HMPT workshops, Weston & Sampson provided information about local features and hazards impacting the City of Cambridge and reviewed the City's vulnerability to these hazards. Participants identified and prioritized key actions that will improve the City's resilience to natural and climate-related hazards.

The full list of community representatives who were invited and those who participated in the process are presented in Appendix B, along with the agenda from each workshop. The broad representation of local and regional entities that participated in these workshops helps align the NHMP update with the operational policies and hazard mitigation strategies at various levels of government and implementation.

To include consideration of high hazard potential dams in the planning process, the Cambridge Water Department participated in the STC and the HMTP, and the Department of Conservation and Recreation (DCR) participated in the HMPT. The Cambridge Water Department owns and operates two high hazard dams for the City's drinking water reservoirs. DCR owns and operates two regionally significant dams which are near Cambridge and could impact the city, but neither is

classified as high hazard.[1]

A summary of key findings from each workshop is included on the following pages.

To enhance accessibility, stakeholder workshops were conducted as a series of three online sessions. HMPT workshops were organized around topic areas that included:

1. Asset, vulnerability, and impact identification
2. Mitigation action development
3. Mitigation action prioritization

Table 2.2: Natural Hazard Mitigation Planning Team Workshop Schedule

Meeting	Date	Meeting Topics
HMPT Workshop #1	June 29, 2023	• Overview of plan • Discussion of natural hazards • Asset inventory • Identify vulnerabilities. • Review all groups who may be impacted (focusing on those with limited resources)
HMPT Workshop #2	July 11, 2023	• Review climate adaptation strategies and mitigation goals. • Solicit feedback on how well these goals protective of all groups. • Initial discussion to identify mitigation actions. Incorporate input from public surveys.
HMPT Workshop #3	July 25, 2023	• Review hazards, vulnerabilities, and community concerns. • Review proposed mitigation actions and confirm prioritization of actions.

2.4.1 | HMPT Workshop #1: Hazards, Vulnerabilities, and Assets

Thirty-seven participants joined the workshop virtually and brainstormed key local assets in Cambridge, how those assets might be impacted by hazards, and who would be the most vulnerable to those impacts. A follow-up survey was also sent to participants to capture additional input. The assets were categorized by *people, structures, systems, resources*, and *activities*. The

[1] Engagement with the Massachusetts Office of Dam Safety about the operations and maintenance of high hazard dams is covered in Chapter 4.

workshop format started with a presentation of natural hazards, an overview of the Natural Hazard Mitigation Plan, and an overview of assets. The participants were then broken into four groups to focus on one of the first four categories. After this exercise, the participants came back together to consider *activities* as a group.

Figure 2.3: HMPT Workshop #1 Presentation and Participants

Key Findings

- The most concerning natural hazards were flooding, winter storms, and extreme temperatures.
- Assets in the people category that would be most impacted by natural hazards, especially for more vulnerable groups (such as people with disabilities, currently unhoused people, seniors, and low-income families), were shelters, housing, schools, and food distribution.
- Assets in the structures category that would be most impacted by natural hazards, especially for vulnerable groups, were faith community buildings, grocery stores, medical facilities, transportation infrastructure, schools, and Fresh Pond Water Treatment Plant.
- Assets in the systems category that would be most impacted by natural hazards were the power grid, cell towers, transit routes, MWRA facilities, and water/sewer system.
- Assets in the resources category that would be most impacted by natural hazards, especially for vulnerable groups, were parks, open spaces, community gardens, and arts and cultural facilities.
- Activities included several Cambridge festivals and events like Head of the Charles, Cambridge Science Fest, farmers markets, Honk Fest, block parties, and other community-building activities that strengthen social capital and resilience.

2.4.2 | HMPT Workshop #2: Mitigation Actions

Sixteen participants joined the second workshop virtually and brainstormed mitigation actions that would prevent the impacts discussed in Workshop #1. The mitigation actions used corresponding categories as the assets: structure, people, systems, and resources. The workshop format started with an overview presentation of the Natural Hazard Mitigation Planning process, assets, and mitigation actions. Then, there was a short introductory presentation on mitigation actions for structures followed by a brainstorming exercise where participants were assigned groups to create mitigation actions for structures. This format (presentation then breakout group brainstorming activity) repeated for all four categories and resulted in mitigation actions in all four categories.

Spotlight On Engagement

[1] Some actions are reliant on staffing a supply availability which may not be available. A shortage was experienced during the Covid-19 pandemic and serves as an example of what could happen in a global or regional emergency.

[2] It was noted that although non-electrical communications were utilized successfully in the past, this process should not be the only method of communication as it limits the experience of those who are deaf or hard of hearing.

Figure 2.4: HMPT Workshop #2 Presentation and Participants

Key Findings

- Key mitigation actions for *structures* included coordinated emergency planning, an emergency & extreme weather shelter assessment plan, and back-up power/generator plans.
- Key mitigation actions for *people* included public campaigns for hazard preparedness,

neighbor buddy system and community connections, and warming/cooling centers or resources.[1]

- Key mitigation actions for *systems* included non-electrical communications systems (i.e., loudspeaker or door-knocking)[2], redundancies in the water supply system, and energy system flood resiliency.
- Key mitigation actions for resources included improving parks and public pools, incorporating resiliency education into public art projects, and assessing tree vulnerability to pests.

2.4.3 | HMPT Workshop #3: Mitigation Action Prioritization

Twenty-three participants joined the third workshop virtually and worked on prioritizing the mitigation actions that were generated in Workshop #2 (along with mitigation actions from other city plans). The workshop started with an overview presentation of the Natural Hazard Mitigation Plan, mitigation actions, and the prioritization process. Then, the group was polled on the most important or critical mitigation actions in eleven distinct categories: communications, drinking water + snow removal, housing + public health, community facilities + structures, cooling + tree canopy, stormwater + sewer, energy + back up power, transportation + evacuation, miscellaneous, and equitable emergency response planning.

Figure 2.5: HMPT Workshop #3 Presentation and Participants

Key Findings

- *Communications*: The action voted most critical was developing an enhanced communication plan and program related to natural hazards in collaboration with the community.

- *Drinking Water + Snow Removal*: The action voted most critical was improving and updating the cybersecurity measures for the public water supply system.
- *Housing + Public Health*: The action voted most critical creating a list of health services which are operational during extreme events for community reference.
- *Community Facilities + Structures*: The actions voted most critical were (1) ensure building renovations for priority populations are incorporated into resiliency strategies and (2) evaluate the resiliency of community services on a case-by-case basis (e.g., individual food pantries).
- *Cooling + Tree Canopy*: The actions voted most critical were (1) identify areas for green stormwater infrastructure and reducing impervious surface and (2) identify Cambridge housing development community rooms that have commercial kitchens and use them as cooling centers and shelters during storms.
- *Stormwater + Sewer*: The actions voted most critical were (1) update and improve the Cambridge Floodplain Viewer online map and (2) inspect and maintain targeted infrastructure before storm events.
- *Energy + Back Up Power*: The action voted most critical was prioritize clean energy solutions for power (i.e., solar, battery, geothermal) where feasible.
- *Transportation + Evacuation*: The action voted most critical was coordinating with adjacent communities for hazards preparation and response.
- *Miscellaneous*: The action voted most critical was to develop a historic resources resilience plan.
- *Equitable Emergency Response Planning*: The actions voted most critical were to (1) ensure emergency response plan is multi-lingual and (2) develop a centralized emergency response management system (i.e., communications and coordination).

2.5. Public Engagement

2.5.1 | Equitable Public Engagement

Equitable public engagement in the planning process is a crucial aspect of ensuring that all members of the community have a voice and are represented in decision-making. The City of Cambridge has recognized the importance of inclusive and equitable engagement and has taken steps to redefine community engagement practices. Elements of this commitment include dedicated public engagement and community access teams. Leaders of this work were included in the development process of the Natural Hazard Mitigation Plan by participating on the steering committee.

To strengthen existing social infrastructure and to support a more equitable and resilient future, the engagement team prioritized stakeholders, residents, and community organizations early in the process. The project-specific equity goals include:

- Being intentional about the composition of the HMPT so that it better reflected the communities in Cambridge neighborhoods and community knowledge.
- Tracking success metrics such as attendance at meetings, social media engagement, and

participation in surveys.

- Identifying approaches to engage residents with the understanding that time and resources are stressed by other issues. Respectfully and meaningfully asking for community input, addressing barriers to participation (including technology, time, and language barriers).
- Understanding the community context and local initiatives through interactive engagement techniques.
- Avoid "planning fatigue" by building on previous and ongoing efforts, leveraging local expertise, and empowering residents, and the HMPT, to continue considering natural hazard preparedness beyond the duration of this project.
- Developing accessible engagement materials by using visuals and text, using multilingual designs, increasing the use of plain language, and providing translation.

2.5.2 | Fact Sheet & Public Survey

The project team developed a visual fact sheet summarizing project information, along with an online survey to collect information on the local experience of natural hazards and needs to increase resilience.

The Natural Hazard Mitigation Plan public survey was distributed to community members through virtual, hard copy, and community outreach network methods. These included the City Daily Update email, social media, virtual and hard copy flier distribution, and promotion in partnership with Cambridge Community Corp, and the Community Engagement Team. The survey was also distributed through the Natural Hazard Mitigation Planning Team and Steering Committee networks.

The fact sheet, at right, was distributed through social media networks and aimed at capturing a snapshot of the project as well as promoting the public survey.

Over 150 residents responded to the survey in July 2023. All the responses were in English, although additional languages were provided. All Cambridge neighborhoods were represented among the Survey respondents. A variety of ages, racial identities, and amount of time spent living in Cambridge were also represented among the Survey respondents. A full report of survey responses can be found in Appendix C.

Responses indicated that winter storms/nor'easters were the top hazard of concern for over 90% of respondents, followed by extreme heat at over 80%.

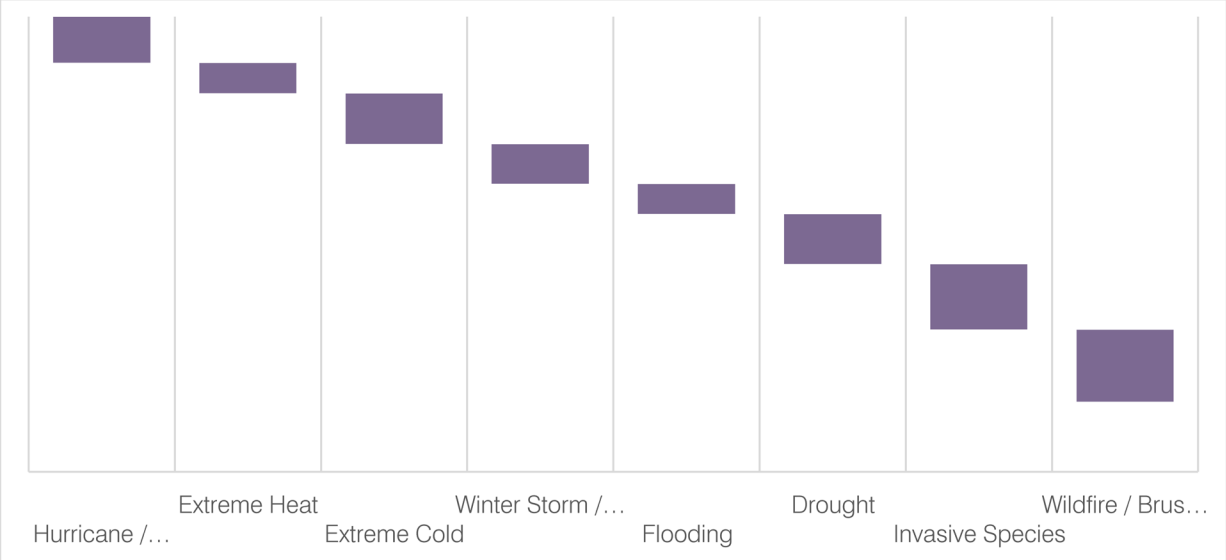


Figure 2.6: Survey Responses: Natural Hazards You Are Most Concerned About

The hazard impacts that were of top concern to respondents were power outages (>75%), damage to the home (72%), or contaminated drinking water (69%), although fewer than 10% reported having experienced contaminated drinking water from natural hazards. Seventy-two percent of respondents indicated that they had experienced power outages, 49% experienced property damage, and 32% experienced limited access to transportation. Limited access to medical care was a concern for more than 27% of respondents, although only 9% had experienced this from natural hazards in the past.

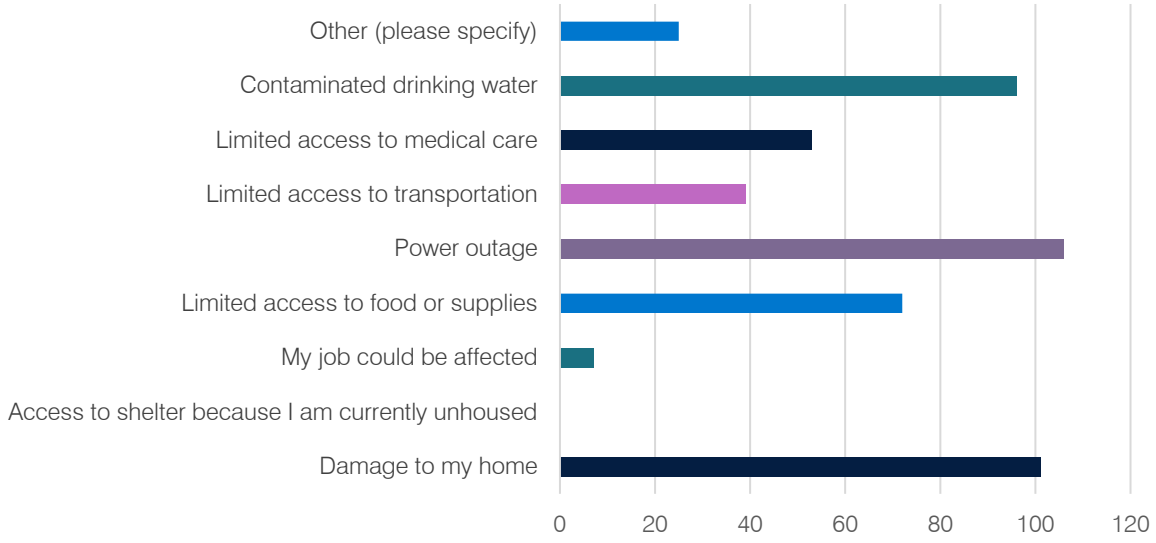


Figure 2.7: Survey Responses to the question, "What problems from natural hazards concern you the most?"

The most common answers to the question, **"What do you typically do, if anything, to prepare for a natural hazard event?"** were:

1 I have an emergency kit with supplies, food, flashlight, batteries, etc. (77%).

2 I check on a vulnerable neighbor and help them with food, snow removal, or other support (40%); and

3 I have a backup generator in case of power outage (10%).

The most common answers to the question, **"What could the city improve on to prepare for natural hazards?"** were:

- Flood protection and response (55%)
- Climate resilience planning (50%)
- Reliable public transportation (45%)
- Tree planting (42%)
- Renewable energy implementation (41%)

The survey also provided the city with guidance on existing natural hazard mitigation measures that were working well, and information about the best ways to reach residents during future emergencies, shown below.

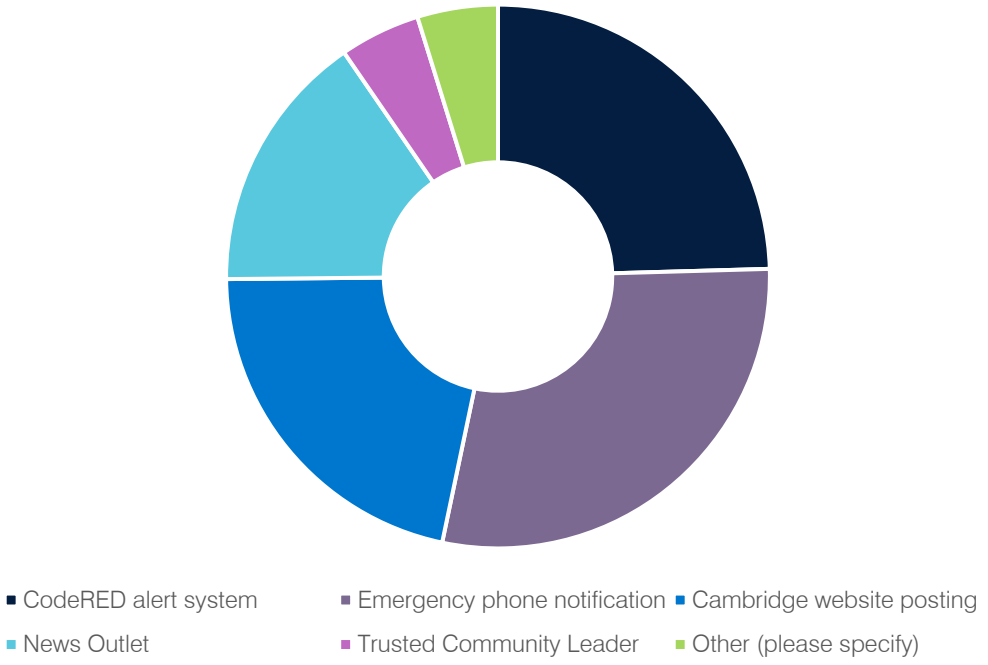


Figure 2.8: Survey Responses: How Would You Like to Receive Information in an Emergency?

2.5.3 | Public Meetings

Community input was also collected through a series of three public meetings with the help of the

STC and HMPT. Public Meetings were announced to community members through virtual, hard copy, and community outreach network methods. These included several notices in the Daily Update email from the City Manager's office, posting on Cambridge social media and the project webpage, virtual and hard copy flier distribution, and promotion in partnership with local networks and the community engagement teams from various city departments.

The first meeting was held on June 13, 2023, from 6:00 to 7:00 PM, and was primarily focused on informing the public about the history and purpose of the NHMP update, FEMA mitigation funding programs, project work plan, and the overall planning process. The meeting included a discussion of local vulnerabilities, strengths, historic hazard impacts on the community, and potential adaptation action items.

The second and third meetings were held on October 25, 2023, to present the initial results and review the draft NHMP Update. The second public meeting was held virtually from 12:00 to 1:00 PM on October 25, 2023, and the third public meeting was held in a hybrid in-person and virtual format from 6:00 to 7:00 PM on October 25, 2023.

2.5.3.1. Addressing Challenges to Virtual Engagement

The project team planned each webinar to encourage participation and engagement. Equitable engagement modifiers were used to facilitate participation during meetings, including:

2.6. Local Long-Range Plans Related to Hazard Mitigation

The City of Cambridge has undertaken significant long-range planning efforts related to hazard mitigation, climate resilience, and sustainability. Key focus areas of these efforts include reducing the city's carbon footprint, preparing the community for extreme events and chronic impacts, and mitigating risks to the built and natural environments from natural hazards. The following plans, studies, reports, and technical information were reviewed and incorporated into the update of this NHMP. Specifically, the information is used in developing portions of Chapter 3 Hazard Profiles, Chapter 4 Asset Inventory, and Chapter 5 Vulnerability and Impact Assessment.

There are also a variety of ordinances and regulations, as well as committees and task forces, that further the city's efforts to proactively address natural hazards and climate change, which are discussed in Chapter 6 in the Capabilities Assessment.

2015 Cambridge Natural Hazard Mitigation Plan

The City of Cambridge completed a Hazard Mitigation Plan in 2015. This plan was led by the Cambridge Local Hazard Mitigation Planning Committee (LHMPC), staff from city departments, and in collaboration with the Massachusetts Office of Emergency Management (MEMA) and Department of Conservation and Recreation (DCR). The LHMPC helped determine where natural hazards most significantly impact the city, developed goals pertaining to hazard mitigation, and identified strategies and actions to limit the impacts of hazards on Cambridge residents. Primary goals of this plan include protecting the health and safety of Cambridge residents, protecting properties and structures, ensuring continuity of essential services, promoting effective communication, collaborating regionally, and protecting natural resources. The strategies identified in this plan were informed by a risk assessment of flooding, high winds, winter storms, brush fires, and geological hazards. The 2023 NHMP update builds on the foundations of this plan with updated information regarding hazards, capabilities, and actions that have been completed during the last several years.

The 2015 Cambridge Hazard Mitigation Plan was integrated into the following plans. The 2015 HMP established key goals and strategies to address hazard mitigation in the community. This plan laid the foundation for future planning efforts by setting objectives for disaster preparedness, property protection, infrastructure resilience, and effective communication strategies. Several actions were integrated into in-progress planning efforts to further reinforce their importance or the actions in this plan became the precursor for planning efforts to come.

- Development of the complete hydraulic modeling for the city's FloodViewer Tool was an action identified in the 2015 HMP. The 2015 HMP evaluated flooding as a natural hazard and identified that more city-specific stormwater infrastructure modeling was needed to better inform local vulnerability and impacts.
- The 2015 HMP determined that providing facilities for additional vulnerable populations during extreme temperature events was critical for reducing impacts to the community. This mitigation action resulted in development of the CCVA heat strategy for vulnerable populations and development of strategies in the Resilient Cambridge Plan.
- Increasing public education on the benefits and proper care of trees on private property was determined to be an important mitigation action under the 2015 HMP to reduce the impacts of

urban heat, improve air quality, and uptake stormwater runoff. This recommendation became part of the engagement completed during the development of the Resilient Urban Forest Masterplan.

- The 2015 HMP identified that Cambridge should encourage energy efficiency in buildings through zoning requirements and community outreach. This action informed development and contents of the Net Zero Action Plan.

Resilient Cambridge Plan

The Resilient Cambridge Plan is a citywide plan to mitigate the impact of potentially devastating rain fall events, riverine flooding, winter storms, and rising temperatures. The Resilient Cambridge Plan is organized into four focus areas – Closer Neighborhoods, Better Buildings, Stronger

Infrastructure, and a Greener City. Each focus area includes strategies organized by scale including regional, citywide, neighborhood-level, and property-level actions. These actions are intended to be implemented by a variety of stakeholders including city departments, agencies, community-based organizations, and residents. The strategies identified were informed by public meetings, workshops, focus groups, surveys, and technical studies, including the Climate Change Vulnerability Assessment (CCVA). The actions presented in Resilient Cambridge were incorporated into the Mitigation Actions presented in Chapter 7.

Climate Change Vulnerability Assessment (CCVA)

To establish the technical foundation for the Resilient Cambridge Plan, the city conducted a climate change vulnerability assessment, focusing on the risks from increasing temperatures, precipitation, and sea level rise. This assessment focused on Cambridge's physical and social vulnerabilities under the future conditions of climate change. This assessment was completed in two parts in 2015 and 2017 and is accompanied by an online web-viewer for flooding.

Components of this vulnerability assessment are cited throughout the description of natural hazards presented in Chapter 3 and the vulnerability and impact assessment presented in Chapter 5. In addition, the inventory of assets supported the updated asset inventory prepared in Chapter 4 and used for the NHMP vulnerability and impact assessment.

Neighborhood Climate Resilience Plans for the Port and Alewife

Prior to the development of the citywide Resilient Cambridge Plan, the city created two detailed neighborhood plans for its most vulnerable areas - the Port and Alewife. These plans were informed by the Climate Change Vulnerability Assessment and include strategies to make infrastructure, natural resources, buildings, and communities more resilient in each neighborhood. The Port and Alewife are home to many of Cambridge's priority populations.

Envision Cambridge

The Envision Cambridge Plan is a citywide comprehensive plan focused on the city's growth and development through 2030. The Envision Cambridge Plan has a dedicated section on climate and environment. This section of the plan includes analysis and strategies related to greenhouse gas emissions reductions and renewable energy, waste reduction, ecological protection, climate change preparedness, water quality, and environmental justice.

Urban Forest Master Plan

The Urban Forest Master Plan (UFMP) was completed in 2019 and is intended to guide's the city's development of the urban forest into the future and will include a strategic plan to evaluate, maintain and expand the urban forest canopy while being more resilient to climate change,

reducing the urban heat island effect, mitigating stormwater runoff, reducing nutrient runoff, and contributing to community well-being.

Net Zero Action Plan

The city's Net Zero Action Plan was adopted in 2015 and includes detailed recommendations to reduce greenhouse gas emissions from the built environment, improve energy efficiency, support renewable energy generation on and off-site, and employ best practices to engage and educate residents about occupant behavior. In 2020, the city began a five-year review process to evaluate its progress on its goal of being carbon neutral by 2050, and in 2021 began updating this plan.

Climate Action Plan

The City of Cambridge Climate Action Plan (CAP) was written in 2018 and is based on a community-wide greenhouse gas (GHG) inventory completed in 2016. Using the GHG inventory, the CAP identified actions for achieving deep carbon reductions in the buildings, transportation, and waste sections. The CAP was updated in 2018.

Cambridge also developed a citywide sustainability dashboard to accompany this plan as a way of interactively tracking its progress on GHG reduction measures. The dashboard tracks progress on climate, transportation, and energy initiatives. The dashboard is an accessible tool to help residents get involved and visually comprehend the impact on carbon reductions.

Climate Protection Plan

The Climate Protection Plan was developed in 2002, preceding the city's Climate Action Plan. This plan was informed by an inventory of the city's emissions from 1990 and 1998. The impetus for the plan was that the City Council voted to join Cities for Climate Protection (CCP), an international consortium of communities working to reduce greenhouse gas emissions in 1999.

Climate Resilience Zoning Amendment

Cambridge City Council adopted the Climate Resilience Zoning Amendment on February 27, 2023. The updates to the city's zoning regulations were stewarded by a task force appointed by the City Manager in 2018. The purpose of this task force was to develop recommendations to make development in Cambridge more resilient to climate change risks. The new zoning includes regulations related to flooding and heat.

2.7. State Long-Range Plans Related to Hazard Mitigation

Massachusetts Integrated State Hazard Mitigation & Climate Adaptation Plan

The Commonwealth of Massachusetts adopted a state hazard mitigation and action plan in 2018. This plan integrates climate adaptation and hazard mitigation into one statewide plan that complies with FEMA's federal requirements for state Hazard Mitigation Planning. Adoption and maintenance of this plan makes Massachusetts eligible for federal disaster recovery and mitigation funding under the Stafford Act. The state's Hazard Mitigation Plan (called ResilientMass Plan) five-year update was released in the fall of 2023. The ResilientMass Plan is based on the Massachusetts Climate Change Assessment, a statewide assessment of climate vulnerability,

informed by the best available data and climate science at the time of publication. The ResilientMass Plan is an important document referenced in this NHMP and many other local planning efforts.

Massachusetts Climate Change Assessment

The Massachusetts Climate Change Assessment was completed in 2022. The assessment is organized into seven geographic regions of the Commonwealth including the Cape Islands, and South Coast, North and South Shores, Boston Harbor, Eastern Inland, Central, Greater Connecticut River Valley, and Berkshires and Hilltowns. For each region, the assessment includes an evaluation of thirty-seven impacts on five sectors that include human, infrastructure, natural environment, governance, and economy. This statewide assessment was the basis for the SHMCAP.

Massachusetts Climate Resilience Design Standards Tool

The Resilient Massachusetts Action Team (RMAT) created a Climate Resilience Design Standards tool that is publicly available online to any residents, locality, or agency in the Commonwealth of Massachusetts. The tool provides parcel-level climate data for all properties in Massachusetts. The Tool was created to advance the goals of the SHMCAP. The tool provides climate projections in addition to a recommended planning horizon and return period for critical assets on a parcel input into the Tool by a user. This tool is intended to help agencies with state capital planning and make grants across Massachusetts respond to local climate data. Specifically, the tool provides:

- A preliminary climate change exposure and risk rating
- Recommended climate resilience design standards for projects with physical assets
- Guidance of best practices to support implementation.

The tool was developed with climate science data for Massachusetts and will be updated overtime to incorporate the best available information.

Cambridge Owned Dams

Cambridge's 2019 Emergency Action Plan (EAP) and subsequent inspection/evaluation reports for the Cambridge Reservoir Dam and Stony Brook Reservoir Dam were considered in the development of the HMP. The Emergency Action Plan (EAP) was prepared for the owner of the Cambridge Reservoir Dam and Stony Brook Reservoir Dam to establish a basic plan of action if conditions at the dams indicate potential for dam failure or if dangerous conditions are developing at the dams.

The Cambridge Reservoir Dam Phase I Inspection/ Evaluation Report and The Stony Brook Reservoir Dam Phase I Inspection/ Evaluation Report were completed in 2022 and both dams were found to be in satisfactory condition. These inspection/ evaluation reports provide an evaluation summary including reports, investigations, data, and visual inspection, evaluation of an emergency action plan for the site, and recommendations and remedial actions to address deficiencies found.

The city communicates at a minimum every two years with the Massachusetts Office of Dam Safety(ODS). The Commonwealth requires geotechnical engineers inspect the dams and communicate the findings back to ODS. In between regular inspections, Cambridge communicates with them when they do work that requires an A or B permit. Most recently Cambridge has been working with ODS for a repair to the gate house and downstream culvert outlet (headwall and wingwall and scouring) at the Cambridge Reservoir Dam (Hobbs Brook Dam)

2.8. FEMA Review Tool

All aspects of the planning process were created and implemented in accordance with the updated FEMA Local Mitigation Planning Policy Guide (FEMA, 2022).

Chapter 3:
Natural Hazard Profiles

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3. Natural Hazard Profiles

"Natural hazards are a source of harm or difficulty created by a meteorological, environmental or geological event. Natural hazards, such as flooding and earthquakes, impact the built environment, including dams and levees"
- (FEMA, 2022)

Natural hazards have the potential to induce damage or loss to physical assets, such as buildings, infrastructure, or natural, historic, and cultural resources, within the city. Natural hazards also have the potential to affect people, including underserved communities and priority populations, city processes and workflows, and activities that have value to the community. Analysis conducted through the Environmental Protection Agency (EPA) reveals that socially priority populations are disproportionately affected by the impacts of natural hazards (EPA, EPA Report Shows Disproportionate Impacts of Climate Change on Socially Vulnerable Populations in the United States, 2021).

For each natural hazard profile, the following components of the hazard are identified in this chapter:

I. **Description:** A description for each natural hazard stemming from the Massachusetts 2018 State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) (EEA & EOPSS, 2018) and the existing City of Cambridge Hazard Mitigation Plan 2015 Update (City of Cambridge & MAPC, 2015).

The following hazard profiles were developed based on the natural hazards that can affect the jurisdiction (i.e. Cambridge):

Flooding Hazards

- Inland Flooding (Stormwater and Riverine)
- Coastal Flooding

Dam Hazards

- Dam Failure

Wind-Related Hazards

- Hurricanes / Tropical Storms
- Tornadoes

Winter Storm Hazards

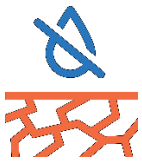
- Winter Storms / Nor'easters

Geological Hazards

- Earthquakes
- Landslides
- Tsunami

Temperature-Related Hazards

- Average/Extreme Temperatures



Drought Hazards

- Drought

Fire-Related Hazards

- Brushfire

Invasive Species Hazards

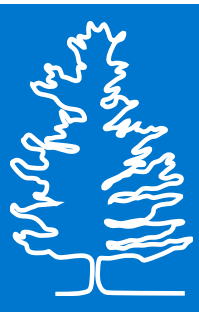
- Invasive Species

II. Previous Occurrence(s) of the Hazard Event: A list of historical occurrences of the natural hazard event, in chronological order. Understanding the history of a hazard in the city or Middlesex County, including the extent, frequency, and location of occurrence, aids in planning processes.

i. *Extent (Severity or Magnitude):* FEMA defines extent, "as the range of anticipated intensities of the identified hazards" (FEMA, 2022). This can be expressed in varying scientific charts and scales, as relevant to the hazard and city. Extent can be summarized as "how serious the hazard event is."

ii. *Frequency*: Frequency refers to the likelihood of occurrence over a given period of time.

iii. *Location*: The geographic boundary in which a hazard occurs. This may include areas larger or smaller than the City of Cambridge's jurisdiction.



Common Hazard Impacts

- Flooding basement
- Tree limbs falling and causing damage to house or car
- Extreme heat – health impact
- Mobility and transit difficulty in extreme weather
- Power outages
- Poor air quality

III. Probability of Future Hazard Events due to Climate Change: Climate projections indicate a change in long-term weather patterns. This section identifies how climate change may affect the extent, frequency, and location of natural hazard events occurring, and to what degree in which they change. Future climate change projections for the city, and climate change preparedness planning, design and engineering that the city conducted to date have focused on the 2030 planning horizon as defined by the bounding years 2015-2044, and the 2070 planning horizon as defined by the bounding years 2055-2084. In 2018, MA EOEEA created ResilientMA, an online clearinghouse for local governments and the public to explore climate change science and data, information on community resilience, and decision support tools. The climate change planning efforts that ResilientMA has undertaken have focused on the 2030, 2050, 2070 and 2090 planning horizons, which are defined by the bounding years 2020-2039, 2040-2059, 2060-2079 and 2080-2099, respectively. Since there is overlap in years between the city and the state's planning efforts for the 2030 and the 2070 planning horizons, we are using these to characterize future hazards.

i. *Extent (Magnitude/Intensity):* Future changes in the extent of a hazard event may differ from what was previously described.

ii. *Probability:* Future changes in the probability of a hazard event may differ from what was previously described. For example, the intensity and frequency of precipitation-based events are expected to increase in the future.

iii. *Location:* Future changes in the location of a hazard event may differ from what was previously described.

Table 3.1 provides definitions of hazard location, extent, frequency, and probably. The definitions support the basis of determination in Table 3.2. In accordance with guidance from FEMA, quantification and definitions are necessary,

Table 3.1: Summary of Natural Hazard Risks for the City of Cambridge (Continued) (City of Cambridge & MAPC, 2015)

Points	Description
Hazard Extent (Severity/Intensity)	
Minor	Limited damages to property, no damage to public infrastructure (roads, bridges, trains, airports, public parks, etc.); contained geographic area (i.e., one or two neighborhoods); essential services (utilities, hospitals, schools, etc.) not interrupted; no injuries or fatalities.
Serious	Scattered major property damage (more than 10% destroyed); some minor infrastructure damage; wider geographic area (several communities); essential services briefly interrupted up to 1 day; some minor injuries.
Extensive	Consistent major property damage (more than 25%); major damage public infrastructure damage (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and possible fatalities.

Points	Description
Catastrophic	Property and public infrastructure destroyed (more than 50%); essential services stopped for 30 days or more, multiple injuries and fatalities.
Present Frequency of Hazard	
Very Low	Events that occur less frequently than once in 100 years (less than 1% chance per year).
Low	Events that occur from once in 50 years to once in 100 years (1% to 2% chance per year).
Medium	Events that occur from once in 5 years to once in 50 years (2% to 20% chance per year).
High	Events that occur more frequently than once in 5 years (greater than 20% chance per year).
Future Probability of Hazard	
Very Low	Events that are projected to occur less frequently than once in 100 years (less than 1% chance per year).
Low	Events that are projected to occur from once in 50 years to once in 100 years (1% to 2% chance per year).
Medium	Events that are projected to occur from once in 5 years to once in 50 years (2% to 20% chance per year).
High	Events that are projected occur more frequently than once in 5 years (greater than 20% chance per year).
Location of Hazard	
N/A	Hazard has not yet affected city area
Small	Less than 10% of the city is or could be affected by the hazard
Medium	Between 10-50% of the city is or could be affected by the hazard
Large	More than 50% of the city is or could be affected by the hazard

Table 3.2, below, provides a summary of the natural hazards affecting Cambridge. This evaluation takes into account historical records, the extent (severity and magnitude), frequency, and location, and anticipated future probability and location. Information regarding future projections for specific scenarios is not available for every natural hazard. Each hazard section contains best available science, and discusses projections in the context of specific future scenarios when available and appropriate.

"I am concerned about climate change above all other issues."

- Public Survey Respondent

Table 3.2: Summary of Natural Hazard Risks for the City of Cambridge

Natural Hazard	Previous Occurrence of Hazard Event in Cambridge	PRESENT			FUTURE		
		Extent	Frequency	Location	Extent	Probability of Occurrence	Location
Inland Flooding	Yes	Serious	High	Medium	Serious	High	Large
Winter Storms & Nor'easters	Yes	Serious	High	Large	Serious	High	Large
Coastal Flooding as a result of Dam Failure	No	Extensive	Low	N/A	Extensive	High	Medium
Hurricanes & Tropical Storms	Yes	Extensive	Medium	Large	Extensive	High	Large
Tornadoes	No	Catastrophic	Low	N/A	Catastrophic	Low	Small
Earthquakes	No	Catastrophic	Low	N/A	Catastrophic	Low	Large
Landslides	No	Minor	Very Low	N/A	Minor	Very Low	Small
Tsunamis	No	Catastrophic	Very Low	N/A	Catastrophic	Very Low	Medium
Extreme Temperatures	Yes	Serious	High	Large	Serious	High	Large
Drought	Yes	Minor	High	Large	Serious	High	Large
Wildfire / Brush Fire	Yes	Serious	Low	Small	Extensive	Medium	Small
Invasive Species	Yes	Minor	High	Large	Serious	High	Large

"Global warming is going to accelerate faster than we can really imagine."
- Public Survey Respondent

3.1. State And Federal Disaster Declaration

To understand the importance of hazard mitigation, it is useful to know the types and frequencies of disasters that occur in Massachusetts. Federal Disaster Declarations are official acknowledgments that a disaster has overwhelmed local resources and warrants federal assistance to supplement state and local recovery efforts. Massachusetts State of Emergency Declarations are declarations made by the Governor to mobilize state resources and implement emergency measures in response to significant threats or disasters within the state's jurisdiction. Since the last Cambridge Hazard Mitigation Plan update in 2015, there have been four storms in Massachusetts that resulted in Federal or State Disaster Declarations in Middlesex County, which includes the City of Cambridge. In addition, there have been two Disaster Declarations related to the COVID-19 pandemic, which are not considered natural hazards for the purposes of this plan but are listed for completeness in documenting Declarations since the last HMP was prepared. These federally declared disasters, related assistance from FEMA, and whether there was a corresponding Massachusetts State of Emergency Declaration are described in Table 3.3.

Table 3.3: Federal/State Disaster Declarations for Middlesex County since 2015 (FEMA, n.d.)

Disaster Name	Disaster Number	Begin Date	End Date	Type of Assistance	Both Federal and State Emergency Declaration	Areas Under Declaration
Severe winter storm, snowstorm, and flooding.	DR-4214-MA	1/26/2015	1/28/2015	FEMA Public Assistance; FEMA Hazard Mitigation Grant Program	Yes	Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, and Worcester
Winter Storm	n/a	2/9/2015	2/25/2015	n/a	Only MA declared emergency,	All 14 Counties in MA.

Disaster Name	Disaster Number	Begin Date	End Date	Type of Assistance	Both Federal and State Emergency Declaration	Areas Under Declaration
					not a FEMA declared emergency.	
Severe winter storm and snowstorm	DR-4379-MA	3/13/2018	3/14/2018	FEMA Public Assistance; FEMA Hazard Mitigation Grant Program	Yes	Essex, Middlesex, Norfolk, Suffolk, and Worcester.
Covid-19 Pandemic	DR-4496-MA	1/20/2020	5/11/2023	FEMA Individual & Households Program; FEMA Public Assistance; FEMA Hazard Mitigation Grant Program	Yes	All 14 Counties in MA.
Covid-19	EM-3438-MA	1/20/2020	5/11/2023	FEMA Public Assistance	Yes	All 14 Counties in MA.
Hurricane Lee	EM-3599-MA	9/15/2023	9/17/2023	FEMA Public Assistance	Yes	All 14 Counties in MA.

3.2. Inland Flooding (Stormwater and Riverine)

3.2.1 | Description

Flooding occurs when normally dry land is inundated by the rising or overflowing of water. Inland (riverine or stormwater) flooding poses a major threat to the city. Identified as the "most prevalent

serious natural hazard identified by local officials" in the 2015 Cambridge NHMP. The frequency and severity of flooding from riverine and stormwater sources is expected to increase as the climate changes. Inland flooding is a result of combined effects of river overbank flooding and flooding from drainage infrastructure capacity issues. Representation of this hazard is best understood using the city's flood model, discussed further in this section.

3.2.2 | Previous Occurrences of Hazard Event(s)

The City of Cambridge has experienced ongoing flood hazard events throughout recent history. For example, during 2010, the months of March and July were some of the most intense rainfall Cambridge has experienced in recent history. In March of 2010, a ten-day stretch brought torrential rainfall of over 14.83 inches of rainfall in accumulation and on July 10, 2010 an hour long storm caused a rainfall accumulation of 3.58 inches in Cambridge (City of Cambridge, 2015). The July 10, 2010 storm corresponds to a 500-yr return period which implies an annual probability of 0.2% or less based on precipitation intensity data from NOAA Atlas 14 (NOAA-Atlas14, 2015).

The following indicated events represent significant historic flood events in Cambridge, with widespread flooding.

- March 1968
- The blizzard of 1978
- January 1979
- April 1987
- October 1991 ("The Perfect Storm")
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010
- July 2010
- July 2018
- Hurricane Ida, September 2021
- April 19, 2022
- June 22, 2022
- August 16, 2022
- October 13, 2022
- November 30, 2022
- Various dates during Summer 2023

3.2.2.1. Extent

Before storm severity can be assessed, average conditions must be understood as the baseline for the city.

Table 3.4: Precipitation Values adopted by the city as part of the CCVA (City of Cambridge, 2015)

Precipitation Changes	Baseline (1971-2000)
Annual Precipitation (in.)	45
Summer Precipitation (in.)	9.5
Winter Precipitation (in.)	11.4
# of days per year > 2 in. rain in 24 hours (days)	2
Max 5-day precipitation per year (in.)	6

The City of Cambridge's flood model, developed in ICM-2D, is a dynamic and integrated flood model that factors both riverine flooding in the Alewife Brook and Lower Charles River areas, as well as piped infrastructure flooding from stormwater (in separated areas) and combined sewer (in combined areas) across the city. The riverine flood model in the Alewife area was built upon and improved from the original 2010 FEMA HEC-RAS riverine hydraulic model for the Mystic River basin. The piped infrastructure flooding in the city has been developed by integrating pipes, manholes, catch basins, outfalls and other drainage/storage structures that already exist or are currently under construction in the city. The dynamic interaction between riverine flood levels, and piped infrastructure flooding, results in more realistic and accurate representation of actual flooding conditions. The city's flood model is also calibrated to available river stage and flow data at multiple locations in the Mystic River and the Charles River watersheds, and it is expected that the models will better simulate the flows and flooding in Cambridge for future precipitation scenarios, as well. The results of the city's flood model can be accessed here. The model results, in terms of maximum flood elevation at each parcel scale in the city for the different design storms under the present and future scenarios, as well as for FEMA 100- and 500-yr floods, are available to view at the city's FloodViewer website (last updated in 2022).

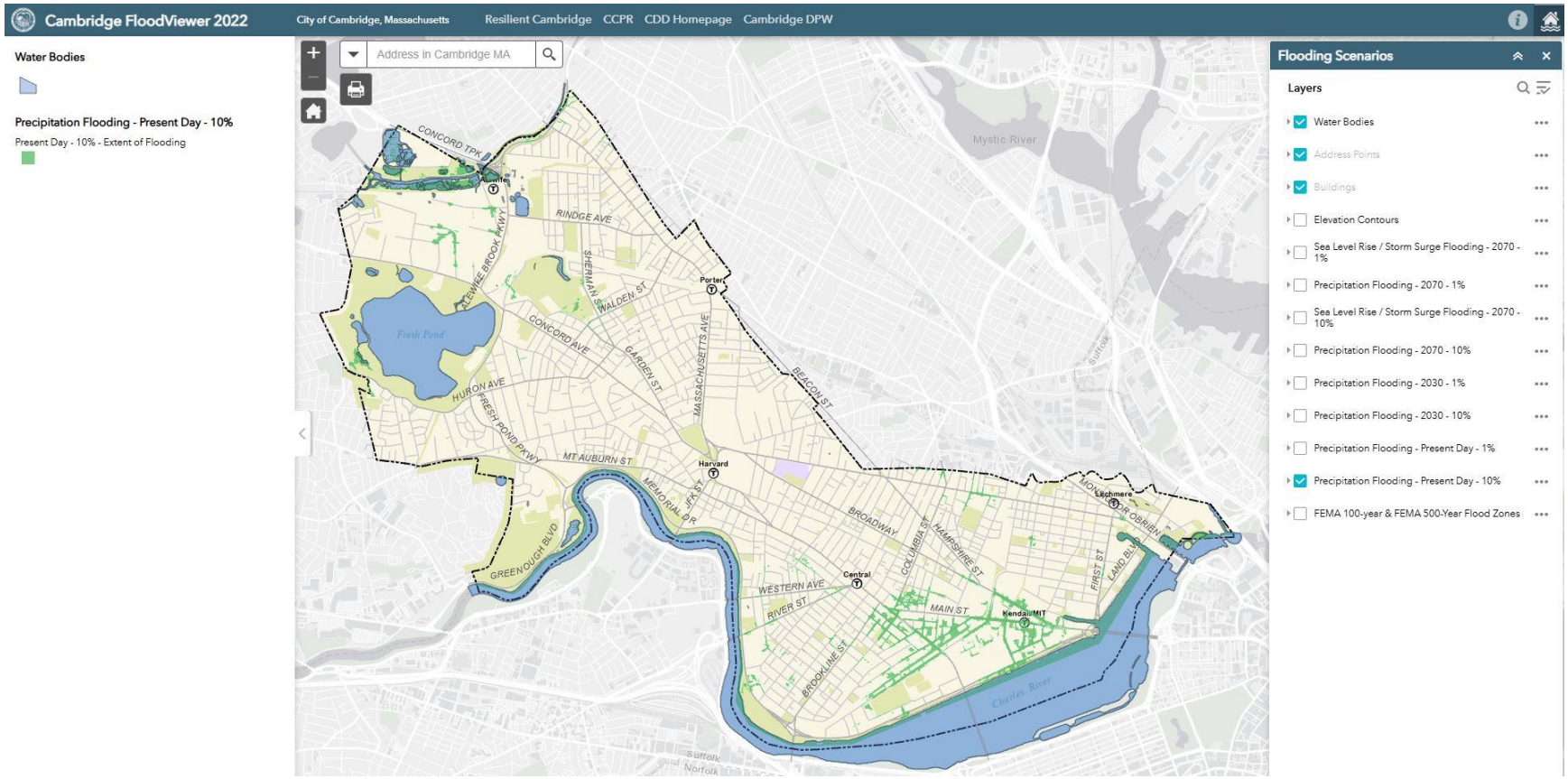


Figure 3.1: Cambridge Flood Viewer Present-day 10% Storm Event Flooding

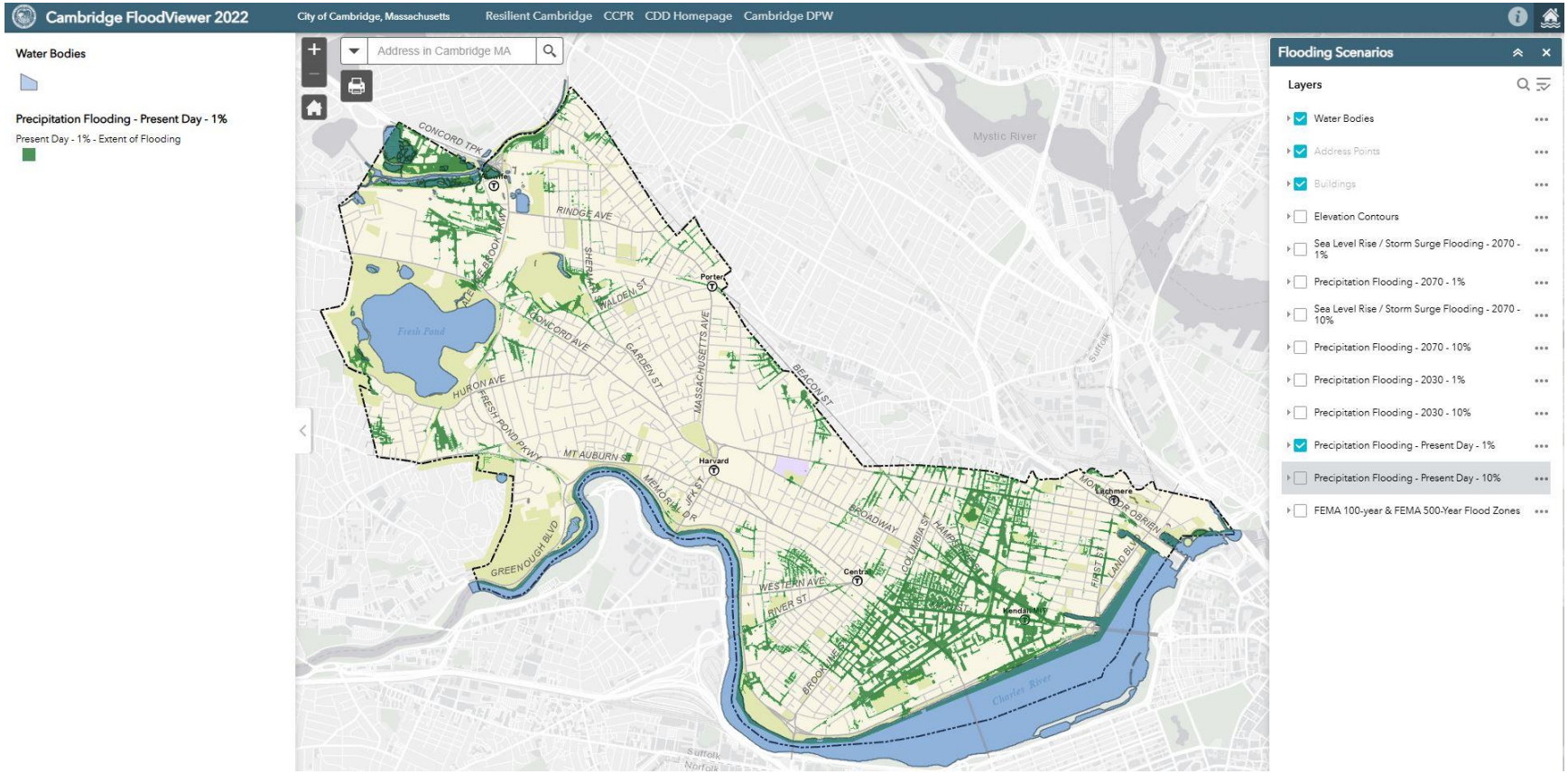


Figure 3.2: Cambridge Flood Viewer Present-day 1% Storm Event Flooding

Extent of flooding can further be measured by the population impacted by the flood events and the percent of land or properties flooded as a result of the event. Table 3.4 and Table 3.5 demonstrate the severity of flooding in the City of Cambridge through these metrics.

Table 3.4 is a summary table reporting extent of inland flooding impacts in the Alewife area from present 10-year and 100-year 24-hour design storms, as reported in the Climate Change Preparedness & Resiliency (CCPR) Alewife Plan (2017).

Table 3.5: Alewife Area Storm Event Flooding Impact

Year	Storm Event	% Flooded Land Area	% Flooded Properties
Present	10-year 24-hour precipitation event	3%	5%
	100-year 24-hour precipitation event	11%	18%

Table 3.5 is a summary table reporting extent of inland flooding impacts in The Port study area from flood events between 2013-2017, as reported in The Port Preparedness Plan (2019).

Table 3.6: Population at Risk in the Port Study Area

Population at Risk	Total Count	Impacted by Flooding
Children Aged 0-5	266	200
Seniors Aged 65+	359	280
Non-English Speakers	1,738	1,200
Residents below the Poverty Line	1.082	810

* The Port neighborhood area (approximately 191 acres) housed an average of 7,023 people between 2013-2017. The number of residents in The Port study area (approximately 153 acres) as considered in CCPR is approximately 4,780 because The Port study area is smaller than The Port neighborhood area. Assumptions were made for this population analysis because census tract data does not match The Port's study area boundaries. (Source: 2016 ACS data)

3.2.2.2. Frequency

The 2018 SHMCAP states that the frequency of substantial flood events in Massachusetts is once every 3 years. Described in Table 3.6, below, are the present day (baseline conditions) for design rainfall storm events of different frequencies for the city. These present day storm depths are based on extreme rainfall estimates provided by the Northeast Regional Climate Center (NRCC) intensity-duration-frequency (IDF) tables and curves.

Table 3.7: Baseline Storm Depths for 24-hr and 48-hr design storms (City of Cambridge, 2015)

Baseline (1971-2000)	
24-hr Design Storms	
10-yr	4.9 in
25-yr	6.2 in
100-yr	8.9 in
48-hr Design Storms	
10-yr	5.5 in
25-yr	7 in
100-yr	10 in

3.2.2.3. Location

As defined by FEMA, a repetitive loss property is any NFIP insured property which has been paid two or more flood claims of $1,000 or more in any given 10-year period (FEMA, 2020). Therefore, repetitive loss data does not represent all losses due to flooding and the number of buildings that experience losses due to flooding is likely higher. Uninsured properties do not received any aid from FEMA, with the exception of during a disaster declaration, when they may be able to receive a grant for individual assistance. Insured properties can apply for a mitigation grant while uninsured properties cannot.

The repetitive loss data below was provided by MEMA (MEMA, 2023). The identified repetitive loss properties are all residential and have received an aggregated total building payment of $99,769 and contents payment of $83,900 from FEMA on three residential properties.

Table 3.8: Repetitive Loss Structures for the City of Cambridge, Massachusetts

Count of Repetitive Loss Properties	Count of Total Losses	Total Building Payments	Total Contents Payments
3	7	$99,768.39	$83,899.91

The city is bordered at the southern end by the Charles River and along the northwestern edge are the Fresh Pond and the Alewife Brook. The resultant Federal Emergency Management Agency (FEMA) flood hazard map is shown below in Figure 3.3. The FEMA National Flood Insurance Program's (NFIP) Flood Insurance Rate Maps (FIRMs) designate areas or Zones likely to experience flooding as high risk (Zones starting with A) or moderate- to low risk (Zones starting with B, C, or X) High risk properties with federally backed mortgages or those that have received federal disaster assistance are required to maintain flood insurance. Properties within moderate- to low- risk areas

are not required, but are highly encouraged, to purchase flood insurance.

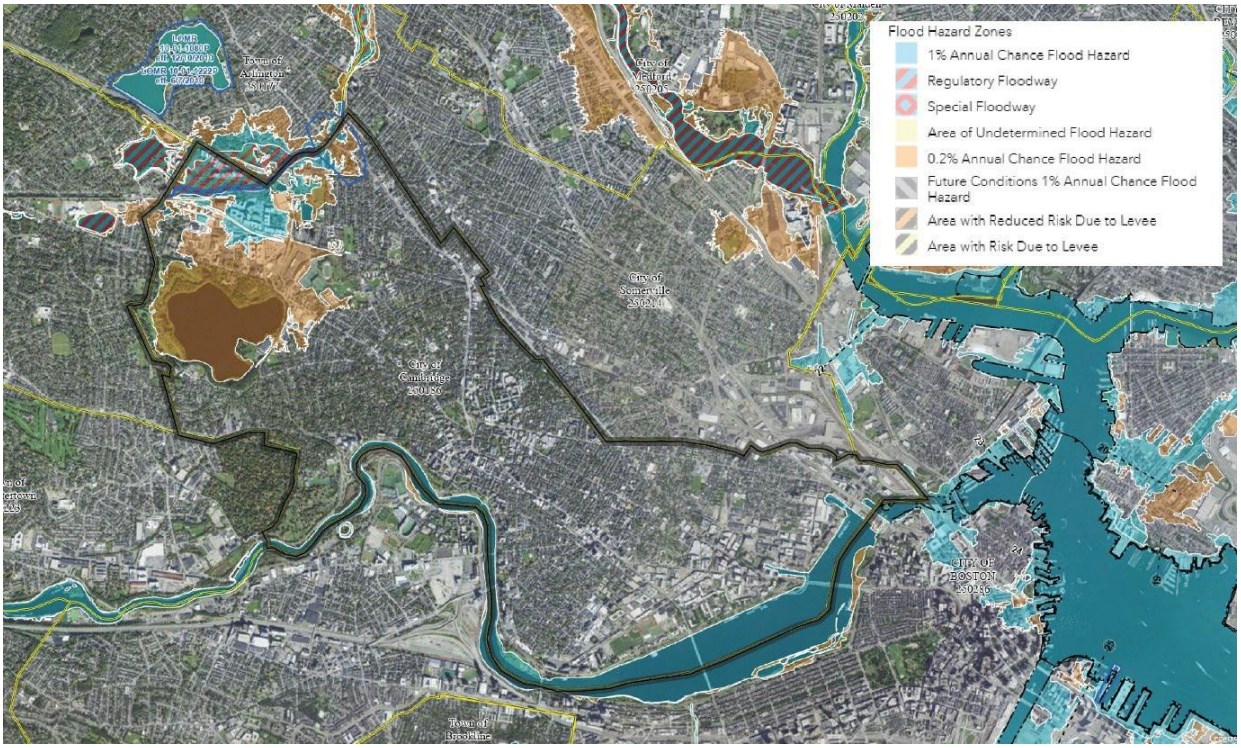


Figure 3.3: FEMA Flood Hazard Layers for the City of Cambridge

The Cambridge Massachusetts water supply system faces several limitations related to its Hobbs Brook Reservoir and Stony Brook Reservoir dams. The primary challenge is that these aging structures were not designed to handle the increasingly intense precipitation events and potential flooding risks associated with climate change. To address these deficiencies, the Cambridge Water Department (CWD) has implemented a comprehensive monitoring network that provides near-real-time information on water quantity, quality, and meteorological parameters. This data allows the CWD to respond rapidly to water-quality issues and optimize reservoir management.

3.2.3 | Probability of Future Hazard Events due to Climate Change

3.2.3.1. Extent

Climate change projections indicate that extreme weather events are likely become more frequent and more intense in coming years. Compounding weather impacts may occur that can exacerbate the impacts of these events. Increases in temperature can lead to greater evaporation, thus increasing atmospheric moisture, and more intense precipitation events. High-intensity or heavy precipitation events can lead to flooding, landslides, infrastructure damage, and erosion.

The Fourth National Climate Assessment, Volume I (Wuebbles, 2017), states that the observed changed in heavy precipitation has increased by 74% between 1901 and 2016 in the northeastern

states. Long-term impacts of these changes may involve a change in floodplain boundaries, leaving areas once safe now vulnerable to flooding. Inland flooding intensity will increase as heavy rain falls in short periods of time, overloading soil absorption and riverbanks. These events can be particularly devastating in urban cities like Cambridge, where impervious surface and buildings can further prevent rainwater from absorbing in the soil. This added runoff may overwhelm stormwater systems, thus increasing the risk of flash flooding.

3.2.3.2. Probability

According to the latest published data from ResilientMA (MA EOEEA, 2021), the annual total precipitation in Cambridge area is projected to increase by ~11% with a projected 22% increase in maximum precipitation by the 2070 planning horizon. Winter precipitation (which includes rain, sleet, snow, and ice) will also be affected, with an estimated 16% increase in total winter precipitation by the 2070 planning horizon. The annual number of days with extreme precipitation is also estimated to increase in the future. Table 3.7 shows the estimated percentage increase in total precipitation and days with extreme precipitation from ResilientMA (MA EOEEA, 2021).

Table 3.9: Projected changes annual total precipitation in the Cambridge region (MA EOEEA, 2021)

Precipitation Parameter	Baseline	2030s	2050s	2070s	2090
Total precipitation: Annual (inches)	43.6	6.4	8.7	10.8	13.4
Total precipitation: Spring (inches)	11.2	8.2	9.5	14.5	16.6
Total precipitation: Summer (inches)	9.2	9.9	7.8	8	10.2
Total precipitation: Fall (inches)	11.6	1.2	4.8	4.2	5.6
Total precipitation: Winter (inches)	11.7	6.9	12.4	15.9	20.8
Number of Days >1" precipitation	6	1	1	2	2

These most recent projections from ResilientMA vary from the projections adopted by the city's 2015 Climate Change Vulnerability Assessment, shown in Table 3.8, and the city is considering updating its projections to be consistent with the latest and best available data from the State.

Table 3.10: Precipitation Changes for the City of Cambridge (City of Cambridge, 2015)

Precipitation Changes	Baseline	2030s (2015-2044)		2070s (2055-2084)	
	1971-2000	*Lower*	*Higher*	*Lower*	*Higher*
Annual Precipitation (in.)	45	48	48	51.5	54
Summer Precipitation (in.)	9.5	9.8	9.8	10.1	10.3
Winter Precipitation (in.)	11.4	12.6	12.7	14.1	15.4

Precipitation Changes	Baseline	2030s (2015-2044)		2070s (2055-2084)	
	1971-2000	*Lower*	*Higher*	*Lower*	*Higher*
# days per year > 2 in. rain in 24 hrs (days)	2	3	3	3	3
Max. 5-day precipitation per year (in.)	6	6.5	6.6	7	7.2
24-hr design storms					
10 yr	4.9	5.6		6.4	
20 yr	6.2	7.3		8.2	
100 yr	8.9	10.2		11.7	
48-hr design storms					
10 yr	5.5	6.4		7.2	
25 yr	7	8.6		9.8	
100 yr	10	13.2		15.7	

Changes in precipitation and temperature in Cambridge could lead to modifications in the current floodplain, putting areas that have not historically flooded at risk. Existing FEMA flood maps utilize historic flood data and do not provide future floodplains. Future flood data was developed for the city's model (Cambridge, 2022) and found that the floodplain expands geographically compared with FEMA floodplains. This could impact residents and businesses that are located in areas that have not experienced flooding in the past, which could result in significant economic and social costs.

Future projections show an increase in intensity and frequency of storm event. Design storms with higher return periods will become more frequent. Design storms are regularly used by engineers and planners to evaluate the performance of different systems and structures, such as drainage systems, flood control structures, and buildings, under extreme weather conditions. A 100-yr design storm has a 1% chance of occurrence in any given year and a 25-yr design storm has a 4% chance of occurrence in any given year.

Precipitation data projections developed for Cambridge (from MA EEA's Climate and Hydrologic Risk Project (Steinschneider, 2022)) indicate that the frequency of future extreme design storms will be higher in future. Future projected total precipitation depths over 24-hours were pulled from this data source and are indicated in Table 3.9. The projections are also plotted with NOAA Atlas 14 present day baselines, for a series of recurrence intervals, as shown in Figure 3.4. This figure shows the following relationships:

- Rainfall over a 24-hr period that historically had a 1-in-100 year frequency (8.2 inches) is likely to increase to a frequency of 1-in-10 by 2070.

- Rainfall over a 24-hr period that historically had a 1-in-25 year frequency (6.3 inches) is likely to increase to a frequency of 1-in-10 year by 2050.

Table 3.11: Future 24-hr design storm depth predictions (inches) in Cambridge

24-hr Design Storm Depth Predictions (inches)				
Recurrence Interval	**Present Day Baseline (NOAA Atlas14)**	**Cornell IDF Projection 2030**	**Cornell IDF Projection 2050**	**Cornell IDF Projection 2070**
1yr	2.6	3.0	3.2	3.6
2yr	3.3	3.7	4.0	4.4
5yr	4.3	4.9	5.3	5.8
10yr	5.2	5.9	6.4	7.0
25yr	6.3	7.3	7.8	8.6
50yr	7.2	8.3	8.8	9.8
100yr	8.2	9.3	10.0	11.1
200yr	9.3	10.7	11.4	12.7
500yr	11.2	12.8	13.7	15.1

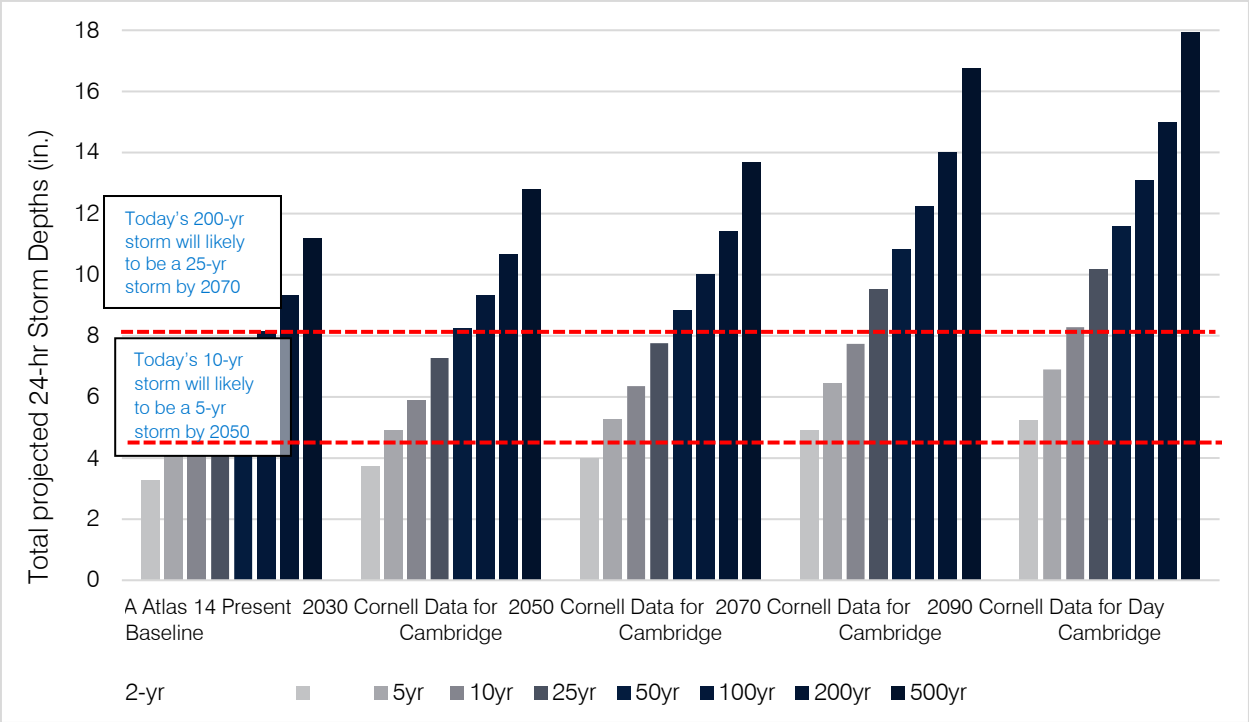


Figure 3.4: Future precipitation projections for 24-hr storm depths in Cambridge (Using Cornell University generated IDF projections as part of MA EEA's Climate and Hydrologic Risk Project)

3.2.3.3. Location

Figure 3.5 shows the impact of a 100-yr 24-hour duration storm by 2030 (left) and 2070 (right) in the city, as presented in the city's flood viewer (City of Cambridge, 2022). Low lying areas in Cambridge, particularly areas that are located close to the Charles River and Fresh Pond are more susceptible to inland flooding. The extent of floodplain will expand causing flooding in parcels that have not experienced flooding in the past.

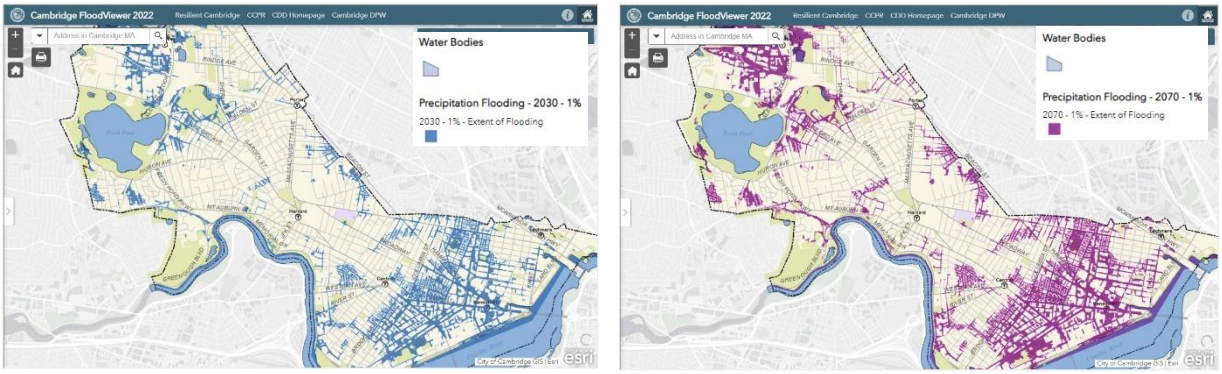


Figure 3.5: Potential flooding from a projected 100-year 24-hour storm with climate change (Left- 2030, Right -2070) and an estimated rainfall of 11.7 inches over 24 hours (Source: Cambridge Flood Viewer)

3.3. Winter Storms and Nor'easters

3.3.1 | Description

Winter storms in Massachusetts can bring heavy snowfall and below-freezing temperatures. They can also include blizzards, ice storms, nor'easters, and other extreme forms of winter precipitation.

- Blizzards are characterized as snowstorms that reduce visibility to or below a quarter mile, while also being accompanied by wind gusts of 35 mph or greater (EEA & EOPSS, 2018).
- Ice storms can also be an issue during winter months, where liquid precipitation falls and freezes upon contact with the cold ground, creating ice buildups. These instances can create impaired walking and driving conditions and can also result in damage to power lines and trees (EEA & EOPSS, 2018).
- Nor'easters (which get their name from being a northeastern coastal storm) typically develop as a large counterclockwise wind circulation, around a low-pressure center. These storms include strong winds that blow in from the ocean, onto coastal areas. They are typically associated with heavy rains or snow and can cause storm surge of greater than 2 ft, coastal flooding, and coastal erosion (City of Cambridge & MAPC, 2015). Sustained winds of 20 to 40 mph are also common during nor'easters, even bringing wind gusts up to 50-60 mph.

3.3.2 | Previous Occurrences of Hazard Event(s)

The City of Cambridge has experienced a multitude of severe winter storm events since 1978. These hazard events are indicated in Table 3.10 below.

Table 3.12: Severe winter storm events since 1978, in the City of Cambridge, based on FEMA Disaster Declarations (FEMA, Declared Disasters, n.d.)

Date	Event
February 1978	Blizzard
March 1993	Blizzard
January 1996	Severe Snowstorm
March 2001	Severe Snowstorm
December 2003	Severe Snowstorm
January 2004	Severe Snowstorm
January 2005	Severe Snowstorm
April 2007	Severe Snowstorm

Date	Event
December 2010	Severe Snowstorm
February 2013	Blizzard
January 2015	Winter Storm Juno
March 2018	Back-to-back Nor-Easters
January 2022	Blizzard

3.3.2.1. Extent

The severity or extent of winter storm events is characterized by two scales: Northeast Snowfall Impact Scale (NESIS) and Regional Snowfall Index (RSI).

The NESIS was established by Paul Kocin (The Weather Channel) and Louis Uccellini (National Weather Service) and is used to classify "high impact northeast snowstorms with large areas of 10-inch snowfall accumulations and greater)" (EEA & EOPSS, 2018). The scale has five categories, which are categorized by impact to an area. The calculated NESIS value is a function of the area affected by the storm, quantity of snow that fell, and population living within the path of the storm (NOAA, 2023).

Table 3.13: Northeast Snowfall Impact Scale (NESIS)

Category	NESIS Value	Description
1	1-2.499	Notable
2	2.5-3.99	Significant
3	4-5.99	Major
4	6-9.99	Crippling
5	10.0+	Extreme

More recently, however, the RSI has become more popular for use in quantifying the impact of a winter storm event for the eastern two-thirds of the U.S. While the NESIS is calibrated to the northeast, it has been used more nationally. Developed in 2005, the RSI is a more regional index that has come to replace the NESIS. The RSI calculates impact of storm based on the spatial extent, quantity of snow that fell, and population information, tied to societal impacts. It is cited as better able to "place snowstorms and their societal impacts into a historical perspective on a regional scale" (NOAA, 2023). Table 3.12 shows the classification of winter storms and nor'easters by their RSI and respective descriptions.

Table 3.14: Regional Snowfall Index (RSI)

Category	RSI	Description
1	1-3	Notable
2	3-6	Significant
3	6-10	Major
4	10-18	Crippling
5	18.0+	Extreme

3.3.2.2. Frequency

Notable winter storms and nor'easters often occur on an annual basis, if not more frequently. The SHMCAP describes the frequency of Nor'easters as one or two per year, with some years containing up to four of these hazard events (EEA & EOPSS, 2018). The Northeast generally experiences one or two major winter storms each year with varying degrees of severity (NESEC, 2017).

3.3.2.3. Location

Winter storms and nor'easters are citywide natural hazards. These events can create issues for residential, commercial, and emergency operations.

3.3.3 | Probability of Future Hazard Events due to Climate Change

3.3.3.1. Extent

Winter storms and Nor'easters are powerful storms that can cause significant damage and disruption to communities. Climate change is expected to cause an increase in precipitation in Massachusetts over the next 80 years, and the proportion of this precipitation that falls during extreme events is predicted to increase.

Although rising temperatures suggest that more precipitation will fall as rain than snow, historical data show that the frequency of extreme snowstorms in the U.S. doubled between the first and second half of the 20th century (EEA & EOPSS, 2018). With warmer air over the Atlantic Ocean, it will lead to more moisture laden air causing more intense blizzard events in the winter when they collide with cold air systems from the north in the NE US including cities like Boston and Cambridge (MA EOEEA, 2021).

Potential climate change impacts in Cambridge will likely include increased snowfall, sea level rise, storm surge, and more intense storm events. The projected sea level rise will exacerbate the impact of severe winter storms, particularly when they coincide with high tides creating higher coastal erosion and flooding. This could result in substantial damages from future nor'easters.

It is important for cities like Cambridge to prepare for the potential impacts of nor'easters, including

cumulative impact of back-to-back storms. It is crucial that the city considers increasing its resilience to extreme weather events and investing in infrastructure and emergency management plans that can help mitigate the effects of these storms. As design wind speeds have increased in the last few years, it is crucial to consider the safety and stability of buildings and other structures in the face of stronger winds. By taking proactive steps to prepare for future winter storms, Cambridge can minimize the damage to their built infrastructure and protect the safety and well-being of their residents.

3.3.3.2. Probability

The probability of future winter storms and nor'easters are expected to increase in Cambridge potentially causing more damage to the city than present day. The future flooding impacts from winter storms and nor'easters combined with sea level rise and storm surge in the coastal areas are included in the Massachusetts Coast Flood Model (MC-FRM) that has been adopted by the City of Cambridge. The MC-FRM is a probabilistic based hydrodynamic flood model that provides future probabilities of flooding from nor'easters, tropical storms, hurricanes for the 2030, 2050 and 2070 planning horizons. The model also factors respective sea level rise projections for each of the future planning horizons. Based on the MC-FRM results, both the Amelia Earhart Dam and Charles River Dam are likely to be flanked and overtopped in the future from sea level rise and extreme storms, unless mitigation measures are implemented. Flooding may also stem from severe winter weather including winter storms and nor'easters. The probability of flooding maps from MC-FRM (final version as published by Woods Hole Group in September 2021) show that portions of western Cambridge in the Alewife Brook sub-watershed have a likelihood of 50 to 70% annual probability of flooding by 2070 and portions of eastern Cambridge in the lower Charles River sub-watershed have a likelihood of annual probability of flooding between 5 to 10% by 2070.

3.3.3.3. Location

The future flooding impacts from winter storms and nor'easters because of climate change, as discussed in the previous section, are likely to be citywide, with more frequent flooding expected to occur in the western portions of the city in the Alewife area. Citywide impacts from winter storms and nor'easters are also anticipated to cause damages to the built infrastructure.

3.4. Coastal Flooding as a Result of Dam Failure

3.4.1 | Description

Dams are built structures that serve as artificial barriers for the storage or control of water (EEA & EOPSS, 2018). The Massachusetts Department of Conservation & Recreation (DCR) defines dam failure as the "collapse of an impounding structure resulting in an uncontrolled release of impounded water from a dam" (DCR, 2017). Dam failure can occur in two primary ways; catastrophic failure (which includes rapid release of the impounded water) or dam overtopping ("caused by floods that exceed the capacity of the dam"). Dam overtopping is the cause for approximately 34% of all dam failures in the U.S. (EEA & EOPSS, 2018). Non-breach flood risks

can also occur when downstream flooding occurs although the dam is functioning as designed and does not fail. One example of a non-breach risk is dam flanking, occurring when water proceeds to go beyond the dam by passing it on one or both sides.

The City of Cambridge currently relies on two dams for protection against coastal flood inundation: the Amelia Earhart Dam, located along the Mystic River, and the New Charles River Dam, situated at the head of the Charles River. While these two dams are both owned and operated by DCR, instead of the city, their proximity and functionality provide key protection to Cambridge. These two dams serve as vital infrastructure for the City of Cambridge to safeguard the community from the effects of present-day storm surge and coastal inundation. **Dam failure has not occurred at the Amelia Earhart or New Charles River Dam since their establishment in 1965 and 1978, respectively.** However, climate change projections of sea level rise and storm surge published by the city as part of its Climate Change Vulnerability Assessment (Cambridge, Climate Change Vulnerability Assessment, February 2017) project that both the dams are likely to be flanked and overtopped by 2070. Based on this report (Cambridge, Climate Change Vulnerability Assessment, February 2017), the Amelia Earhart Dam is likely to be flanked as soon as 2030-2035 by a 500-year water surface elevation and by 2045-2050 by a 100-year water surface elevation. The probability of complete failure of the Amelia Earhart Dam is unknown. As a low hazard potential dam, there isn't a Emergency Action Plan developed for the dam. Further analysis would need to be conducted on the dam in order to determine the probability of failure.

The Charles River Dam is likely to be flanked as soon as 2045 by a 500-year water surface elevation and by 2055-2060 by a 100-year water surface elevation. The Charles River Dam is likely to be overtopped by 2050 by a 500-year water surface elevation and by 2065 by a 100-year water surface elevation. With the more stringent sea level rise and storm surge projections adopted by the State (EEA & MEMA, 2023) as part of the Massachusetts Coast Flood Risk Model (MC-FRM), both these dams are likely to be flanked and overtopped sooner.

The salinity associated with these possible coastal flooding scenarios is cause for concern in regard to Cambridge's built infrastructure and natural resources (Cambridge, February 2017). If saltwater moves upstream into the Alewife Brook area, including into the Fresh Pond Reservoir, there could be significant impacts to the city's drinking water systems. Above-ground components of the water / stormwater system such as valves, hydrants, manhole covers, and pump stations would also be susceptible to corrosion if exposed to salt water for prolonged periods of time during flood events. Additionally, saline floodwaters may adversely affect the natural habitat and ecology in Cambridge's wetlands and natural areas.

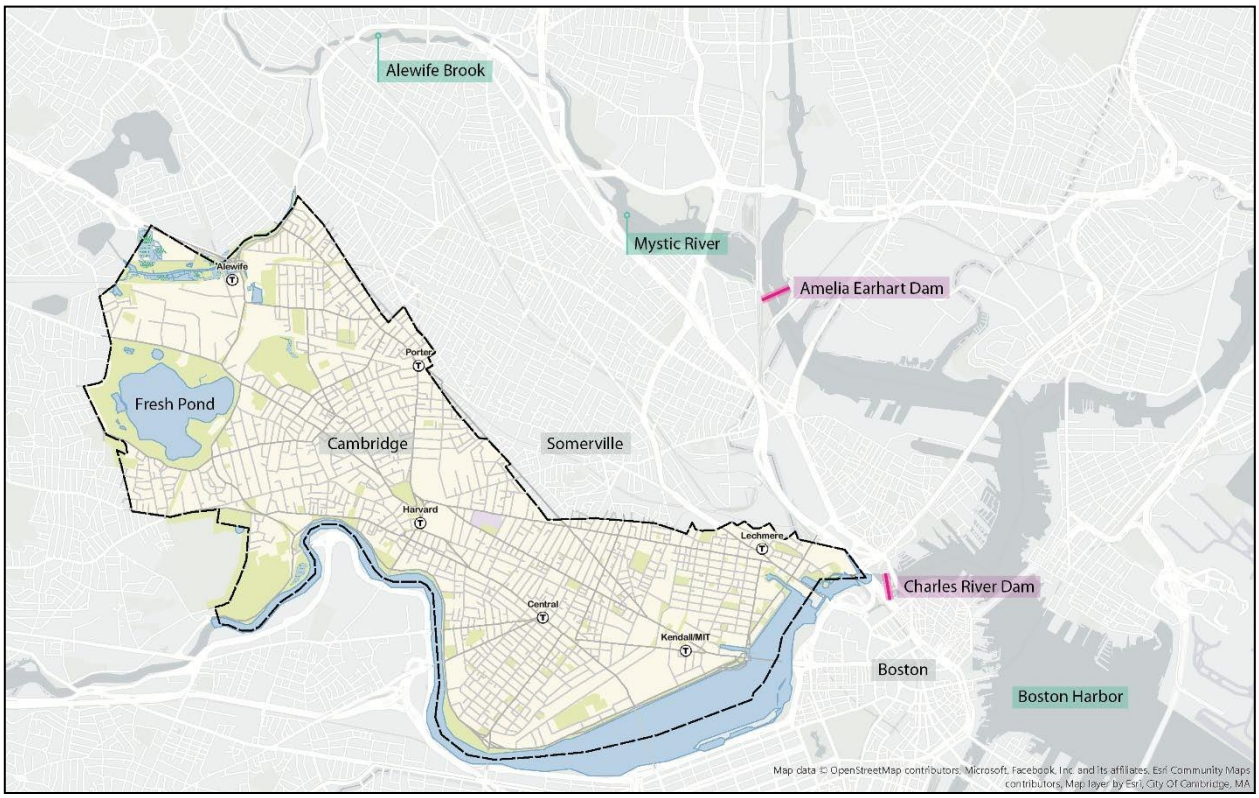


Figure 3.6: Locus map of Cambridge and the two dam locations.

3.4.1.1. Extent

The Cambridge CCVA (Cambridge, Climate Change Vulnerability Assessment, February 2017) states critical infrastructure systems – energy, roadways, public transit, telecommunications, critical service facilities, and water/wastewater systems – located in the Fresh Pond/Alewife area and in low-lying areas of the city linked to the Charles River are at increased risk from sea level rise/storm surge (SLR/SS) driven coastal flooding after 2030. The Fresh Pond-Alewife area is an area of particular concern due to the high probability of SLR/SS flooding and high depth of flooding that could significantly impact priority populations, critical infrastructure, and community resources. The stormwater and combined wastewater systems will likely be significantly impacted by SLR/SS flooding as there are additional areas that are likely to reach capacity and fail due to SLR/SS flooding compared to precipitation driven flooding alone.

The impacts of flooding from SLR/SS as a result of the flanking and overtopping of the dams have significant regional consequences, beyond the city, in terms of disruptions to energy distribution, transportation, and food services. Critical areas containing key infrastructure, such as the MBTA Red Line, Alewife Brook Parkway, and subsequent access to Route 2, as well as residential and vulnerable communities, can be highly impacted from the consequences of either or both of the dams being flanked and overtopped.

Flooding can cause physical damage to buildings and infrastructure, which could make areas inaccessible and create public safety hazards. Damages tend to increase with longer duration flooding, which could occur if the pumps at the Charles River Dam and Amelia Earhart Dam are not able to function properly during and after a storm. Analysis was done as part of CCVA Part II to

estimate the duration of flooding in the city from flanking and overtopping of the Amelia Earhart Dam using the BH-FRM data (Cambridge, 2017). Similar analysis using the MC-FRM has not yet been conducted to date. Saltwater flooding from SLR/SS also has the potential to cause long-term impacts to vulnerable local and regional infrastructure, such as the MBTA Red Line, due to its corrosive effects. Contamination from salt water or hazardous pollutants could also cause damage to water resources, such the Fresh Pond Reservoir.

3.4.1.2. Probability

The coastal flooding results from SLR/SS simulated using the MC-FRM for 2030 (Figure 3.7 through Figure 3.9) show that majority of the areas in the Alewife Brook watershed have a 0.5-1% annual probability of flooding by 2030, with areas north of the Alewife Brook can experience 1-2% annual probability of flooding by 2030. Areas adjacent to the Fresh Pond have a less than 0.1% annual probability of flooding by 2030. There is no coastal flooding in Eastern Cambridge around the Charles River by 2030. Some locations between the New and Old Charles River dams in the North Point area can experience less than 0.1% or between 0.1 to 0.2% annual probability of flooding, as well as at some locations along the Cambridge Somerville border, where there is a 1-2% annual probability of flooding by 2030.

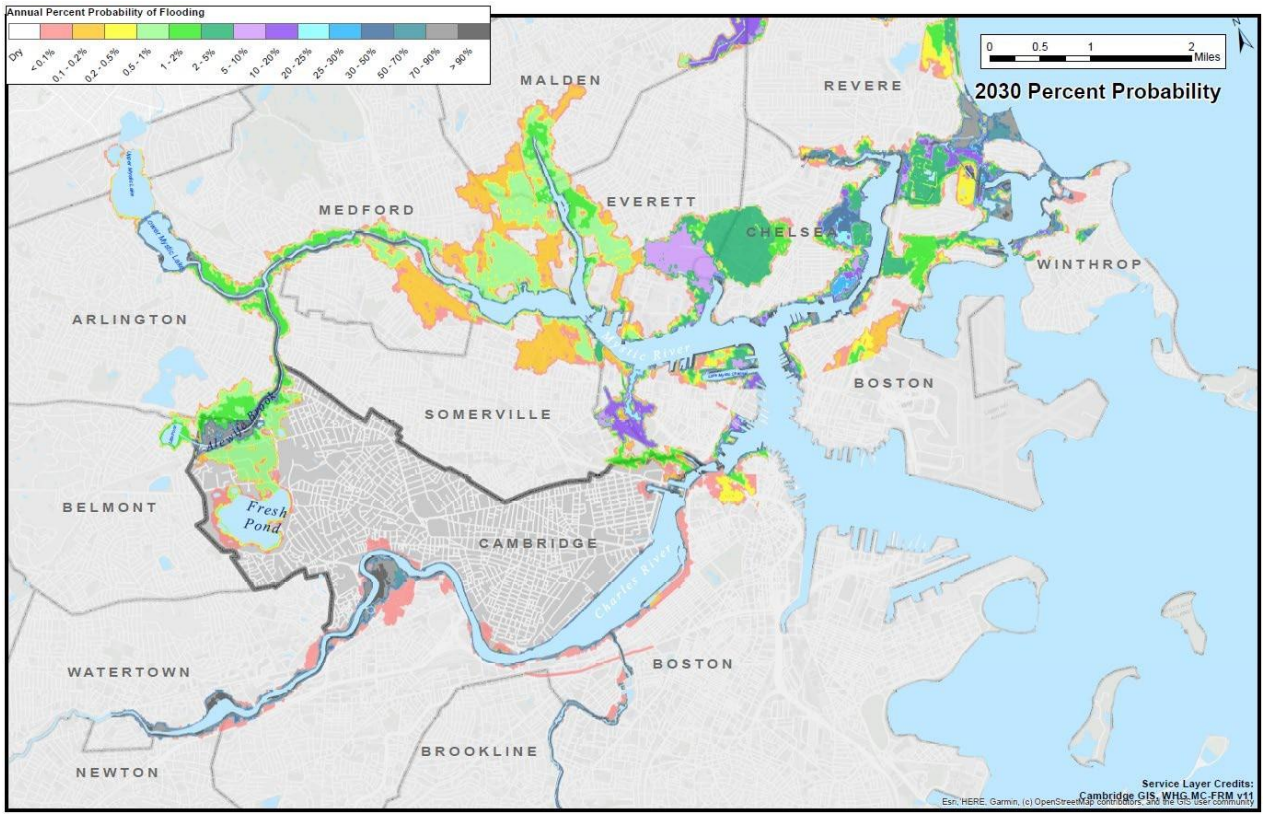


Figure 3.7: Probability and extent of coastal flooding by 2030, based on results from the Massachusetts Coast Flood Risk Model (2021)

MC-FRM results for 2050 (Figure 3.8) shows that majority of the areas in the Alewife Brook watershed have a 5-10% annual probability of flooding by 2050, with some areas north of the

Alewife Brook can experience as high as 70-90% annual probability of flooding by 2050. Areas adjacent to the Fresh Pond have between 2-5% annual probability of flooding by 2050. The Charles River and areas adjacent to the Charles River have 0.1- 0.5% annual probabilities of flooding by 2050. Along the north bank of the Charles River in some locations and in the area between the New and Old Charles River dams in the North Point, the annual probabilities of flooding are as high as 2-5% by 2050.

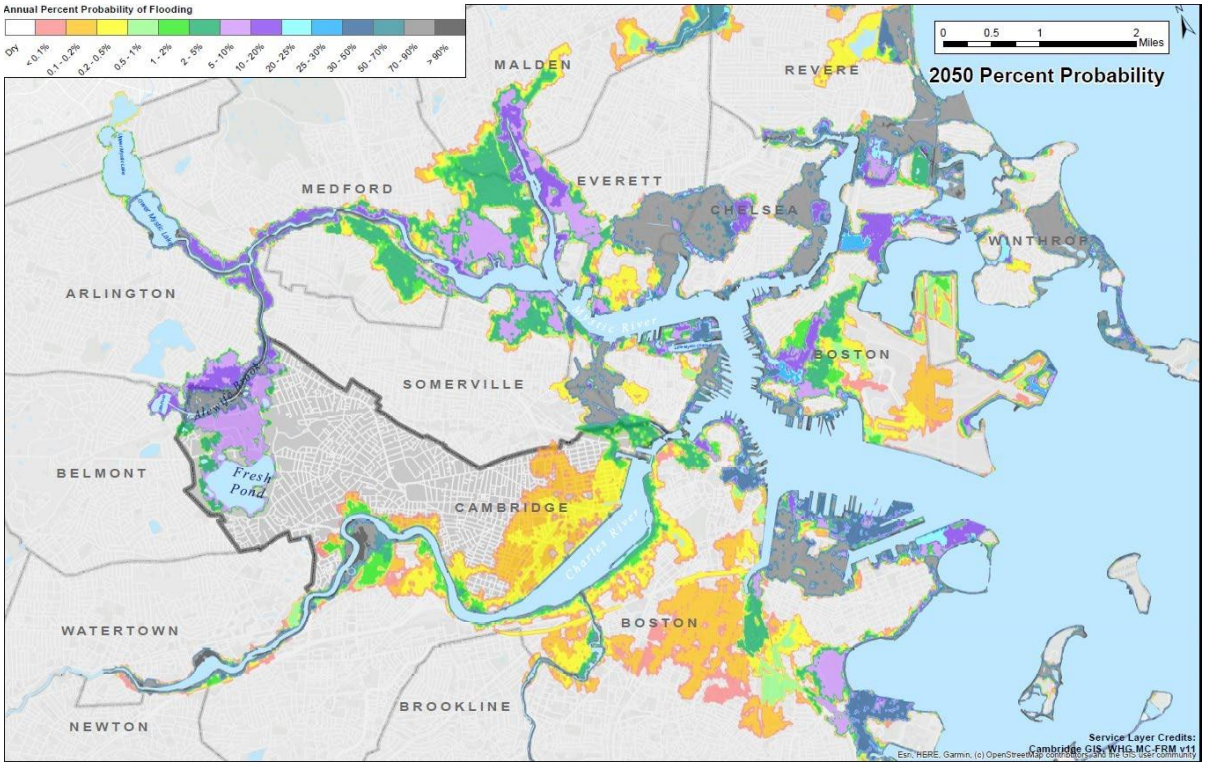


Figure 3.8: Probability and extent of coastal flooding by 2050, based on results from the Massachusetts Coast Flood Risk Model (2021)

MC-FRM results for 2070 (Figure 3.9) shows that majority of the areas adjacent to the Alewife Brook have a 50-70% annual probability of flooding by 2070, with some areas adjacent to the Alewife Brook likely to have 70-90% annual probability of flooding by 2070. The Charles River and areas adjacent to the Charles River have 5-10% annual probabilities of flooding by 2070. Along the north bank of the Charles River in locations between the New and Old Charles River dams in the North Point, the annual probabilities of flooding are as high as 70-90% by 2070.

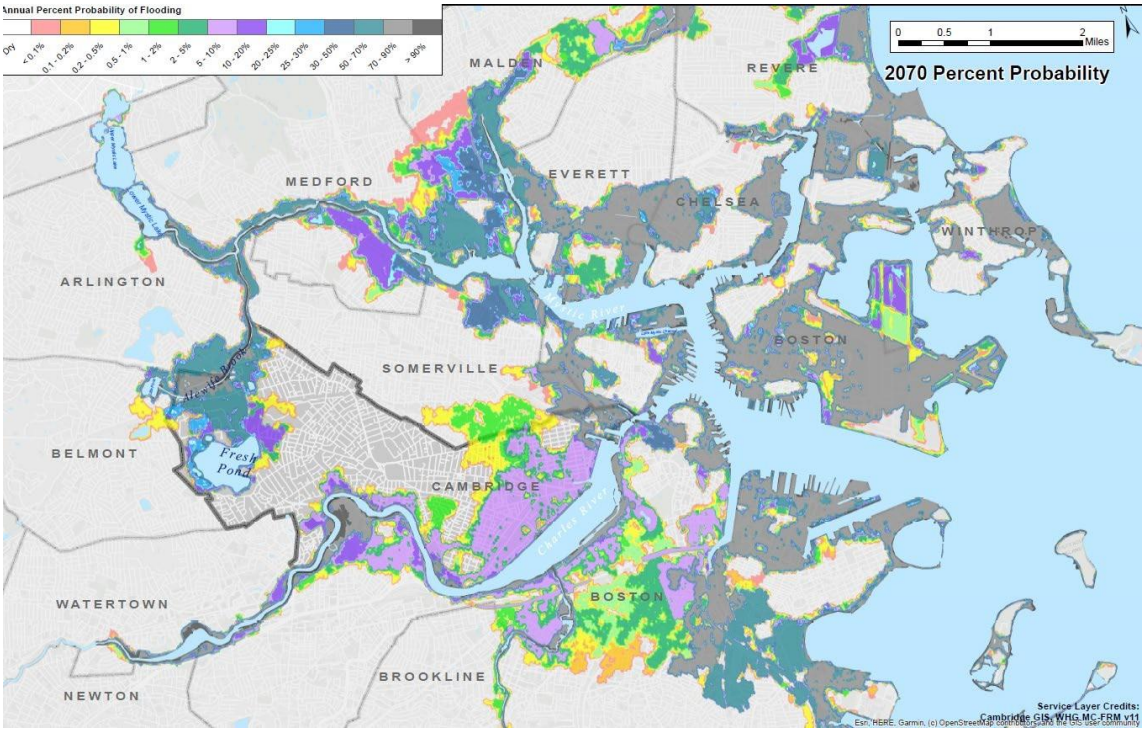


Figure 3.9: Probability and extent of coastal flooding by 2070, based on results from the Massachusetts Coast Flood Risk Model (2021)

3.4.1.3. Location

Figure 3.10 shows the geographic locations in the city that are likely to be flooded from sea level rise/storm surge from a 10% annual probability of flooding (left) and from a 1% annual probability of flooding (right) by 2070. Areas in the Alewife neighborhood are impacted from coastal flooding, with majority of the flooding from the Alewife Brook overtopping, as well as propagated coastal flooding through piped infrastructure in low-lying areas. Similarly, areas in Eastern Cambridge neighborhoods are impacted from coastal flooding, with a combination of flooding from the lower Charles River overtopping and propagated coastal flooding through piped infrastructure in low-lying areas. The extent of the floodplain will expand causing flooding in parcels that have not experienced flooding in the past.

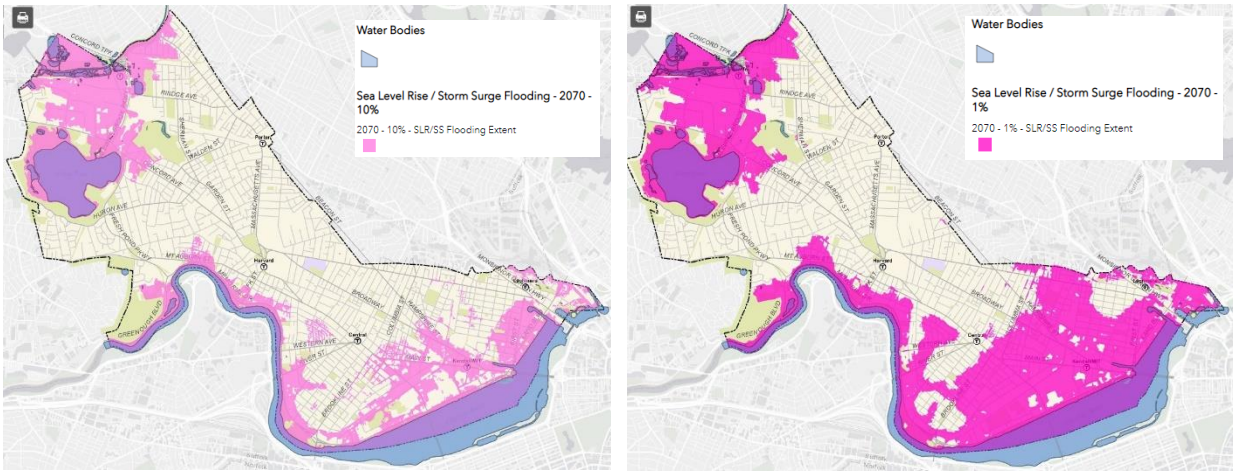


Figure 3.10: Potential flooding locations from projected coastal flooding by 2070 from climate change with sea level rise/storm surge (Left-10% annual probability, Right -1% annual probability) (Source: Cambridge Flood Viewer)

3.5. Hurricanes / Tropical Storms

3.5.1 | Description

Hurricanes originate from tropical storms, which form rotating cloud systems, developing over tropical or subtropical waters. There are four classifications of these types of storms (tropical cyclones) (National Hurricane Center, NOAA):

- **Tropical Depression:** A tropical cyclone with maximum sustained winds of 38 mph (33 knots) or less.
- **Tropical Storm:** A tropical cyclone with maximum sustained winds of 39 to 73 mph (34 to 63 knots).
- **Hurricane:** A tropical cyclone with maximum sustained winds of 74 mph (64 knots) or higher. In the western North Pacific, hurricanes are called typhoons; similar storms in the Indian Ocean and South Pacific Ocean are called cyclones.
- **Major Hurricane:** A tropical cyclone with maximum sustained winds of 111 mph (96 knots) or higher, corresponding to a Category 3, 4 or 5 on the Saffir-Simpson Hurricane Wind Scale.

3.5.2 | Previous Occurrences of Hazard Event(s)

There have been 57 hurricanes and tropical storms that have passed within 60 nautical miles of Cambridge between 1851 and 2021. At the time they passed by Cambridge, these storms ranged from extratropical storms, tropical depressions, and tropical storms, all the way to category 1 through category 3 hurricanes.

3.5.2.1. Extent

Table 3.15: Saffir-Simpson Hurricane Wind Scale (National Hurricane Center, NOAA)

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74 - 95 mph	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap, and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96 – 110 mph	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	111 – 130 mph	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4	131 – 155 mph	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	> 155 mph	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

3.5.2.2. Frequency

According to NOAA's Historical Hurricane Tracks tool, which is a public interactive mapping application that displays Atlantic Basin and East-Central Pacific Basin tropical cyclone data, there are 57 storms (including Extratropical, tropical storms, tropical depression and hurricanes (Category 1 through 5) that have passed within 60 nautical miles of Cambridge between 1858 and 2021 (NOAA, 2023). The tracks of these storms are shown in Figure 3.11. While many of these storms have not been direct hits for the city, some of the worst hurricanes that have impacted the city include Hurricane Bob in 1991; "the twins" from 1954, Hurricanes Carol and Edna; and last but not least, the Great New England Hurricane of 1938 (CZM, 2023). In more recent years, Hurricanes Henri (2021), Hurricane Ida (2021) and Tropical Storm Elsa (2021) have caused significant damage to Cambridge and the surrounding area.

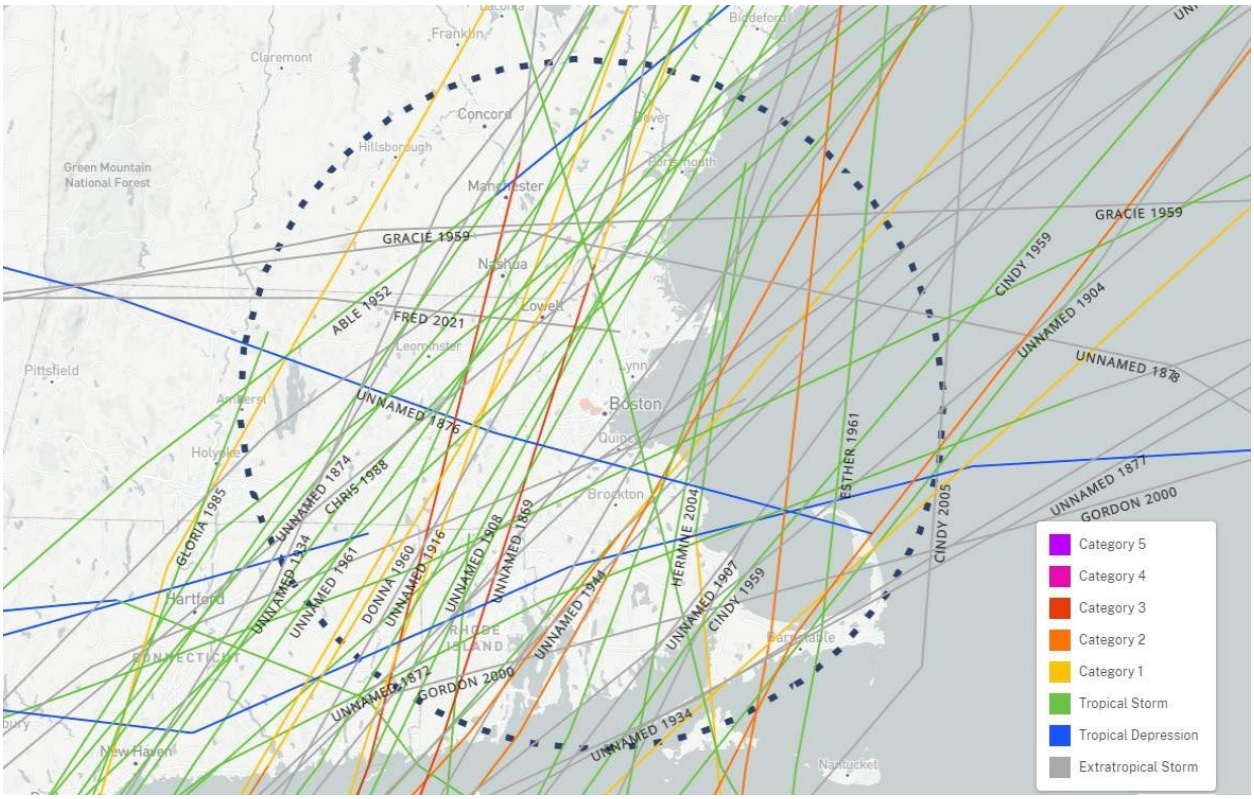


Figure 3.11: Historical Hurricane Tracks followed by storms within 60 nautical miles of Cambridge between 1851 and 2021 (NOAA, 2023)

3.5.2.3. Location

Hurricanes have the potential to impact the entire City of Cambridge. During August 2011, Irene's strong winds swept across Suffolk County, with frequent wind gusts of 35 to 55 mph, along with locally stronger wind gusts exceeding 60 mph. In the case of Hurricane Sandy, the timing meant the difference between millions of dollars of damage, as the storm passed by Boston 5 hours from high tide. A 100-year storm event hitting Boston during the high tide, combined with the 21 inches of sea level rise predicted for Boston by 2050, could result in $444 million in annual damages and could put up to 43,000 Bostonians at risk (City of Boston, 2016a). Since 2012, Massachusetts has experienced impacts from six tropical storms: Arthur, Hermine, Jose, Dorian, Andrea, and Fred.

The hurricane evacuation zone maps published by the Massachusetts Emergency Management Agency (MEMA) provide an indication of the locations of relative flood risk from hurricanes and tropical storms in MA. Figure 3.12 shows the hurricane evacuation zone map for the city of Cambridge. Parts of western Cambridge, including the Alewife area are in Zone A, which includes areas that, depending on predicted inundation, may flood first from storm surge during a tropical storm or hurricane. Parts of eastern Cambridge are in Zone B, which includes areas that would flood after areas in Zone A from storm surge during a tropical storm or hurricane. The cities of Boston and Cambridge have also designated a third zone, Zone C, which may flood depending on the track and intensity of the storm.

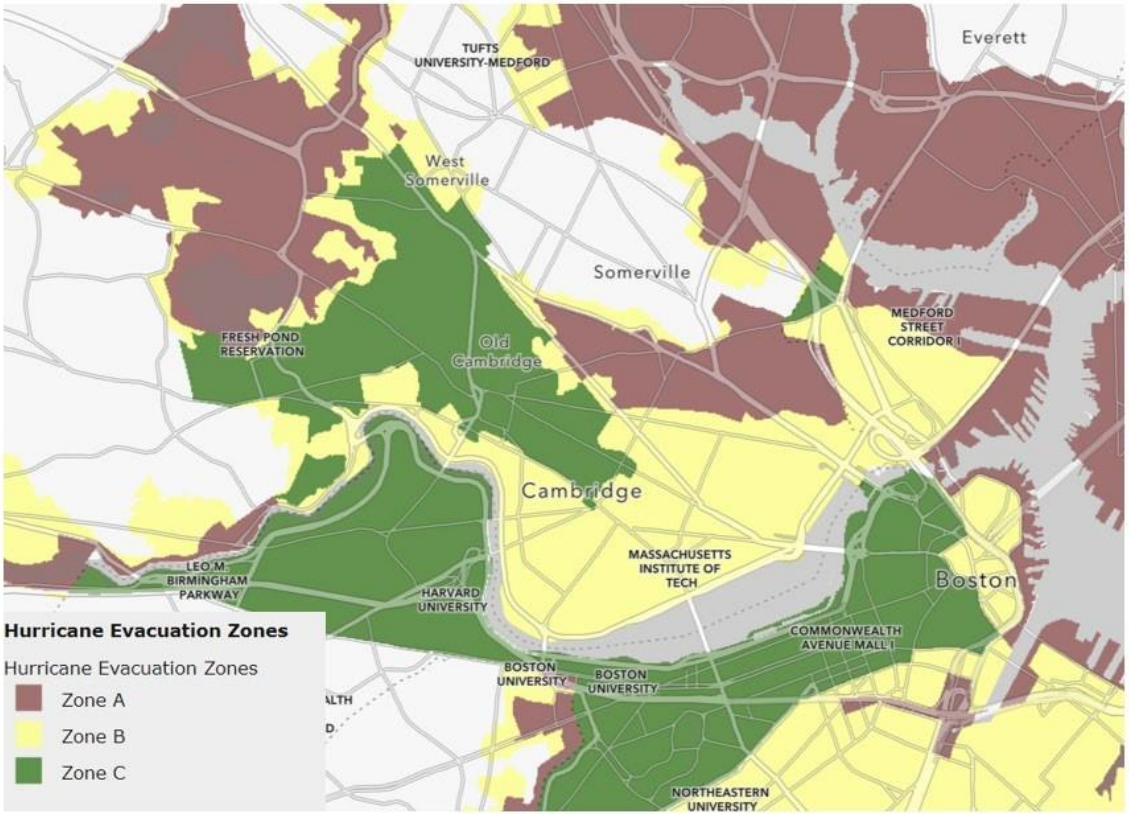


Figure 3.12: Hurricane evacuation zone map for the City of Cambridge (MEMA, mass.gov, 2023)

3.5.3 | Probability of Future Hazard Events due to Climate Change

3.5.3.1. Extent

Climate change will increase the intensity of tropical cyclones including hurricanes, leading to increased precipitation and storm surge in coastal communities (Ellen Douglas, 2022). The frequency of hurricanes is less certain, with some projections indicating a decrease in overall number but an increase in the proportion of the most intense category 4-5 hurricanes. The tracks of hurricanes may also shift northward, potentially making the Northeast more vulnerable to higher intensity storms that could cause a large amount of precipitation.

As a city located near the coast, Cambridge may be particularly vulnerable to the impacts of future hurricanes. Estimated SLR and higher intensity storms coupled with precipitation will likely result in damaging flood within the city during and after hurricanes especially if the rivers overflows their banks or the dams overtop. High winds associated with hurricanes could cause extensive damage to the city including downed trees and branches, structural damage, and power outages. Impacts such as these would leave the city vulnerable if emergency routes became blocked, public transportation was inaccessible, or cell service went down. Damage to infrastructure could leave much of the population with no housing or means of transportation.

To mitigate the potential impacts of future hurricanes, it will be important for the City of Cambridge to implement measures such as improving infrastructure, updating emergency response plans and evacuation routes. It will also be important for individuals and businesses to take steps to prepare for these events, such as developing evacuation plans and ensuring that homes and businesses are protected against flooding.

3.5.3.2. Probability

As cited in the 2022 Climate Change Impacts and Projections for the Greater Boston Area Report, while the overall frequency of hurricanes may remain the same or decrease, the impact of individual storms may increase due to SLR, increased storm surge, wind damage, and extreme precipitation (Ellen Douglas, 2022).

Future flooding impacts from hurricanes and tropical storms combined with sea level rise and storm surge in the coastal areas are included in the Massachusetts Coast Flood Model (MC-FRM) that has been adopted by the City of Cambridge. Based on MC-FRM, both the Amelia Earhart Dam and Charles River Dam are likely to be flanked and overtopped in the future from sea level rise and extreme storms, including hurricanes and tropical storms, which may result in portions of western Cambridge in the Alewife Brook sub-watershed to likely flood between 50 to 70% annual probability by 2070 and portions of eastern Cambridge in the lower Charles River sub-watershed to likely flood between 5 to 10% annual probability by 2070.

3.5.3.3. Location

Future hurricanes are anticipated to impact the entire City of Cambridge. While storm winds have the potential to damage the buildings and infrastructure across the city, flooding will impact primarily the low-lying areas of the city.

3.6. Tornadoes

3.6.1 | Description

Tornadoes are narrow, violently rotating columns of air that extend from the base of a thunderstorm to the ground. These windstorms develop when cool air overlays warm air, causing the warm air to rise rapidly. They are visible when dust and debris are collected in the rotating column.

Components that induce tornado formation include the following, (City of Cambridge & MAPC, 2015),

- Very strong winds in the mid and upper levels of the atmosphere
- Clockwise turning of the wind with height (from southeast at the surface to west aloft)
- Increasing wind speed with altitude in the lowest 10,000 feet of the atmosphere (i.e., 20 mph at the surface and 50 mph at 7,000 feet.)
- Very warm, moist air near the ground with unusually cooler air aloft
- A forcing mechanism such as a cold front or leftover weather boundary from previous shower or thunderstorm activity

3.6.2 | Previous Occurrences of Hazard Event(s)

Table 3.15 indicates the number of tornado events in Middlesex County since 1955 (20 events), as well as their date, severity, direct deaths and injuries from the event, and property damage estimated.

Table 3.16: Tornado Events in Middlesex County, Massachusetts (NCEI NOAA, 2023)

Date	Severity*	Direct Deaths from the Event	Direct Injuries from the Event	Property Damage Estimated
October 24, 1955	EF1	0	0	2.50K
June 19, 1957	EF1	0	0	25.00K
June 19, 1957	EF1	0	0	0.25K
July 11, 1958	EF2	0	0	250.00K
August 25, 1958	EF2	0	0	2.50K
July 3, 1961	EF0	0	0	25.00K
July 18, 1963	EF1	0	0	25.00K
August 28, 1965	EF2	0	0	250.00K
July 11, 1970	EF1	0	0	25.00K
October 3, 1970	EF3	1	0	250.00K
July 1, 1971	EF1	0	1	25.00K
November 7, 1971	EF1	0	0	0.25K
July 21, 1972	EF2	0	4	2.500M
September 29, 1974	EF3	0	1	250.00K
July 18, 1983	EF0	0	0	0.25K
September 27, 1985	EF1	0	0	0.25K
August 7, 1986	EF1	0	0	250.00K
August 22, 2016**	EF1	0	0	1.000M
August 23, 2021	EF0	0	0	8.00K

Date	Severity*	Direct Deaths from the Event	Direct Injuries from the Event	Property Damage Estimated
August 23, 2021	EF0	0	0	2.00K

*Enhanced Fujita (EF) Severity Scale, described below.

**While there has yet to be a tornado that has touched down in Cambridge, the 2016 tornado in Middlesex County hit near the Cambridge Turnpike in Concord, MA, and headed northeast. This tornado caused roughly $1 million in property damages and one house suffered significant structural damage (NOAA NCEI, 2016).

3.6.2.1. Extent

The severity of tornadoes is rated by the National Weather Service (NWS, NOAA) based on 3-second wind gusts and subsequent damage created. Table 3.16 and Table 3.17 describe tornado severity and associated damages for each.

Table 3.17: Enhanced Fujita (EF) Scale for Tornado Damage, (NOAA, n.d.)

Fujita Scale			Derived EF Scale		Operational EF Scale	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

Table 3.18: Tornado Damage

Scale	Potential Damage
EF0	**Minor Damage** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always: rated EFO.
EF1	**Moderate damage** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	**Considerable damage** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	**Severe damage** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	**Extreme damage to near-total destruction** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	**Massive Damage** Strong frame houses leveled off foundations and swept away; steel-reinforced concrete structures critically damaged; high-rise buildings have severe structural deformation. Incredible phenomena will occur.

3.6.2.2. Frequency

Massachusetts has experienced approximately 190 tornadoes from 1950 to 2021, resulting in about 2.7 tornadoes ever year. However, there has been an average frequency of 2.1 events per year in the last 20 years (NCEI NOAA, 2023), and Middlesex County recorded 20 tornadoes between 1950 and 2023 (NCEI NOAA, 2023). Tornadoes most commonly occur in the summer months of June through August, forming in the afternoon or evening (City of Cambridge & MAPC, 2015).

This hazard is stated as having a 2-20% chance of occurrence per year, or a once in 5-50 years chance of occurrence (City of Cambridge & MAPC, 2015).

3.6.2.3. Location

Tornadoes are a potential citywide threat to Cambridge. This is a concern as most structures in Cambridge pre-date current building codes and could be subject to damages (City of Cambridge & MAPC, 2015).

3.6.3 | Probability of Future Hazard Events due to Climate Change

3.6.3.1. Extent

Climate change could lead to more frequent and intense tornadoes similar to the trends predicted with severe thunderstorms (EEA & EOPSS, 2018). Tornadoes are short-lived and relatively small-scale weather events, making it challenging to capture them accurately in global climate models. Additionally, tornadoes are influenced by many factors beyond just climate, including local weather patterns, geography, and atmospheric conditions. Therefore, it is difficult to make accurate predictions about the future frequency of tornadoes.

3.6.3.2. Probability

Based on currently available information, it is difficult to predict the probability of tornadoes in the future. However, climate change is expected to increase extreme weather events. Therefore, probability of tornadoes in Cambridge may increase in frequency and intensity under the influence of climate change.

3.6.3.3. Location

Like other severe storms, tornadoes could impact the whole city and its built infrastructure.

3.7. Earthquake

3.7.1 | Description

Earthquakes originate from a vibration in the Earth's surface, that results in a release of energy in the Earth's crust. This causes movement or trembling of the ground. Earthquakes generally occur along fault boundaries but can also be induced within interior portions of a plate. Massachusetts falls on the eastern edge of the North American plate, which is moving due to compressions and squeezing of global plates (EEA & EOPSS, 2018).

In addition to building collapse, earthquakes can cause structural damage to roadways, breakage of water and gas lines, and flooding and fires. Furthermore, landslides can be triggered by earthquakes.

3.7.2 | Previous Occurrences of Hazard Event(s)

Between 1963 and 2023, approximately 76 earthquakes have occurred in Massachusetts (USGS, 2023). Table 3.18 indicates the earthquakes that have occurred in Massachusetts since 1963, their depths (radius of impact), and their magnitudes (Richter Scale) (USGS, 2023). No earthquake has ever been recorded as originating within Cambridge's boundaries.

Table 3.19: Historical Occurrences of Earthquakes in Massachusetts (USGS, 2023).

Date	Magnitude	Location
1963-10-16	3.41	30 km SE of Gloucester, Massachusetts
1963-10-30	2.59	4 km NE of Ipswich, Massachusetts
1974-10-09	1.5	3 km SSE of Hopkinton, Massachusetts
1975-08-03	2.4	1 km SW of Ipswich, Massachusetts
1976-03-14	3	2 km SSW of Chatham, Massachusetts
1976-05-10	2.7	9 km SW of Bliss Corner, Massachusetts
1977-12-20	3.1	7 km NW of White Island Shores, Massachusetts
1978-09-01	2	2 km WSW of Acton, Massachusetts
1980-11-23	2.5	2 km NW of Chelmsford, Massachusetts
1981-09-12	2.1	1 km WNW of Teaticket, Massachusetts
1982-01-27	3	2 km WNW of North Lakeville, Massachusetts
1982-10-27	2.8	46 km E of Rockport, Massachusetts
1982-10-28	2.2	40 km ENE of Rockport, Massachusetts
1982-11-01	2.3	10 km ESE of Green Harbor-Cedar Crest, Massachusetts
1982-11-01	2.2	38 km ENE of Rockport, Massachusetts
1982-11-01	2.6	42 km E of Rockport, Massachusetts
1982-11-09	2.3	4 km N of Petersham, Massachusetts
1985-10-15	3	2 km E of Boxborough, Massachusetts
1989-08-24	3	2 km S of Fairhaven, Massachusetts
1990-01-23	2.5	3 km NNW of Boxborough, Massachusetts
1990-10-11	2.7	5 km NNE of The Pinehills, Massachusetts
1993-07-22	2.1	1 km E of Abington, Massachusetts
1993-07-28	2.3	3 km WNW of Chelmsford, Massachusetts
1994-10-02	3.3	1 km NW of Hardwick, Massachusetts
1994-10-02	3.7	6 km W of Hardwick, Massachusetts
1996-04-22	2.6	3 km NE of North Westport, Massachusetts
1999-10-13	2.7	2 km E of Littleton Common, Massachusetts
2000-06-16	3.3	5 km NE of Granville, Massachusetts
2002-06-07	2.5	3 km NNW of Hopedale, Massachusetts
2003-07-22	2.98	72 km NNE of Provincetown, Massachusetts
2004-02-24	2	8 km SSW of Bliss Corner, Massachusetts
2004-10-08	1.8	3 km SSE of Littleton Common, Massachusetts
2005-04-05	2.23	2 km NNE of Fairhaven, Massachusetts

Date	Magnitude	Location
2005-11-17	2.5	4 km S of Plymouth, Massachusetts
2007-10-08	1.8	2 km SSW of Merrimac, Massachusetts
2007-10-19	2.5	2 km WSW of Littleton Common, Massachusetts
2009-04-10	2.3	2 km ESE of Winthrop, Massachusetts
2011-05-16	2.1	16 km NW of Chilmark, Massachusetts
2012-09-16	2.11	69 km ENE of Rockport, Massachusetts
2012-11-06	1.94	3 km N of Northampton, Massachusetts
2013-02-20	2.3	6 km ESE of Newburyport, Massachusetts
2014-01-09	2.03	2 km SW of Mattapoisett, Massachusetts
2014-02-11	2.23	4 km SW of Mattapoisett, Massachusetts
2014-05-03	1.38	4 km SW of Mattapoisett, Massachusetts
2014-08-18	2	28 km SE of Gloucester, Massachusetts
2015-04-21	1.8	1 km N of Plympton, Massachusetts
2015-11-18	1.5	2 km ESE of Holliston, Massachusetts
2016-02-22	1.3	3 km WNW of Acton, Massachusetts
2016-06-01	2.2	50 km ENE of Rockport, Massachusetts
2017-09-06	1.7	1 km SW of Athol, Massachusetts
2017-10-01	1.6	1 km N of Fairhaven, Massachusetts
2017-11-28	1.6	1 km SW of Boxborough, Massachusetts
2018-06-25	1.4	2 km ENE of Franklin, Massachusetts
2018-12-21	1.4	3 km WNW of Gardner, Massachusetts
2018-12-21	2.1	3 km NNE of Templeton, Massachusetts
2018-12-23	2.2	2 km W of Gardner, Massachusetts
2019-01-26	0.9	2 km S of Boxborough, Massachusetts
2019-01-28	1.6	3 km ESE of Baldwinville, Massachusetts
2019-02-08	1.4	7 km E of Nahant, Massachusetts
2019-02-18	1.1	3 km ESE of Boxborough, Massachusetts
2019-04-22	1.7	19 km SSE of Gloucester, Massachusetts
2019-04-27	2.1	27 km NE of Rockport, Massachusetts
2019-07-01	1.5	27 km SE of Gloucester, Massachusetts
2019-08-21	1.7	0 km S of Onset, Massachusetts
2019-10-26	1.3	4 km ESE of Essex, Massachusetts
2019-12-03	2.1	1 km W of North Plymouth, Massachusetts
2020-07-24	2.1	16 km ENE of Edgartown, Massachusetts
2020-11-08	3.6	10 km S of Bliss Corner, Massachusetts
2020-11-22	2	9 km SSW of Bliss Corner, Massachusetts
2021-07-25	1.4	2 km N of South Peabody, Massachusetts
2021-08-04	1.2	1 km NE of Peabody, Massachusetts
2021-08-18	1.3	0 km ESE of Peabody, Massachusetts

Date	Magnitude	Location
2022-01-01	2	15 km N of Rockport, Massachusetts
2022-03-04	2.2	2 km SSE of Erving, Massachusetts
2022-09-24	1.8	1 km S of Boxborough, Massachusetts
2022-11-05	2.1	5 km NNW of Nantucket, Massachusetts

3.7.2.1. Extent

To measure the magnitude and intensity of an earthquake, the Richter Magnitude Scale and the Modified Mercalli Intensity scale are used (refer to Table 3.19 and 3.20).

Table 3.20: Richter Magnitude Scale & Subsequent Effects (City of Cambridge & MAPC, 2015).

Richter Magnitude	Earthquake Effects
Less than 3.5	Generally not felt but recorded.
3.5 - 5.4	Often felt, but rarely causes damage.
Under 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1 - 6.9	Can be destructive in areas up to about 100 km. across where people live.
7.0 - 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or greater	Great earthquake. Can cause serious damage in areas several hundred meters across.

Table 3.21: Modified Mercalli Intensity Scale (USGS, n.d.)

Intensity	Shaking	Description/Damage
I	Not Felt	Not felt except by very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings.
FIV	Light	Felt indoors by many, outdoors by few during the day. At night some awakened. Dishes, windows, doors disturbed, walls make cracking sounds.

Intensity	Shaking	Description/Damage
V	Moderate	Felt by nearly everyone, many awakened. Unstable objects overturned.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved. Damage slight.
VII	Very Strong	Damage negligible in buildings of good design and construction, slight to moderate in well-built structures, considerable damage in poorly built.
VIII	Severe	Damage slight in specially designed structures, considerable damage and partial collapse in standard buildings. Damage great in poorly built structures
IX	Violent	Damage considerable in specially designed structures. Damage great in substantial buildings with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed, most masonry and frame structures destroyed with foundations. Rails bent.

3.7.2.2. Frequency

The 2018 State Hazard Mitigation and Climate Adaptation Plan states that there is about a 10-15% chance, over a ten-year period, that a magnitude 5.0 or greater earthquake could occur somewhere in New England (EEA & EOPSS, 2018). The 2018 State Hazard Mitigation and Climate Adaptation Plan further states that earthquake events occur with a 1-2% chance of occurrence per year, or once in 50-100 years.

Based on the USGS 2014 Massachusetts Seismic Hazard map (Figure 3.13), Cambridge is also stated to have an earthquake peak ground acceleration (PGA) that has a 2% chance of being exceeded in 50 years, has a value between 14-20 %g (%g: percent of gravity (or, percentage of the force we experience from gravity) (USGS, n.d.).

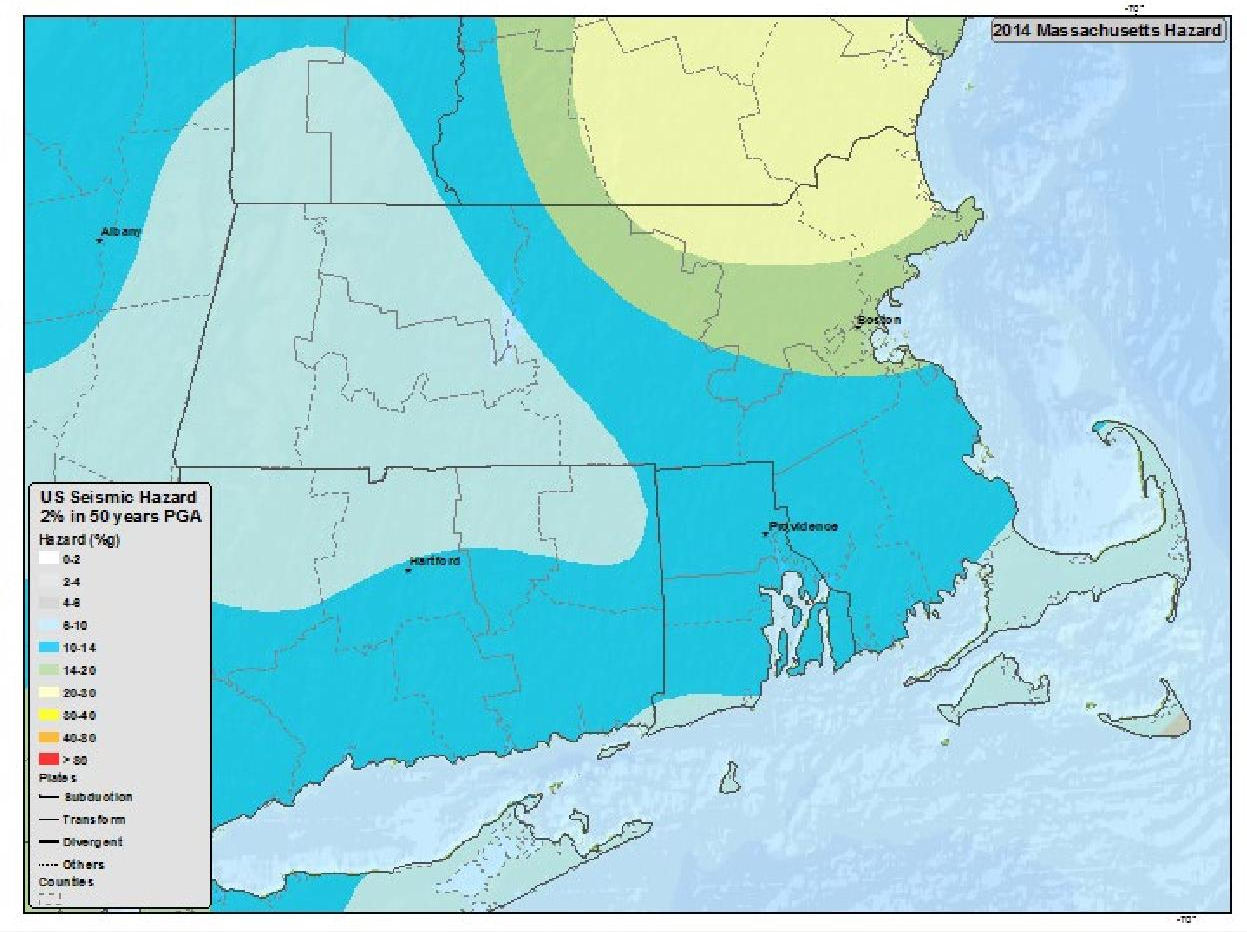


Figure 3.13: 2014 Massachusetts Seismic Hazard, (USGS, n.d.)

3.7.2.3. Location

Earthquakes are expected to be a citywide hazard event for Cambridge. However, certain areas of the city are more susceptible to damages and liquefaction than others. Liquefaction is when loosely packed, water-logged sediments lose strength and shift in large masses. Portions of Cambridge, particularly the southern end along the Charles River, were built on non-engineered artificial fill. Other sections of the city subsist on glacial outwash or glacial till. Both these soil types are highly susceptible to liquefaction, which can be triggered with an earthquake magnitude of 5.0 or greater. Figure 3.13 and Figure 3.14 depict the current geology and liquefaction potential.

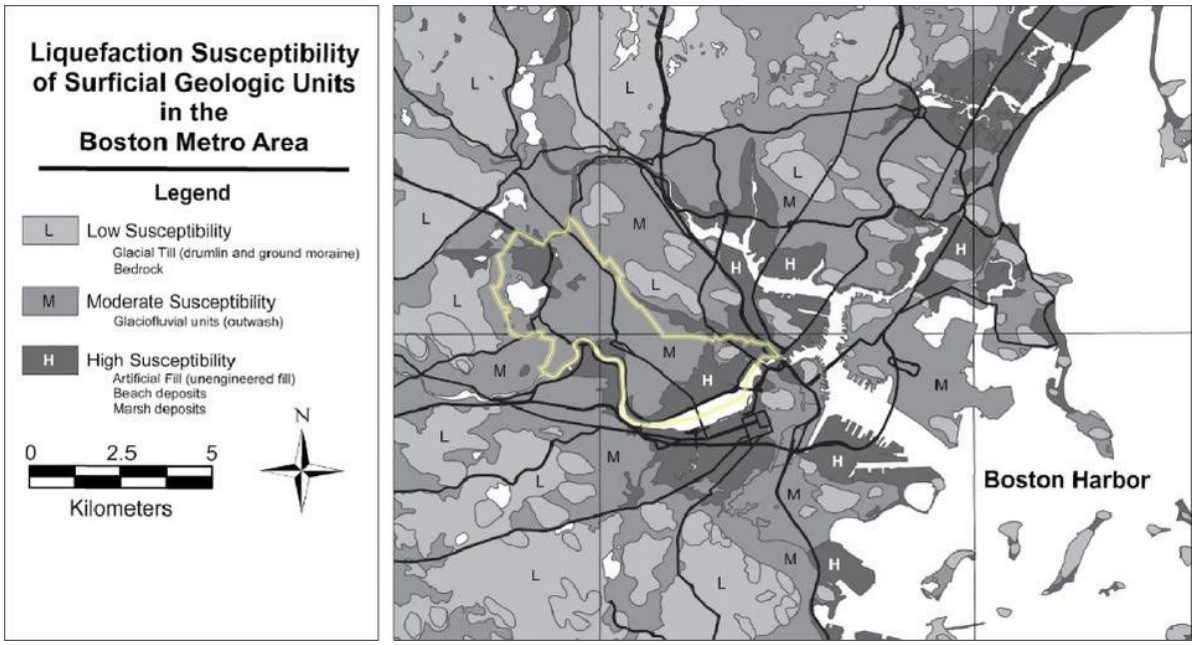


Figure 3.14: Boston Study Region Liquefaction Potential (City of Cambridge & MAPC, 2015)

3.7.3 | Probability of Future Hazard Events due to Climate Change

3.7.3.1. Extent

Earthquakes are natural hazards that can occur at any time and without warning. While it is not possible to predict exactly when and where an earthquake will occur, scientists can estimate the probability of earthquake occurrences based on historical data and geological studies. According to (NASA, 2019), "induced seismicity" can occur as a result of human water usage, which causes changes in water levels at fault lines. This phenomenon has been observed in the vicinity of dams in the United States, particularly when there are rapid fluctuations in the water level behind the dam.

3.7.3.2. Probability

Although earthquakes cannot be predicted, the USGS 2014 Seismic Hazard Map helps identifying areas that are more likely to experience earthquakes. For Cambridge, the map predicts moderate peak gravity acceleration of 14 to 20 percent (Figure 3.13).

3.7.3.3. Location

Earthquakes will impact the entire city. Areas with soft soils or loose sediments and buildings with weak foundation and poor seismic design are more vulnerable to earthquake damage due to their tendency to amplify seismic waves.

3.8. Landslides

3.8.1 | Description

The U.S. Geological Survey describes landslides as including, "a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows." While gravity is a primary instigator for a steepened slope becoming a landslide, other contributing factors exist. When sloped material is subject to heavy rainfall or over-saturates in another way, debris or mud may flow. The resultant flow can be dangerous to trees, houses, cars, and built infrastructure. This effect can be exacerbated when erosion from rivers, glaciers, or waves create over steepened slopes.

3.8.2 | Previous Occurrences of Hazard Event(s)

There are no documented previous occurrences of landslides in Cambridge.

3.8.2.1. Extent

Landslides are measured in terms of intensity and velocity. Factors of landslide vulnerability include location, type of human activity, use, and frequency of landslides. Hazards can be reduced by avoiding construction on steep slopes and in locations of existing or known landslides, or by first stabilizing these slopes. Refer to the table below for a description of the resultant volume of moving land from the two qualitative measurements. This table can clarify the consequential destructiveness of a landslide based on the aforementioned characteristics.

Table 3.22: Landslide Measurement of Volume and Velocity (Cardinali et al., 2002)

Estimated Volume (m^3)	Expected Landslide Velocity		
	Fast Moving (Rock Fall)	Rapid Moving (Debris Flow)	Slow Moving (Slide)
<0.001	Slight Intensity	-	-
<0.5	Medium Intensity	-	-
>0.5	High Intensity	-	-
<500	High Intensity	Slight Intensity	-
500-10,000	High Intensity	Medium Intensity	Slight Intensity
10,000-50,000	Very High Intensity	High Intensity	Medium Intensity
>500,000	-	Very High Intensity	High Intensity

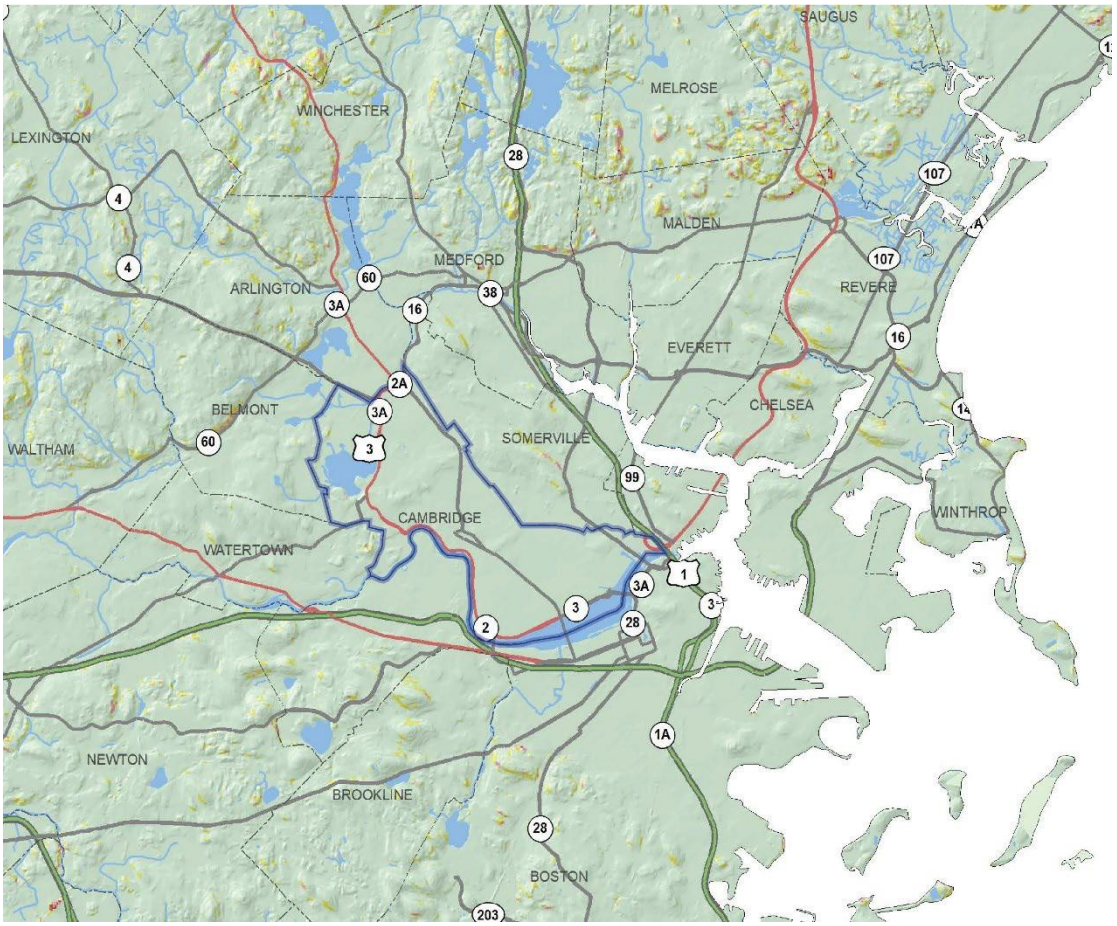
Estimated Volume (m^3)	Expected Landslide Velocity		
	Fast Moving (Rock Fall)	Rapid Moving (Debris Flow)	Slow Moving (Slide)
>>500,000	-	-	Very High Intensity

3.8.2.2. *Frequency*

Due to the lack of previous occurrences in Cambridge, landslides have a very low frequency of occurrence. It is estimated that these events can occur less than 1% per year.

3.8.2.3. *Location*

Landslides have the potential to be a citywide hazard event, although the overall flat topography of the city is generally not conducive for a landslide to occur. It is likely that if a landslide were to occur in Cambridge, it would occur as a slow-moving slide rather than a fast-moving rock fall. As evident in Figure 3.15 below, the City of Cambridge is classified as the green, stable area, with a very low relative slide ranking.



Map Color Code	Predicted Stability Zone	Relative Slide Ranking[1]	Stability Index Range[2]	Factor of Safety (FS)[3]	Probability of Instability[4]	Predicted Stability With Parameter Ranges Used in Analysis	Possible Influence of Stabilizing or Destabilizing Factors[5]
	Unstable	High	0	Maximum FS<1	100%	Range cannot model stability	Stabilizing factors required for stability
	Upper Threshold of Instability		0 - 0.5	>50% of FS1	>50%	Optimistic half of range required for stability	Stabilizing factors may be responsible for stability
	Lower Threshold of Instability	Moderate	0.5 - 1	≥50% of FS>1	<50%	Pessimistic half of range required for instability	Destabilizing factors are not required for instability
	Nominally Stable	Low	1 - 1.25	Minimum FS=1	_	Cannot model instability with most conservative parameters specified	Minor destabilizing factors could lead to instability
	Moderately Stable		1.25 - 1.5	Minimum FS=1.25	_	Cannot model instability with most conservative parameters specified	Moderate destabilizing factors are required for instability
	Stable	Very Low	>1.5	Minimum FS=1.5	_	Cannot model instability with most conservative parameters specified	Significant destabilizing factors are required for instability

Figure 3.15: Slope Stability Map and Legend of Northeastern Massachusetts, Focusing on Cambridge (Massachusetts Geological Survey, UMass Amherst, 2013)

[1]Relative Slide Ranking - This column designates the relative hazard ranking for the initiation of shallow slides on unmodified slopes.

[2]Stability Index Range - The stability index is a numerical representation of the relative hazard for shallow translational slope movement initiation based on the factors of safety computed at each point on a 9 meter (~30 foot) digital elevation model grid derived from the National Elevation Dataset. The stability index is a dimensionless number based on factors of safety generated by SINMAP that indicates the probability that a location is stable considering the most and least favorable

parameters for stability input into the model. The breaks in the ranges of values for the stability index categories are the default values recommended by the program developers.

[3]Factors of Safety - The factor of safety is a dimensionless number computed by SINMAP using a modified version of the infinite slope equation that represents the ratio of the stabilizing forces that resist slope movement to destabilizing forces that drive slope movement (Pack et al., 2001). A FS>1 indicates a stable slope, a FS<1 indicates an unstable slope, and a FS=1 indicates the marginally stable situation where the resisting forces and driving forces are in balance.

[4]Probability of Instability - This column shows the likelihood that the factor of safety computed within this map unit is less than one (FS<1, i.e., unstable) given the range of parameters used in the analysis. For example, a <50% probability of instability means that a location is more likely to be stable than unstable given the range of parameters used in the analysis.

[5]Possible Influence of Stabilizing and Destabilizing Factors - Stabilizing factors include increased soil strength, root strength, or improved drainage. Destabilizing factors include increased wetness or loading, or loss of root strength.

3.8.3 | Probability of Future Hazard Events due to Climate Change

3.8.3.1. Extent

Climate change may lead to an increase in the frequency and severity of rainfall events, which could cause soil saturation and erosion, potentially triggering landslide events (Gariano, 2016). Furthermore, rapid snow melt and rain-on-snow events can also increase the risk of landslides.

3.8.3.2. Probability

Although Cambridge has a low frequency of landslides occurrence, climate change may increase the likelihood of landslides in the area due to more frequent and intense storms, reduced vegetation cover resulting from increased drought events, or increased urbanization.

3.8.3.3. Location

Landslides will be a citywide phenomenon particularly areas with low vegetation will likely to be most affected by potential landslides. As can be seen in Figure 3.16 above, all of Cambridge has a very low risk for landslides.

3.9. Tsunami

3.9.1 | Description

A tsunami is a devastating onshore surge of water or a string of waves created by the displacement of a large volume of water (EEA & EOPSS, 2018). A tsunami may form following an earthquake or volcanic activity occurring below or near the ocean floor, but can also be caused by landslides, glacier calving, and meteorite impacts. Tsunamis can move hundreds of miles per hour (mph) in the open ocean and can come ashore with waves as high as 100 feet or more (EEA & EOPSS, 2018). As they approach shallower water and land, tsunamis are often no more than 10 ft in height, and slow to speeds of 20 to 30 mph (NOAA, 2018).

The previous Cambridge Hazard Mitigation Plan 2015 Update did not include mention of tsunamis, likely due to the rarity of occurrence for the city, as the city is located inland of direct coastal exposure.

3.9.2 | Previous Occurrences of Hazard Event(s)

Research conducted by NOAA and USGS, for the United States and Territories National Tsunami Hazard Assessment, Historical Record and Sources for Waves – Update, indicates that there have been two occurrences of a tsunami in Massachusetts: one of an undetermined height and one with wave runup between 0.01 and 0.3 meters. The report indicates the runup event was earthquake-triggered (NOAA & USGS, 2015). There is no documentation that these events affected the City of Cambridge.

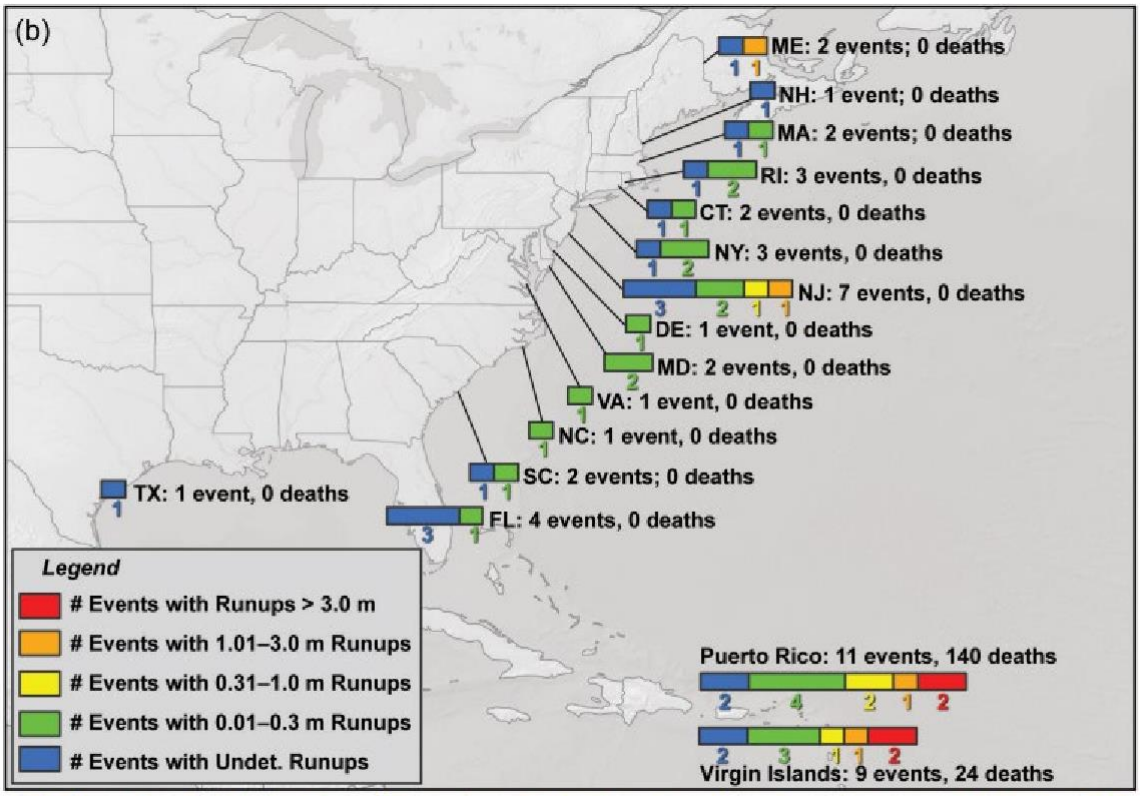


Figure 2-4. Maps showing total number of tsunami events, total number of events causing runup heights from 0.01 m to >3.0 m, and total deaths due to tsunamis for U.S. states and territories in the (a) Pacific Ocean and (b) Atlantic Ocean. (Note: Bar scales in (a) and (b) are not the same.)

Figure 3.16: Runup events along the East Coast of the U.S. (NOAA & USGS, 2015)

3.9.2.1. Extent

Tsunamis are generally measured by their height and runup of their waves on shore, with most tsunamis measuring usually less than 10 feet high when they hit land. Of the two tsunami occurrences within Massachusetts, only one of the events had observed runup of an undetermined height, while the other observed runups of 0.1-0.3 meters (Figure 3.16) demonstrating the extent of the tsunamis to be low.

The severity of these two occurrences in Massachusetts were minimal, with no reported deaths or damages (NOAA & USGS, 2015). There has been no threat of a significant tsunami for the coast of Massachusetts in recent history (EEA & EOPSS, 2018).

3.9.2.2. Frequency

The frequency of occurrence of a tsunami in Massachusetts is 1 event every 39 years (EEA & EOPSS, 2018), with 0.01 total events per year and all tsunami runups of less than 1.0 m (NOAA & USGS, 2015).

3.9.2.3. Location

If a tsunami were to occur, the geographic location of the tsunami could potentially result in an impact to a significant part of the city, depending on the runup (NOAA & USGS, 2015). It is more likely that locations within Cambridge likely to experience coastal flooding will be the area impacted.

3.9.3 | Probability of Future Hazard Events due to Climate Change

3.9.3.1. Extent

Natural disasters such as earthquakes, volcanic activity, and landslides can trigger tsunamis. As a result of melting ice and collapsing glaciers, earthquakes, landslides, and submarine landslides are expected to increase, potentially leading to more frequent or stronger tsunamis. Additionally, isotonic rebound and glacier earthquakes caused by a warmer climate could trigger additional tsunamis in the future (EEA & EOPSS, 2018). Currently, there is no information available about the likelihood of a destructive tsunami occurring along the Massachusetts coastline. The existence of two dams may protect Cambridge from some coastal impacts, including the potential to lessen damage from a tsunami. However, the extent of damage would be dependent on the magnitude of the tsunami.

3.9.3.2. Probability

Given the infrequency of tsunami occurrences along the East Coast, the probability of tsunamis affecting Cambridge is very low.

3.9.3.3. Location

Depending on the magnitude of a tsunami, it could have the potential to impact all of Cambridge, or locations within Cambridge likely to experience coastal flooding.

3.10. Extreme Temperatures

3.10.1 | Description

Temperatures are considered extreme when they extend outside of the typical range of average conditions for acute or prolonged periods of time. Extremes can vary seasonally and occur in the form of either extreme cold or extreme heat. These temperature extremes can affect everyday life for the city and its residents. Hazard events can trigger issues for public and environmental health,

economic activities, electrical grids, and reliable transportation. While Massachusetts has a climate of four well-defined seasons with varying temperature averages, extremes outside of these seasonal fluctuations can cause major problems for the city.

3.10.2 | Previous Occurrences of Hazard Event(s)

3.10.2.1. Extreme Heat

Table 3.22 below summarizes some of the annual average and extreme heat parameters for the City of Cambridge.

Table 3.23: Annual Temperatures for the City of Cambridge (City of Cambridge, 2015)

Temperature Changes	Baseline (1971-2000)
Annual Temperature (°F)	50
Summer Temperature (°F)	70.6
Days > 90°F (days/year)	11
Days > 100°F (days/year)	<1
Heat Index (°F)	85

The NWS issues a Heat Advisory when the maximum heat index temperature is expected to be 100° or higher for at least 2 days, and night time air temperatures will not drop below 75°. The NWS issues an Excessive Heat Warning when the maximum heat index temperature is expected to be 105° or higher for at least 2 days and night time air temperatures will not drop below 75°.

According to the NOAA Storm Events Database (NOAA, Storms Event Database, 2023), there have been 22 heat events reported between 2016 and 2022, and 10 excessive heat events reported in the same time period.

3.10.2.2. Extreme Cold

Table 3.23 below summarizes the annual average and extreme cold parameters for the City of Cambridge.

Table 3.24: Annual Temperatures for the City of Cambridge (City of Cambridge, 2015)

Temperature Changes	Baseline (1971-2000)
Annual Temperature (°F)	50
Winter Temperature (°F)	29.8
Days < 32°F (days/year)	145

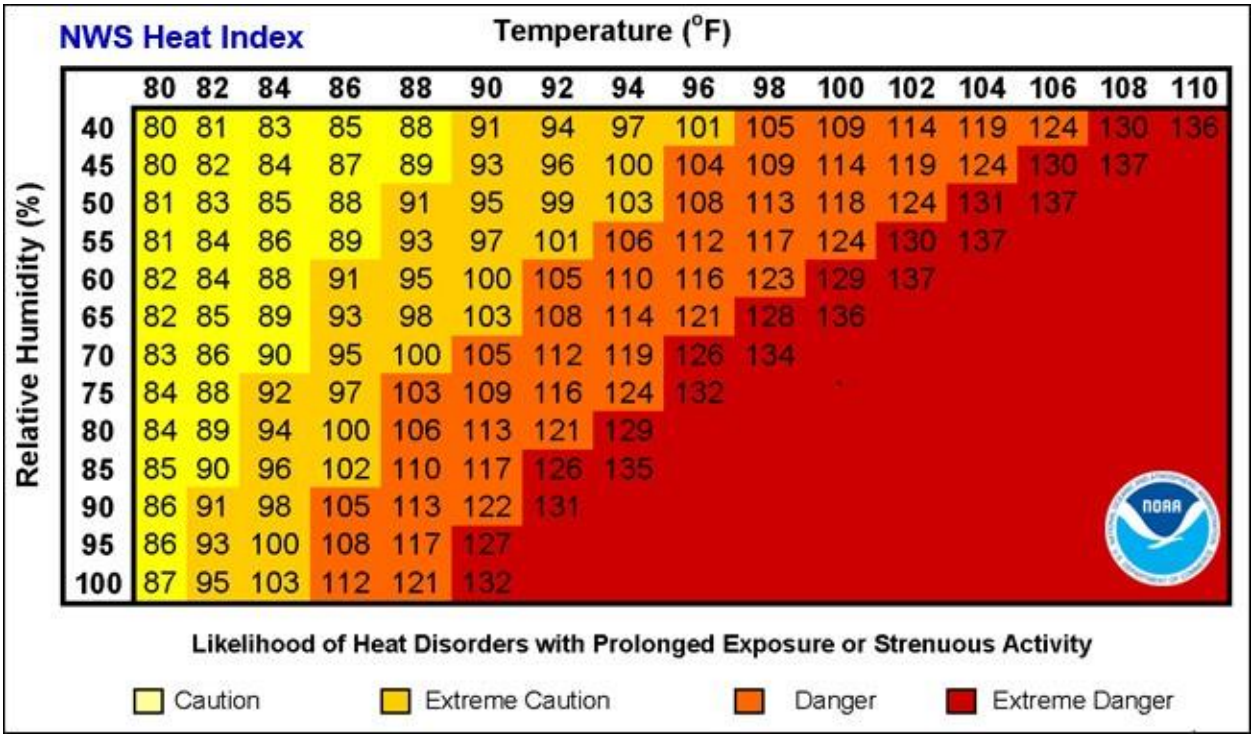
Temperature Changes	Baseline (1971-2000)
Days < 0°F (days/year)	6
Heat Index (°F)	85

An average of 1.5 extreme cold weather events per year have occurred over the last two decades. Between 1994 and 2018, there were 33 cold weather events within the Commonwealth.

3.10.2.3. Extent

Extreme Heat

Relative humidity can worsen human health effects as temperatures increase. The extent of extreme heat temperatures is generally measured through the NWS Heat Index, which is based both on temperature and relative humidity, and describes a temperature equivalent to what a person would feel at a baseline humidity level. Figure 3.19 presents the heat index chart as published by NOAA National Weather Service. Understanding this relationship is helpful for measuring or predicting the impact of high temperatures and humidity on human health. Often coined the "feels like" temperature, the heat index is an indicator of heat stress on the human body.



Classification	Heat Index	Effect on the body
Caution	80°F - 90°F	Fatigue possible with prolonged exposure and/or physical activity
Extreme Caution	90°F - 103°F	Heat stroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity
Danger	103°F - 124°F	Heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity
Extreme Danger	125°F or higher	Heat stroke highly likely

Figure 3.17: National Weather Service Heat Index (NWS NOAA)

Heat wave is an extreme heat phenomenon that affects the city. Heat waves are identifiable as 3 or more consecutive days when maximum temperatures greater than 90°F occur. This implies that there is an extended period of unusually high temperatures, causing stress on everyday operations and physical health (EEA & EOPSS, 2018).

Another extreme heat phenomenon that is relevant for the City of Cambridge is the urban heat island (UHI) effect. The term "heat island" describes built-up areas that are hotter than nearby rural or shaded areas. An urban environment like the city also exacerbate the effects of extreme heat through the presence of impervious surfaces. Increased tree canopy and other engineered green infrastructure solutions, such as bioretention basins, rain gardens, green roofs, and highly reflective surfaces, as well as built shade structures have the potential to reduce the UHI effect in Cambridge. The city's UHI provides additional detail.

Extreme Cold

Extreme cold temperatures can be exacerbated by factors such as wind and relative humidity. The extent of extreme cold temperatures is generally measured through the Wind Chill Temperature Index, and Figure 3.18 shows the Wind Chill Temperature Index. As evident from the figure, temperatures can feel colder and cause more damage to human health as wind speeds increase. Wind Chill Temperature is the temperature that people and animals feel when they are outside, and it is based on the rate of heat loss from exposed skin by the effects of wind and cold. As wind increases, the body loses heat at a faster rate, causing the skin's temperature to drop. The NWS issues a Wind Chill Advisory if the Wind Chill Index is forecast to dip to –15°F to – 24°F for at least 3 hours, based on sustained winds (not gusts). For example, frostbite can occur in 30 minutes at warmer than usual temperatures if wind speeds are greater.

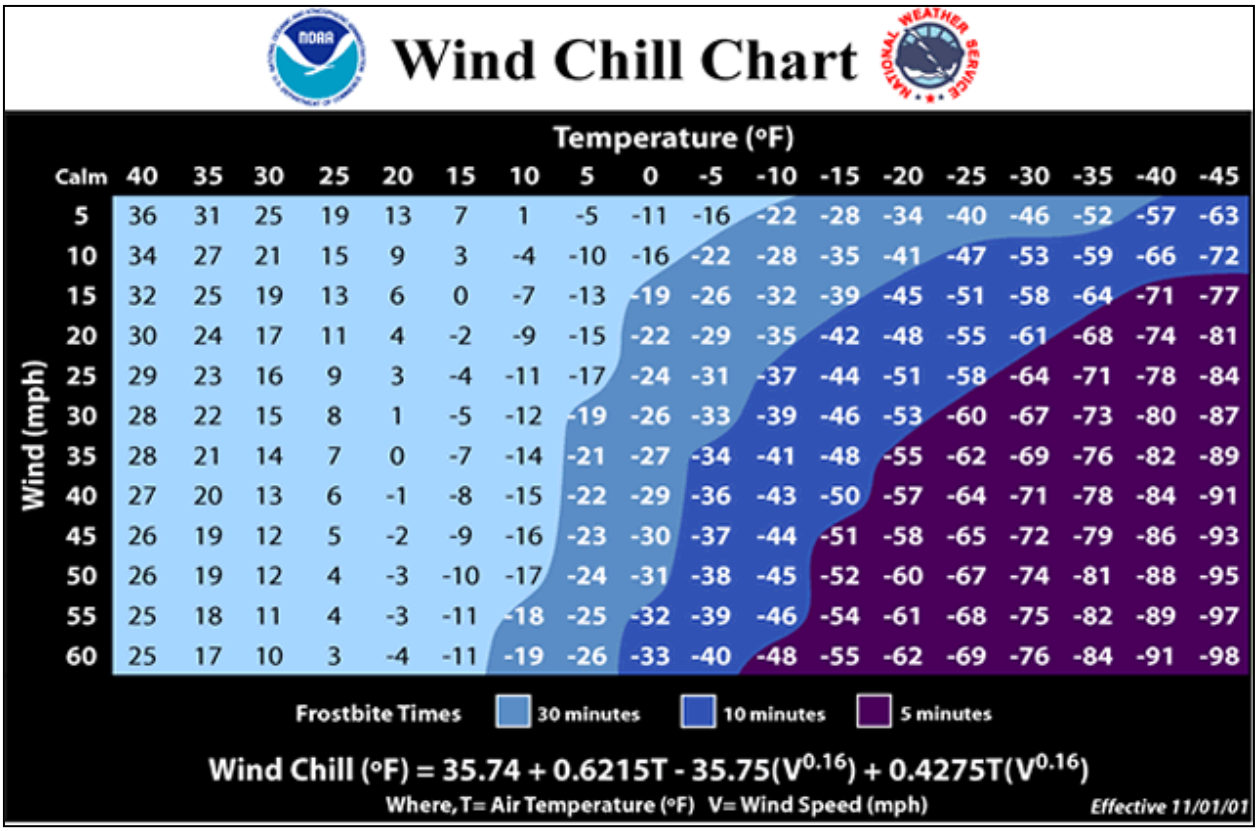


Figure 3.18: National Weather Service Wind Chill Chart (NWS NOAA, 2001)

3.10.2.4. Frequency

Extreme Heat

The 2018 SHMCAP states that two extreme hot weather events have occurred annually in Massachusetts (EEA & EOPSS, 2018). Additionally, from 1971 to 2000, there have historically been an average of 11 days per year over 90^{O} F, and only one day over 100^{O} F every seven years or so (City of Cambridge and ATMOS, 2015). In 2022, the hottest 30 day stretch on record was recorded in the Boston metro area with over 26 days of temperatures over the 80^{O} F (Epstein, 2022).

Extreme Cold

The 2018 SHMCAP states that 1.5 extreme cold weather events have occurred annually in Massachusetts (EEA & EOPSS, 2018).

3.10.2.5. Location

Extreme Heat

Extreme heat is often more extreme in concentrated parts of the city that have less tree canopy, more pavement, and dark surfaces such a roofs that absorb more heat, as evident in Figure 3.20

and Figure 3.21.

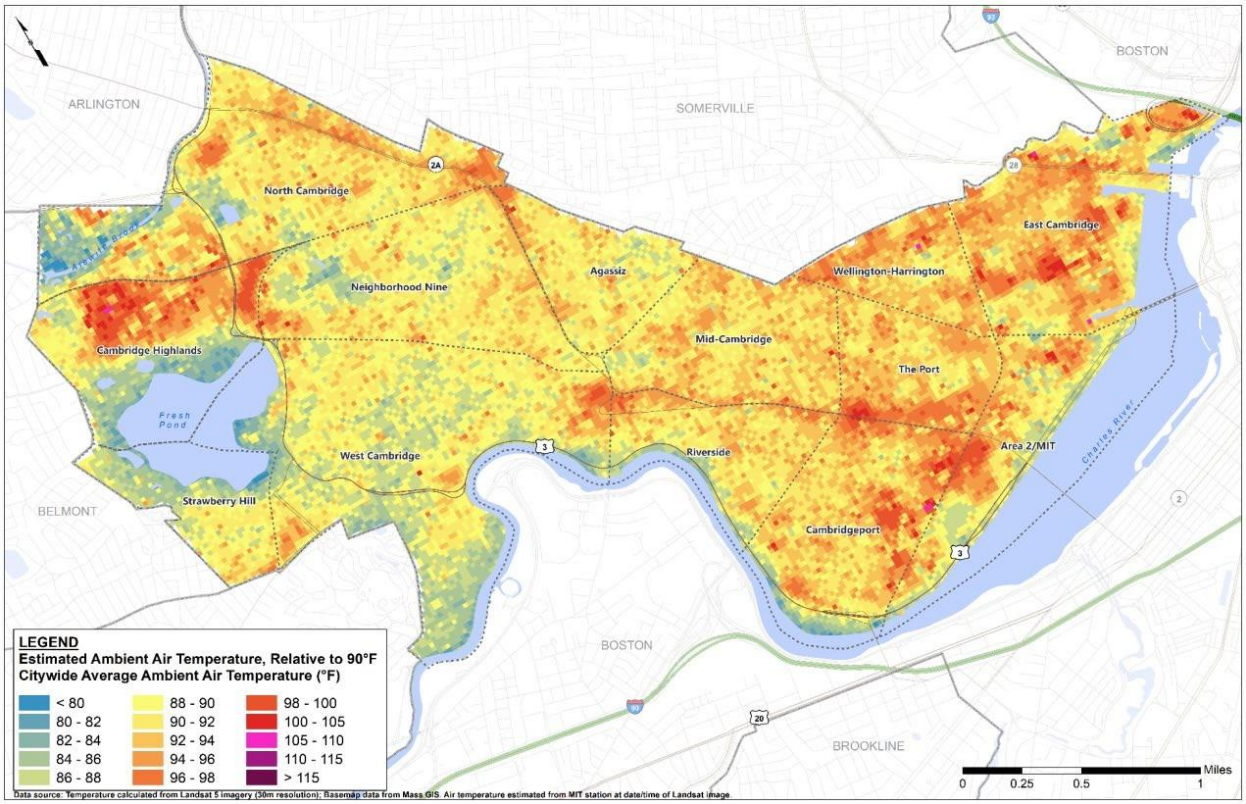


Figure 3.19: Estimated Ambient Air Temperature Relative to 90°F under 2018 canopy, impervious surface and cool roof conditions (City of Cambridge, 2022)

A critical measure for temperature is the heat index, which combines ambient air temperature and relative humidity to determine the "feels-like" or the human-perceived temperature. Heat index is a key indicator for reporting public health concerns since heat index exceeding 91°F is considered to be in the "extreme caution" zone from prolonged exposure to heat or strenuous activity.

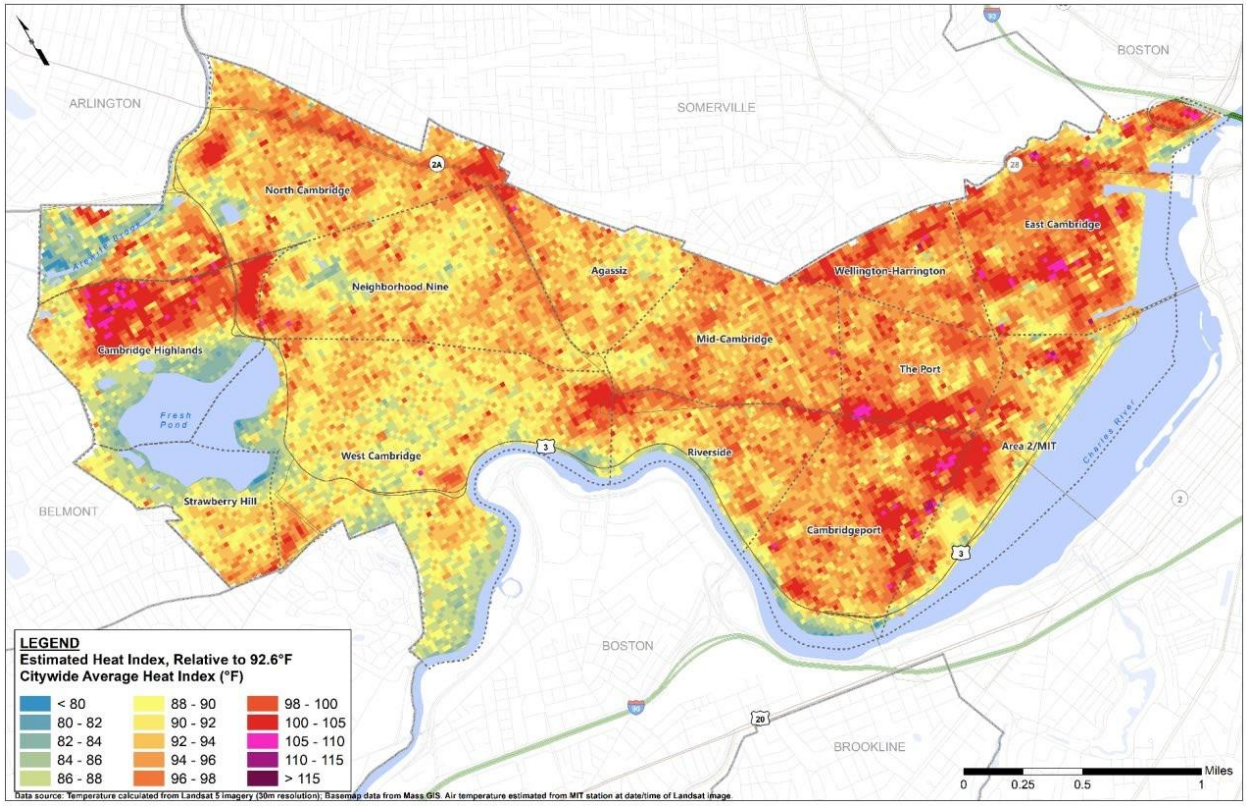


Figure 3.20: Estimated Heat Index Relative to 93°F under 2018 canopy, impervious surface and cool roof conditions (City of Cambridge, 2022)

Extreme Cold

Extreme cold can occur city-wide. Extreme cold can disproportionately affect priority community members through the city, especially for people without shelter, those who are stranded, and those who live in home that are poorly insulated or without heat.

3.10.3 | Probability of Future Hazard Events due to Climate Change

3.10.3.1. Extent

Extreme Heat

Based on all the recently published reports (IPCC, MA Climate Assessment, GBRAG) temperatures will continue to increase through the 21st century. Summers are expected to get hotter with a higher number of days with maximum temperature above 90°F and above 100°F.

The following figure (Figure 3.22) shows the future warming scenarios from Cambridge CCVA (City of Cambridge and ATMOS, 2015). As shown in the report, annual average temperatures and winter temperature are projected to increase by 8°F, whereas summer temperature is estimated to increase up to 10°F by 2070 under high emission scenarios. Both the number of days above 90°F and 100°F are estimated to increase considerably by 2070. Summer temperature is estimated to increase up to 10°F by 2070 under high emission scenarios. The graphic from CCVA report (Figure 3.22) shows the relative changes in high heat days over the three-month summer period (June, July, August) in the future. As depicted in the figure, if the warmest days of the year only occurred during the summer months of June through August, it is possible that temperatures in Cambridge could surpass 90°F for majority of the summer.

Figure 3.21 shows baseline and projected temperature of Cambridge (City of Cambridge and ATMOS, 2015).

Temperature Changes	Baseline	2030s (2015-2044)		2070s (2055-2084)	
	1971-2000	Lower	Higher	Lower	Higher
Annual Temperature (°F)	50	53.3	53.5	55.8	58.7
Summer Temperature (°F)	70.6	74.5	74.8	77.4	80.6
Winter Temperature (°F)	29.8	32.2	33	34.6	38
Days > 90°F (days/year)	11	29	31	47	68
Days > 100°F (days/year)	<1	2	2	6	16
Heat Index (°F)	85	94.75	96	101	115.5

Figure 3.21: Baseline and projected temperature of Cambridge

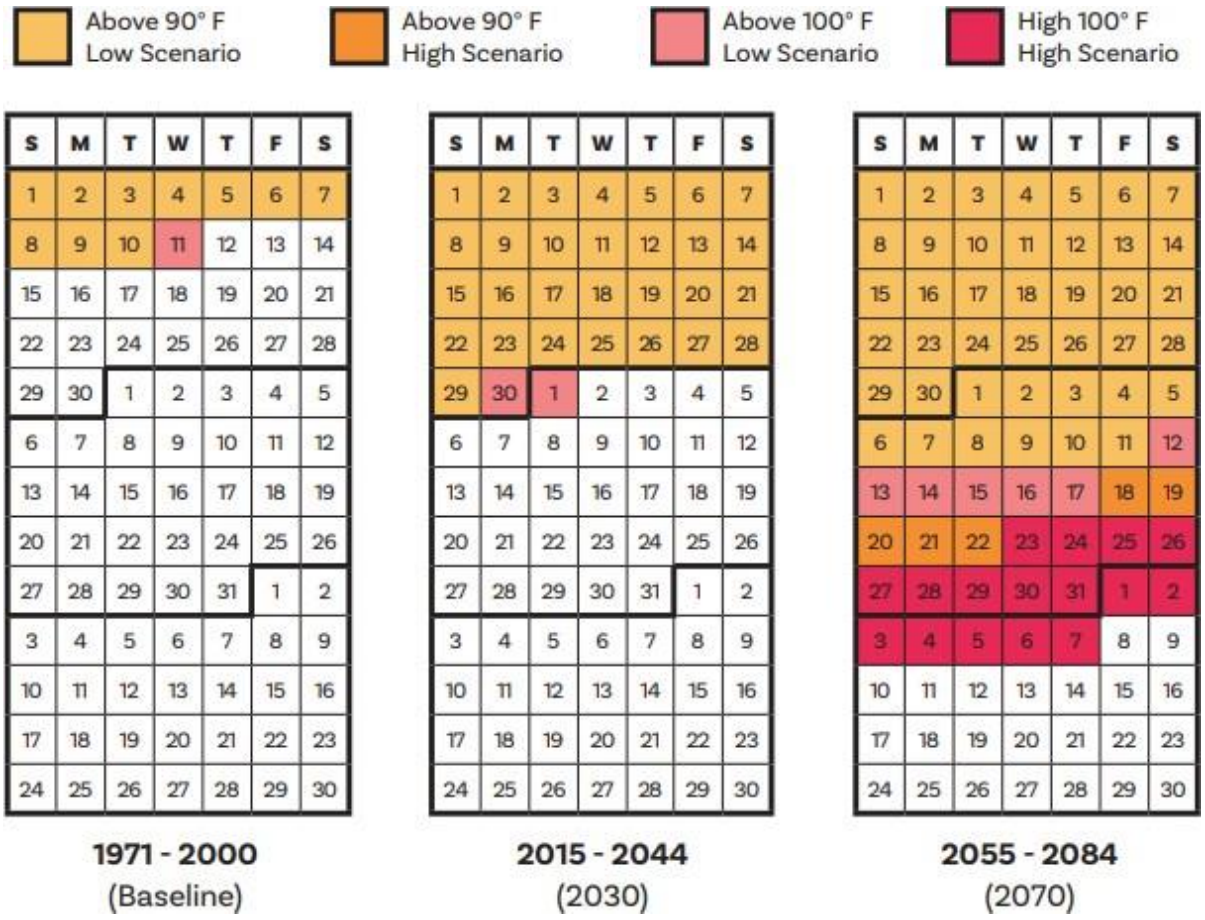


Figure 3.22: Relative increase in projected days above 90F and 100F over a three-month period as shown in Cambridge CCVA (City of Cambridge and ATMOS, 2015)

The state has recently published updated climate projections in ResilientMA ((MA EOEEA, 2021) from MA EEA's Climate and Hydrologic Risk Project (Phase 1). The projections in ResilientMA are based on higher emission scenario (RCP8.5) and the data is available at the HUC-8 basin scale. The updated numbers are reported in Table 3.23 for heat related climate parameters for the Charles River Basin. The inference from the data still remains the same as the CCVA report namely that the annual, summer, and winter average temperatures are estimated to increase by the end of the century. Summer is anticipated to be hotter by up to 39 more number of days above 90°F by 2070.

Additionally, updated viewer also provide data of heat stress events which is defined as a number of instances when a 3-day moving average of temperature is above 86 °F (MA EOEEA, 2021). Heat stress event is an indicator of extreme heat events that cause heat-related illnesses (Department of Health, New York State, 2020). Number of heat stress events is projected to increase up to 6 events per year by 2070 and 11 events per year by 2090. The impact of heat stress will be more pronounced in cities like Cambridge where built infrastructure dominates the landscape and lower amounts of shade is available.

Table 3.25: Projected changes in temperature parameters from baseline as reported in ResilientMA

Heat Parameters	Baseline (1971-2000)	2030 (2020-2049)	2050 (2040-2069)	2070 (2060-2089)	2090 (2080-2099)
	Higher Emission Scenario (RCP8.5)				
Annual Average Temperature (°F)	50.4	3.6	5.4	8.1	9.9
Summer Average Temperature (°F)	69.6	3.6	5.4	8.1	9.9
Winter Average Temperature (°F)	30.6	3.6	6.3	8.1	9.9
Days above 90°F (days/year)	8	12	21	39	52
Days above 95°F (days/year)	1	4	8	17	25
Days above 100°F (days/year)	0	0	1	4	8
Days below 32°F (days/year)	120	-28	-41	-57	-65
Number of heat stress events (events/year)	0	1	2	6	11

Extreme Cold

In Massachusetts, the winters are projected to get warmer with a smaller number of sub-zero days. As shown in Figure 3.22 above, annual average temperatures and winter temperatures are projected to increase by 8°F. The winter is estimated to become warmer, and we may see up to 57 fewer days below sub-zero.

3.10.3.2. Probability

Extreme Heat

Extreme heat is highly probable to impact the city in the future. The urban environment of Cambridge with higher impervious surfaces and lower canopy coverage and shade structures is particularly responsible for high heat impacts.

Extreme Cold

Although extreme cold weather events are predicted to decrease in frequency, the city should remained prepared to respond to these events.

3.10.3.3. Location

Extreme Heat

Although high heat is anticipated to impact the entire City of Cambridge, parts of the city are more vulnerable than others. Figure 3.23 (top) shows the urban heat island (UHI) variability in the city when the average temperature for that day is 95°F, which is a scenario that is likely to occur more frequently by 2030 and 2050. Figure 3.23 (bottom) also shows the UHI variability in the city when the average temperature for that day is 100°F, which is a scenario that is likely to occur more frequently by 2070 and 2090 (City of Cambridge, 2015). As illustrated in the figures, the heat impacts will be more concentrated in the NW and SE corners of the city.

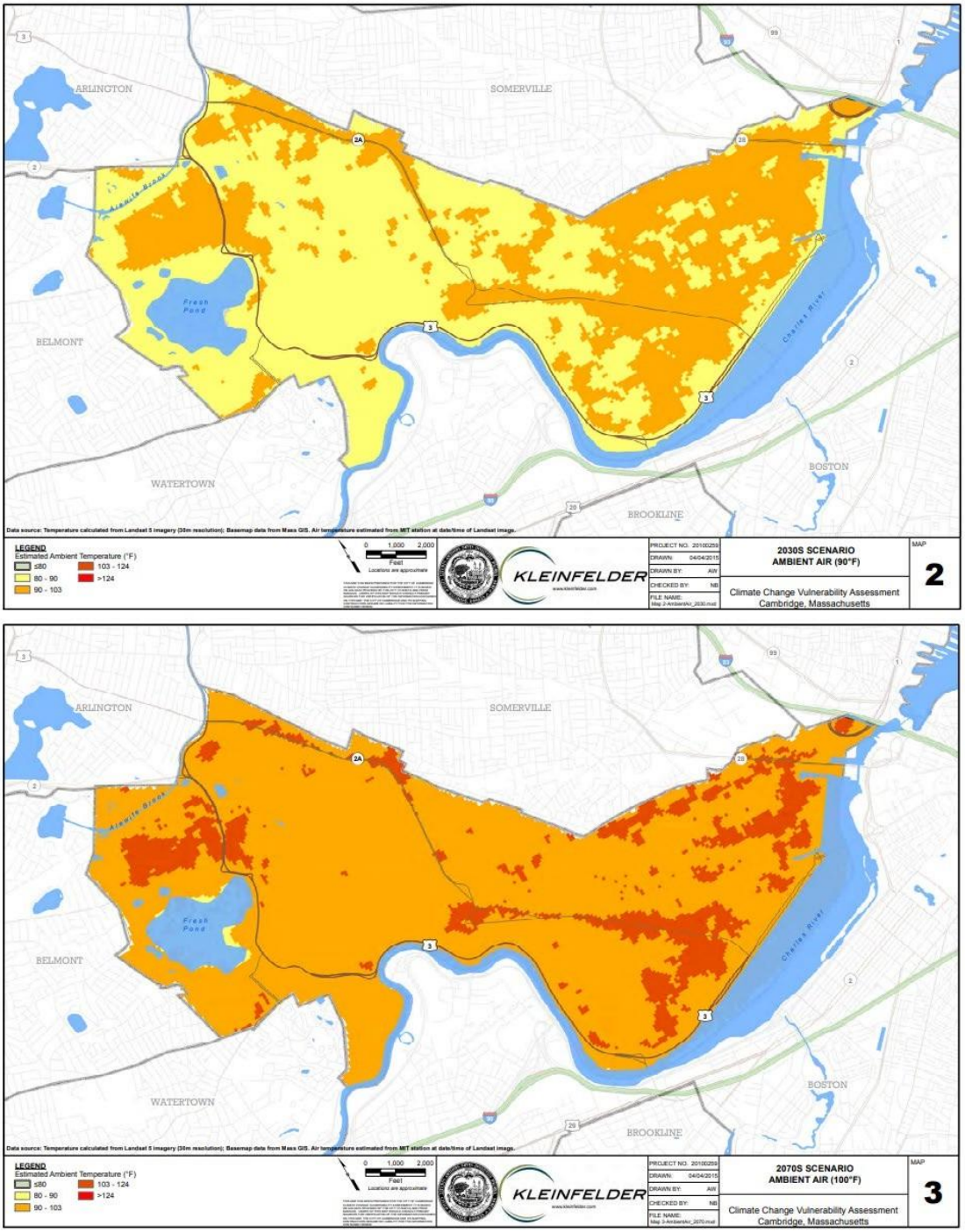


Figure 3.23: Projected future ambient temperature by 2030 (at 90°F) and by 2070 (at 100°F) (City of Cambridge, 2015)

Extreme Cold

Extreme cold weather events are predicted to impact Cambridge city-wide when they occur in the future. Those unable to find shelter, with inadequate or no heating sources, and additional priority populations are located all over the city and are all highly vulnerable to impacts of extreme cold.

3.11. Drought

3.11.1 | Description

Drought is an extended duration of time characterized by below normal levels of precipitation. The duration of drought can vary widely and can occur in virtually all climatic zones, with different conditions based on the region-specific precipitation normals. Drought differs from aridity, in which a region experiences low precipitation as a typical or permanent characteristic of the climate (i.e., a desert).

Drought is classified in Massachusetts by the Secretary of Energy and Environmental Affairs (EEA), through recommendations provided by the Drought Management Task Force (DMTF). The DMTF is comprised of members of EEA and the Massachusetts Emergency Management Agency (MEMA). The DMTF gathers information about current drought conditions, makes recommendations to governing officials, and manages responses. To aid in understanding and disseminating information about drought across the State, the Massachusetts Drought Management Plan (MA DMP) was adopted in September 2019. The plan states that its goal is to "minimize drought impacts to the Commonwealth by improving agency coordination; enhancing monitoring and early drought warning capabilities; and outlining preparedness, response, and recovery activities for state agencies, local communities, and other entities affected by drought" (EEA & MEMA, 2019).

3.11.2 | Previous Occurrences of Hazard Event(s)

3.11.2.1. Extent

The MA DMP classifies drought into five levels, based on six drought indices.

FIVE DROUGHT LEVELS	SIX DROUGHT INDICES
LEVEL 0: Normal	1. Precipitation
LEVEL 1: Mild Drought (formerly Advisory)	2. Groundwater
LEVEL 2: Significant Drought (formerly Watch)	3. Streamflow
LEVEL 3: Critical Drought (formerly Warning)	4. Lakes and Impoundments
LEVEL 4: Emergency Drought	5. Evapotranspiration (crop moisture)
	6. Fire Danger

3.11.2.2. Frequency

The US Drought Monitor (USDM) defines the frequency of occurrence of a drought event in percentiles, "relative to all historical measured events… to gage the severity of a measurement at individual stations and to gage the severity of overall drought" (EEA & MEMA, 2019). Percentile ranges are therefore assigned for each drought level, allowing for the comparison of data across

locations. Described in Table 3.24 are the percentile ranges, as classified by the MA DMP and USDM. Table 3.25 and Table 3.26 indicate the drought status for Massachusetts since 1929.

Table 3.26: Comparison of Percentile Ranges between the Massachusetts DMP and USDM.

MA DMP Drought Levels	DMP Drought Level Names	Percentile Ranges	USDM Drought Levels	USDM Drought Level Names	Recurrence	Percentile Ranges
1	*Mild Drought*	**20 to ≤30%**	D0	*Abnormally Dry*	Once per 3-5 years	**21 to 30**
2	*Significant Drought*	**10 to ≤20%**	D1	*Moderate*	Once per 5-10 years	**11 to 20**
3	*Critical Drought*	**2 to ≤10%**	D2	*Severe Drought*	Once per 10-20 years	**6 to 10**
			D3	*Extreme Drought*	Once per 20-50 years	**3 to 5**
4	*Emergency*	**≤2%**	D4	*Exceptional Drought*	Once per 50-100 years	**0 to 2**

Table 3.27: Historical Occurrences of Drought in MA from 1929-2019 (EEA & MEMA, 2019)

Date	Area Affected	Recurrence Interval (years)	Remarks
1929-32	Statewide	10 to >50	Water-supply sources altered in 13 communities. Multistate.
1939-44	Statewide	15 to >50	More severe in eastern and extreme western Massachusetts. Multistate.
1957-59	Statewide	5 to 25	Record low water levels in observation wells, northeastern Massachusetts.
1961-69	Statewide	35 to >50	Water-supply shortages common. Record drought. Multistate.
1980-83	Statewide	10 to 30	Most severe in Ipswich and Taunton River basins; minimal effect in Nashua River basin. Multistate.
1985-88	Housatonic River Basin	25	Duration and severity as yet unknown. Streamflow showed mixed trends elsewhere.

Date	Area Affected	Recurrence Interval (years)	Remarks
1995	-	-	Based on statewide average precipitation
1998-99	-	-	Based on statewide average precipitation
Dec 2001 – Jan 2003	Statewide	-	Level 2 drought (out of 4 levels) was reached statewide for several months
Oct 2007 – Mar 2008	Statewide except West and Cape & Islands regions	-	Level 1 drought (out of 4 levels)
Aug 2010 – Nov 2010	Connecticut River Valley, Central and Northeast regions	-	Level 1 drought (out of 4 levels)
Oct 2014 – Nov 2014	Southeast and Cape & Islands regions	-	Level 1 drought (out of 4 levels)
Jul 2016 -Apr 2017	Statewide	-	Level 3 drought (out of 4 levels)

Table 3.28: Drought Status from 2018-2022 for Northeastern MA (EEA & MEMA, 2023).

Year	Month	Northeastern MA Drought Status
2020	May	Significant
	June	Mild
	July	Significant
	August	Significant
	September	Significant *(Charles Basin – Critical)*
	October	Mild
	November	Mild
2021	March	Mild
2022	May	Significant
	June	Significant

Year	Month	Northeastern MA Drought Status
	July	Critical
	August	Critical
	September	Significant
	October	Mild
	November	Significant
	December	Mild

3.11.2.3. Location

Drought is classified by the Drought Management Task Force of the EEA Water Resources Commission. The Drought Management Plan (EEA & MEMA, 2019) divides the state into seven regions: Western, Central, Connecticut River Valley, Northeast, Southeast, Cape, and Islands. The City of Cambridge is located within Middlesex County, and therefore, the Northeast Drought Region. The city's drinking water supply sources including the Hobbs Brook Reservoir Subbasin and the Stony Brook Reservoir Subbasin are located outside of the city in Lexington, Lincoln, Weston, and Waltham, which are also part of the Northeast Drought Region. In addition, the city has the ability to pivot between city sources and the Massachusetts Water Resources Authority (MWRA) water supply as a source, of which many reservoirs are outside of the Northeast Region, and therefore drought status may be different than the status within Cambridge.

Demonstrated in Figure 3.24 is a Massachusetts Drought Status Map, effective for January 13, 2023. This map shows how drought statuses can be declared at the regional level.

The Cambridge reservoir system, which includes the Cambridge Reservoir (also known as Hobbs Brook Reservoir) and Stony Brook Reservoir, faces several limitations in addressing drought conditions. During severe droughts, such as the one experienced in 2016, the system's capacity can be significantly strained. To address these deficiencies, the Cambridge Water Department has implemented a multi-faceted approach.

Drought Management Strategies

Water Conservation Measures: The city has developed a tiered system of water use restrictions based on drought severity, ranging from mild to emergency conditions. These measures include limiting outdoor water use and encouraging water-saving practices among residents and businesses.

Interconnections and Backup Supply: Cambridge has established interconnections with the Massachusetts Water Resources Authority (MWRA) system to supplement its water supply during shortages. In 2016, the city had to purchase $3.6 million worth of water from the MWRA to meet demand during an extreme drought.

Monitoring and Assessment: The Cambridge Water Department, in collaboration with the U.S. Geological Survey, has implemented an extensive monitoring network to assess water quality and quantity in the reservoirs and their tributaries. This data helps in making informed decisions about

water management during drought periods.

Long-term Planning: The city is working on improving its drought resilience by updating its Surface Water Supply Protection Plan and considering climate change impacts on future water availability. This includes potential infrastructure improvements and exploring additional water sources to enhance the system's capacity during prolonged dry periods.

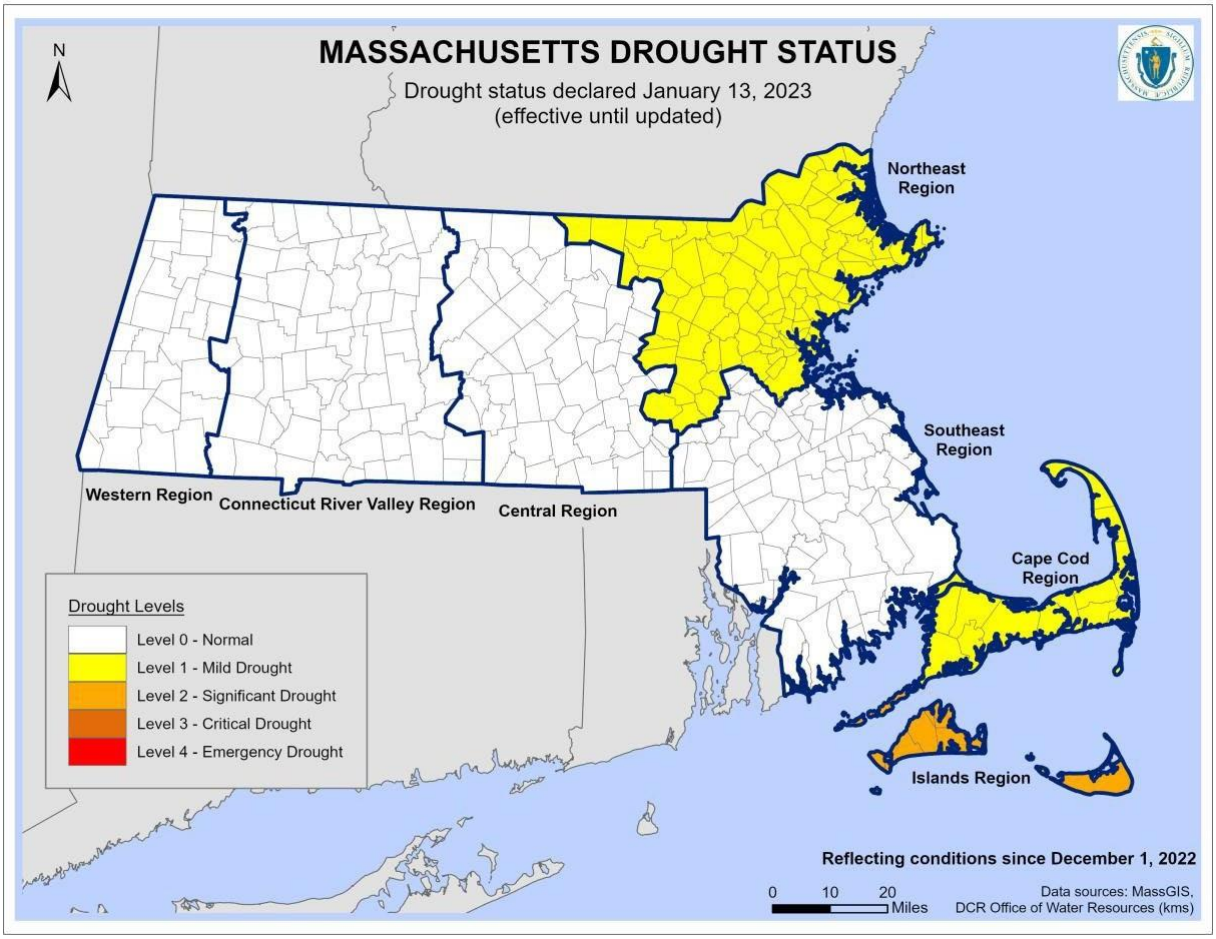


Figure 3.24: Massachusetts Drought Status Map, effective for January 13, 2023, (EEA & MEMA, 2023)

3.11.3 | Probability of Future Hazard Events due to Climate Change

3.11.3.1. Extent

Climate change is anticipated to intensify drought conditions due to rising air temperatures and changes in precipitation patterns. Although overall precipitation is predicted to increase, the frequency of rain events is expected to decrease, leading to prolonged dry periods that elevate the likelihood of drought conditions (EEA & EOPSS, 2018).

2022 Massachusetts Climate Change Assessment uses projected number of events of consecutive dry days and projected annual total number of days without rain as the two primary

indicators for future drought predictions. The following table (Table 3.27) shows the projected change in these two parameters over time (MA EOEEA, 2021). Both parameters indicate that number of dry days (annual and consecutive) will increase by three to six percent (3-6%).

Table 3.29: Drought Indicators as Mentioned in 2022 MA Climate Assessment

Drought Indicators (Boston Harbor Basin)	Baseline	2030s	2050s	2070s	2090
Consecutive dry day events: Annual	31	31	32	32	33
Annual number of days without rain (days per year)	182	185	192	194	198

3.11.3.2. Probability

Predicting the probability of drought in the future can be complex and uncertain, as it depends on a variety of factors, including the climate conditions, land use practices, and geographic location. However, with climate change resulting in a higher number of dry days, the probability of drought is projected to increase. The likelihood of droughts lasting one to three months could increase by up to 75% by the end of the century in Northeastern States under a high emissions scenario (EEA & EOPSS, 2018).

3.11.3.3. Location

Cambridge will continue to be impacted by drought on a citywide scale. In addition the public water supply for Cambridge is located outside jurisdictional boundaries and has the potential to be impacted by drought.

3.12. Wildfire / Brush Fire

3.12.1 | Description

A brushfire is considered an uncontrolled fire in vegetative wildland areas primarily burning underbrush, such as grass, shrub, leaf litter, and downed limbs.

Wildfires, or expansive fires burning large swathes of forested land, are considered an indirect hazard to Cambridge. A wildfire is not likely to occur within Cambridge, but impacts from wildfires including air quality decreases, have been experienced in recent years.

Note that Cambridge is also susceptible to urban conflagrations, which are large building to building fires that spread over a relatively large urban area. This type of fire is not considered a natural hazard but can be ignited by a natural hazard event.

3.12.2 | Previous Occurrences of Hazard Event(s)

3.12.2.1. Extent

Wildfire and brushfire data for Cambridge was collected from the LANDFIRE program, which provides information on vegetation, wildland fuel, and fire regimes across the United States (LANDFIRE, 2020). This dataset represents different types of fuel sources for wildfires and is based on 13 Anderson Fire Behavior Fuel (FBF) Models, with each value representing a different type of fuel. The FBFM 3, 11, 12, and 13 values represent fuel for rapidly spreading, high-intensity fires, while FBFM 4, 7, and 10 represent fuel for moderate to quickly spreading intense fires, and FBFM 2, 6, and 9 represent fuel for low flame, moderately paced spreading fires. The values of FBFM 1, 5, and 8 represent fuel for very low-intensity fires that are not easily spread.

Table 3.30: Landfire Fuel Sources Categories

#	Display attribute, fire behavior 13 fuel model
FBFM1	Surface fires that burn fine herbaceous fuels, cured and curing fuels, little shrub or timber present, primarily grasslands and savanna
FBFM2	Burns fine, herbaceous fuels, stand is curing or dead, may produce fire brands on oak or pine stands
FBFM3	Most intense fire of grass group, spreads quickly with wind, one third of stand dead or cured, stands average 3 ft tall
FBFM4	Fast spreading fire, continuous overstory, flammable foliage and dead woody material, deep litter layer can inhibit suppression
FBFM5	Low intensity fires, young, green shrubs with little dead material, fuels consist of litter from understory
FBFM6	Broad range of shrubs, fire requires moderate winds to maintain flame at shrub height, or will drop to the ground with low winds
FBFM7	Foliage highly flammable, allowing fire to reach shrub strata levels, shrubs generally 2 to 6 feet high
FBFM8	Slow, ground burning fires, closed canopy stands with short needle conifers or hardwoods, litter consist mainly of needles and leaves, with little undergrowth, occasional flares with concentrated fuels
FBFM9	Longer flames, quicker surface fires, closed canopy stands of long-needles or hardwoods, rolling leaves in fall can cause spotting, dead-down material can cause occasional crowning
FBFM10	Surface and ground fire more intense, dead-down fuels more abundant, frequent crowning and spotting causing fire control to be more difficult

#	Display attribute, fire behavior 13 fuel model
FBFM11	Fairly active fire, fuels consist of slash and herbaceous materials, slash originates from light partial cuts or thinning projects, fire is limited by spacing of fuel load and shade from overstory
FBFM12	Rapid spreading and high intensity fires, dominated by slash resulting from heavy thinning projects and clearcuts, slash is mostly 3 inches or less
FBFM13	Fire spreads quickly through smaller material and intensity builds slowly as large material ignites, continuous layer of slash larger than 3 inches in diameter predominates, resulting from clearcuts and heavy partial cuts, active flames sustained for long periods of time, fire is susceptible to spotting and weather conditions

3.12.2.2. Frequency

The Fire Department responds to a limited number of brush fires of varying sizes annually.

Table 3.31: Wildfires reported in Cambridge

Year	# of Incidents	# of Acres Burned (Fire Module)	# of Wildland Acres Burned	Total Acres Burned
2017	26	1	0	1
2018	18	0	103	103
2019	8	0	1	1
2020	31	0	4	4
2021	9	1	0	1
2022	17	1	0	1
Total	83	1	108	109

3.12.2.3. Location

Most of Cambridge is not exposed to landfire, with FBF 1, 2, and 8 types being the most common types of fire in the city (Figure 3.25). The data shows that the areas along the bank of the Charles River, Alewife Brook, and Fresh Pond Reservation are more prone to fire than the rest of the city. The marshy land in the Alewife brook area is prone to FBF 3, 8, and 10 fires, while Fresh Pond Reservation is prone to FBF 1 fires. The Cambridge Cemetery is also prone to FBF 1 fires, while Danehy Park is prone to FBF 2 fires. Harvard University Law School and surrounding areas are

prone to FBF 3 fires, and the MIT campus area is prone to FBF 2 fires.

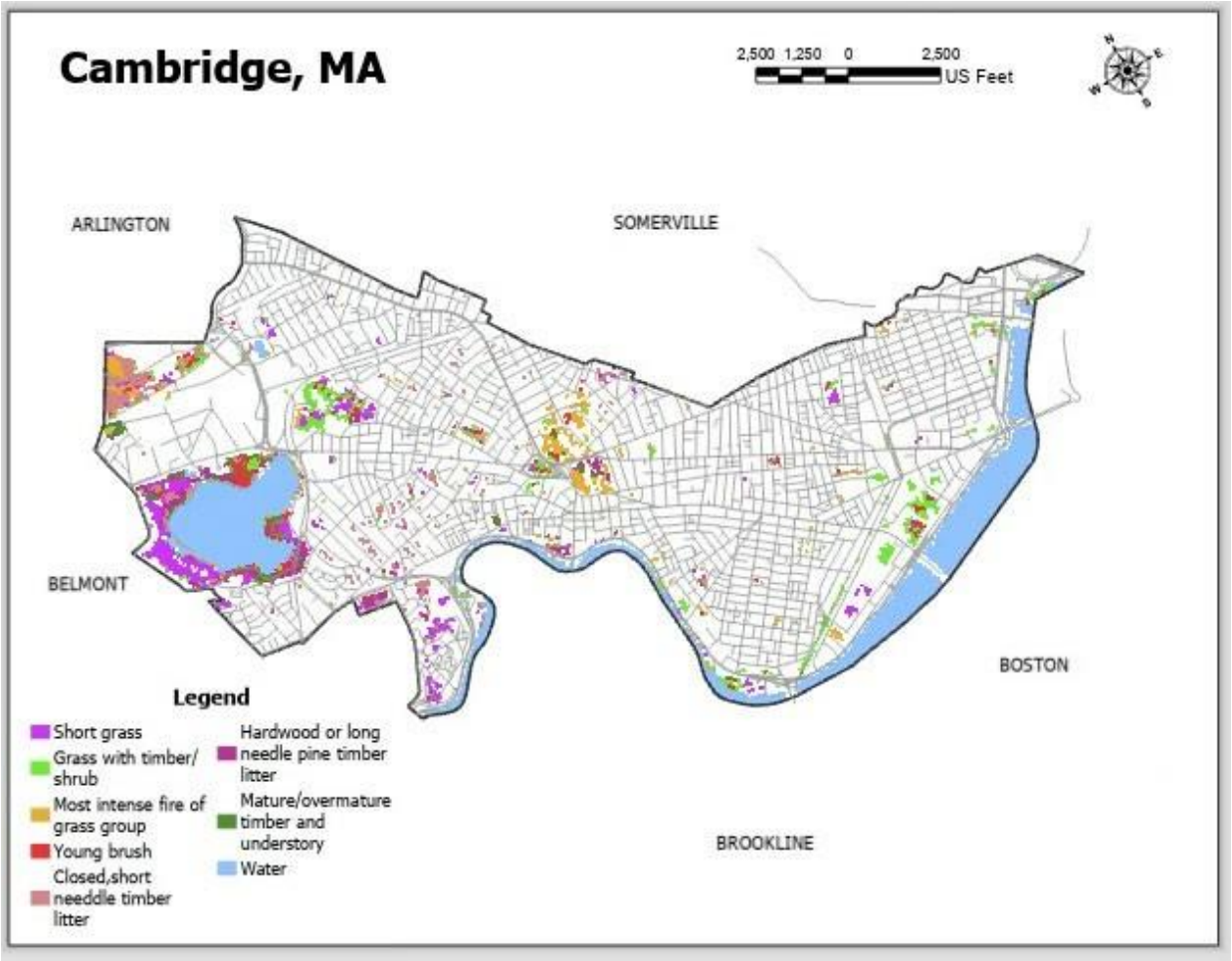


Figure 3.25: Landfire Distribution in the City of Cambridge based on Fuel Type

3.12.3 | Probability of Future Hazard Events due to Climate Change

3.12.3.1. Extent

As has already been seen in the western United States and Canada, increased temperatures coupled with longer periods of drought causes larger and more destructive wildfires. Increased temperatures due to climate change can create drier conditions, promoting evaporation of moisture from vegetation and soils. This can result in more frequent and intense wildfires and the fuel becomes more susceptible to ignition. An increase in fuel, including dried brush and dead vegetation, will allow for fire to spread more rapidly. As discussed previously, climate change can alter precipitation patterns, leading to more prolonged droughts. Drought reduces water supply, which may impact firefighters' ability to respond to fires. Increased hot temperatures in summer months will cause the power system to become overloaded and more likely to start a fire, while other changes in atmospheric circulation patterns have the potential to spread wildfires more quickly due to higher wind speed (EPA, 2022).

3.12.3.2. Probability

The probability of land fires is anticipated to increase due to climate change. As described in the SHMCAP, rising temperatures and changes in precipitation may lead to increased risk of seasonal drought during summer and fall in the Northeast. In addition, higher temperatures lead to greater evaporation and earlier winter and spring snowmelt. Drought and warmer temperatures will increase the risk of wildfire and brush fire, by causing vegetated areas to dry out and become more flammable. Research has found that frequency of lightning strikes could increase 12 percent for every degree of Celsius of warming, further increasing the probability of brush fire due to a lightning strike. (EEA & EOPSS, 2018)

3.12.3.3. Location

The location of potential landfires within the City of Cambridge is only anticipated to change if extent of the city's urban forest, parks, gardens, and natural areas, change, as these are the areas likely to be impacted by the increased potential for brush fire.

3.13. Pests and Invasive Species

3.13.1 | Description

The term invasive species can apply to both flora and fauna. This section will focus on plants and insects (referred to as pests) specifically. The Massachusetts Invasive Plant Advisory Group (MIPAG) was founded in 1995 by the Executive Office of Energy and Environmental Affairs to inform the Commonwealth about the presence and management of invasive species. MIPAG defines invasive species as meeting the following four base criteria (MIPAG, 2022):

- non-indigenous to Massachusetts,
- demonstrates the potential for rapid and widespread dispersion and establishment,
- has the potential to disperse over spatial gaps,
- exists in high numbers in natural habitats.

Often invasive species cause harm to local ecosystems, as they develop self-sustaining populations that become dominant and disruptive to native species. Invasive species often do not have natural predators and therefore are not restricted in their new habitat – monopolizing natural communities and causing economic and environmental damages (EEA & EOPSS, 2018).

Pests exacerbate the problems that invasive plant species pose. Pests often prey on native plant species, causing pre-mature death and creating gaps in the eco-system for invasive species to fill. Certain pests, while not necessarily detrimental to the environment, can pose a threat to public health.

3.13.2 | Previous Occurrences of Hazard Event(s)

There are numerous plants, insects, and fungi species that persist in Massachusetts as invasive. The following tables indicate the species that threaten Massachusetts and more specifically the

Fresh Pond Reservation and surrounding areas in Cambridge.

Table 3.32: Massachusetts "Invasive" Flora Species (MIPAG, 2022) and (City of Cambridge, 2023)

Species	Common Name
Acer platanoides*	Norway maple
Acer pseudoplatanus	Sycamore maple
Aegopodium podagraria	Bishop's goutweed, bishop's weed; goutweed
Ailanthus altissima*	Tree of heaven
Alliaria petiolata*	Garlic mustard
Ambrosia artemisiifolia*	Common ragweed
Arctium minus*	Common burdock
Artemisia vulgaris*	Mugwort
Berberis thunbergii*	Japanese Barberry
Cabomba caroliniana	Carolina fanwort; fanwort
Celastrus orbiculatus*	Asiatic bittersweet
Centaurea maculosa*	Spotted knapweed
Chelidonium arvense*	Celandine
Cirsium arvense*	Canada thistle
Cirsium vulgare*	Bull thistle
Commelina communis*	Asiatic dayflower
Convallaria majalis*	European lily of the valley
Convolvulus arvensis*	Hedge bindweed
Cynanchum louiseae	Black swallow-wort; Louise's swallow-wort
Elaeagnus umbellata	Autumn olive
Eragrostis curvula	Weeping lovegrass
Euonymus alatus	Winged euonymus, burning bush

Species	Common Name
Euphorbia esula	Leafy spurge; wolf's milk
Glaucium flavum	Sea or horned poppy, yellow hornpoppy
Hesperis matronalis	Dame's rocket
Iris pseudacorus*	Yellow iris
Lepidium latifolium	Broad-leaved pepperweed, tall pepperweed
Ligustrum vulgare*	Common privet
Lonicera japonica*	Japanese honeysuckle
Lonicera morrowii	Morrow's honeysuckle
Lonicera x bella [morrowii x tatarica]	Bell's honeysuckle
Lysimachia nummularia	Creeping jenny, moneywort
Lythrum salicaria*	Purple loostrife
Myriophyllum heterophyllum	Variable water-milfoil; two-leaved water-milfoil
Myriophyllum spicatum	Eurasian or European water-milfoil; spike water- milfoil
Phalaris arundinacea	Reed canary-grass
Phragmites australis	Common reed
Phragmitesaustralis*	Phragmites
Phytolacca americana*	Pokeweed
Polygonum cuspidatum*	Japanese knotweed
Polygonum perfoliatum	Mile-a-minute vine or weed; Asiatic tearthumb
Potamogeton crispus	Crisped pondweed, curly pondweed
Ranunculus ficaria/Ficaria verna	Lesser celandine; fig buttercup
Rhamnus cathartica*	Common buckthorn
Rhamnus frangula*	Glossy buckthorn
Rhodotypos scandens*	White kerria jetbead

Species	Common Name
Robinia pseudoacacia*	Black locust
Rosa multiflora*	Multiflora rose
Salix atrocinerea/Salix cinerea	Rusty Willow/Large Gray Willow complex
Solanum dulcamara*	Bittersweet nightshade
Trapa natans	Water-chestnut
Vicia cracca*	Cow vetch
Vincetozicum nigrium*	Black swallow-wort
Xanthium strumarium*	Cocklebur

* Invasive Species Commonly Found at Fresh Pond Reservation and Surrounding Areas

Table 3.33: Invasive Terrestrial Fauna and Fungi Species in Massachusetts (EEA & EOPSS, 2018)

Species	Common Names
Lymantria dispar	Spongy / Gypsy moth (insect)
Ophiostoma ulmi, Ophiostoma himalulmi, Ophiostoma novo-ulmi	Dutch elm disease (fungus)
Adelges tsugae	Hemlock woolly adelgid (insect)
Cryphonectria parasitica	Chestnut blight (fungus)
Anoplophora glabripennis	Asian long-horned beetle (insect)
Cronartium ribicola	White pine blister rust (fungus)
Lycorma delicatula	Spotted Lantern Fly (insect)
Operophtera brumata	Winter Moth (insect)

The City of Cambridge completed a citywide urban forest master planning effort in 2019 that reviewed existing species composition and diversity and examined potential changes to the canopy over time as a result of various climatic factors including heat, drought, and introduction of new pests (CUFMP, 2019). This plan provides specific species composition recommendations for future plantings to help achieve species diversity goals in the city through minimizing the potential impacts of pests. It also outlines pest management strategies for both plants and insects, with the ultimate goal of eradicating many invasive species from Cambridge's ecosystem.

Ticks and mosquitos are not generally harmful to the environment, but instead pose a risk to human health. Rather than eradicate these pests entirely, close monitoring and public awareness campaigns can be an effective protection strategy for the public.

Deer ticks, dog ticks, and Lonestar ticks are species of ticks found in Massachusetts that attach to animals or people that come into direct contact with them (MA DPH, 2023). Deer ticks are responsible for spreading Lyme disease, babesiosis, anaplasmosis, *Borrelia miyamotoi*, and Powassan virus. Dog ticks are responsible for spreading Rocky Mountain spotted fever and certain types of tularemia. Lone star ticks are not a significant source of human illness in Massachusetts at this time but are capable of spreading tularemia, ehrlichiosis and southern tick-associated rash illness. One of the most important forms of prevention is checking for ticks once a day on your body.

Mosquitos can spread diseases to humans, including West Nile virus (WNV) and eastern equine encephalitis (EEE) in Massachusetts (MA DPH, 2023). Only a small number of mosquitoes are infected at any given time, so being bitten by a mosquito does not mean you will get sick.

However, the best way to avoid both of these illnesses is to prevent mosquito bites using insect repellent, wearing full coverage clothing, and removing standing water from areas around your home. The Massachusetts Department of Public Health has released a Risk Map and Reporting form for EEE and WNV that residents can use to live track positive samples over time (MA DPH, 2023). Several counties in Massachusetts show Low or Moderate Risk for both diseases.

Additionally, the CDC has identified malaria cases in Florida and Texas (CDC, 2023). While no malaria cases have presently been identified in Massachusetts, potential spreading of the disease is being closely monitored by CDC.

3.13.2.1. Extent

The damage rendered by pests and invasive species can be significant. Invasive species can trigger a wide-ranging cascade of lost ecosystem services and can reduce the resilience of ecosystems to future hazards by placing a constant stress on the system. (EEA & EOPSS, 2018). Increased spread of disease through ticks and mosquitos can also be a significant detriment to public health across the city, particularly if residents are discouraged from being active outdoors.

Due to the rapidly evolving nature of invasive species, it is difficult to quantify the extent as well as associated costs for monitoring and restoration activities. As a monitoring strategy, MIPAG has developed an "Early Detection" list of invasive plant species distributions (as of November 2010) for the 2023 ResilientMass Plan. The invasive species found in Suffolk County are shown in the table below.

Table 3.34: Early Detection List of Invasive Plant Species (ResilientMA, 2023)

Species	Common Name	Current Distribution (as of November 2010)	Notes
Heracleum mantegazzanum	Giant hogweed	Berkshire County Franklin County Hampden County Hampshire County	Giant hogweed is a federal noxious weed that is currently being eradicated under the U.S. Department

Species	Common Name	Current Distribution (as of November 2010)	Notes
		Middlesex County Norfolk County Suffolk County Worcester County	of Agriculture's authority. This is a perennial herb that can cause painful burns and permanent scarring to humans if they touch the plant.
Persicaria perfoliata syn.: Polygonum perfoliatum	Mile-a-minute vine or weed; Asiatic tearthumb	Barnstable County Essex County Franklin County Norfolk County Plymouth County Suffolk County	Mile-a-minute vine is a barbed vine that can grow up to 6 inches a day. This vine smothers other herbaceous plants, shrubs, and even trees by growing over them and blocking their access to sunlight.
Peuraria montana ssp. lobata	Kudzu; Japanese arrowroot	Barnstable County Bristol County Essex County Middlesex County Plymouth County Suffolk County	Kudzu is native to Japan and southeast China and was introduced to the U.S. during the Philadelphia Centennial Exposition in 1876. Once established, kudzu can grow at a rate of a foot per day, with mature vines as long as 100 feet.
Senecio jacobaea	Tansy ragwort; stinking Willie; stinking Billy	Essex County Suffolk County Worcester County	This biennial herb is a weedy plant that infests woodlands, pastures, and hayfields. This plant is toxic to all classes of livestock but most toxic to cattle and horses. The plant can cause chronic liver disease, and affected animals usually die within a few weeks after ingesting it.
Trapa natans	Water chestnut	Berkshire County Bristol County	Water chestnut is an annual aquatic species

Species	Common Name	Current Distribution (as of November 2010)	Notes
		Essex County Franklin County Hamden County Hampshire County Middlesex County Suffolk County Worcester County	with both floating and submerged leaves.

3.13.2.2. Frequency

It is difficult to quantify the frequency of invasive species occurring because their presence is ongoing rather than a series of discrete events. Invasive species have the ability to travel long distances (either via natural mechanisms or accidental human interference), which allows these species to propagate rapidly and therefore has increased the frequency of threat over the years. (EEA & EOPSS, 2018) In water systems, invasive species can quickly spread once introduced, as there are generally no physical barriers to prevent establishment, outside of physiological tolerances, and there are many opportunities for transport to new locations. (EEA & EOPSS, 2018)

3.13.2.3. Location

Invasive species are a widespread problem throughout Massachusetts and are a citywide issue for Cambridge. The geographic extent of invasive species varies greatly depending on the species in question and other factors, including habitat and the range of the species. (EEA & EOPSS, 2018).

3.13.3 | Probability of Future Hazard Events due to Climate Change

3.13.3.1. Extent

Invasive species distribution and migration will be impacted by climate change. Climate change may increase the growing season and growth during spring and fall, which typically favors invasive species and generalists over native species, reducing biodiversity. In urban areas like Cambridge, invasive species could cause damage to infrastructure and impact human health by outcompeting native species for resources. The warming climate may also accelerate the movement, consumption, dispersion, and generation time of pests, pathogens, and invasive species, benefiting their proliferation (Dukes, 2009). Global trade and travel have created pathways for exotic species to spread, and non-native species accustomed to warmer climates may proliferate northward as the climate warms.

Changing climatic conditions could shift suitable habitats for native species, increase the risk of new species introductions, create competition from established invaders, and lengthen the peak periods for tick and mosquito activity, potentially resulting in losses in native biodiversity and culturally important species as well as increasing risk to public health. Increased presence of pests, invasive species and land use change may also harm native aquatic species and

ecosystems, alter water quality, and impact recreational activities.

3.13.3.2. Probability

Estimated increase in atmospheric CO_2 concentrations may impede the recovery of ecosystems after significant disruptions, increasing the likelihood of successful establishment or expansion of invasive species (EEA & EOPSS, 2018). As a result, probability of damage caused by pests and invasive species is likely to increase in the future.

3.13.3.3. Location

Pests and invasive species will continue to be a citywide issue for Cambridge. The citywide urban forest, parks, gardens, natural areas, and waterbodies are particularly likely to be impacted by the increased populations of pests and invasive species due to climate change.

Chapter 4:

Inventory of Community Assets

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4. Inventory of Community Assets

This section provides an inventory of the community assets that are important to the City of Cambridge and paints a picture of a vibrant community with diverse people, buildings, structures, systems, and important resources which make Cambridge unique. Reducing the vulnerability of these assets to natural hazards is critical to the city's neighborhoods, businesses, operations, and economy, and to ensure its longevity. Assets discussed in this chapter are further assessed for their vulnerability to natural hazards in Chapter 5. Actions the City intends to take to mitigate the impacts from natural hazards are discussed in Chapter 7.

4.1. Categories of Community Assets

Assets are defined broadly as anything that is important to the character and function of a community (FEMA, 2023). These can be built, natural, or non-physical elements. They range from emergency facilities and critical infrastructure to community events that help shape collective identity and social cohesion. Below are asset categories, community lifelines, and the list of assets. This analysis is the first step in identifying who or what is vulnerable and developing a plan for future resilience.

4.1.1 | Overarching Categories

Assets are organized into the following categories which represent the wide variety of perspectives, purposes, and goals that asset categories can include and are based on the categories outlined in FEMA's Hazard Mitigation Handbook.

Critical Facilities	These facilities are critical for life safety and the economy. The operation of these facilities during and after a disaster is crucial. Their ability to keep functioning affects both the severity of the impacts and the speed of recovery.
People	Assets that serve populations that are more vulnerable to disaster (e.g., elderly, children, visiting populations) and/or serve densely populated areas. Areas with greater population density, or populations less able to respond and/or recover during a natural hazard. This includes priority populations, such as people of color, tribal and Indigenous communities, women, members of the LGBTQ+ community, people experiencing homelessness, the elderly, underserved communities, or those without access to transportation. In Cambridge, this category includes many of the aforementioned groups, in addition to a large and transient student population. Cambridge is also mindful of those with disabilities, those with limited proficiency in English, those living below the poverty line, and those with low educational attainment (Cambridge, Resilient Cambridge, 2021; Cambridge, Resilient Cambridge, Resilient People, 2021).

Structures	New and existing buildings, as well as built facilities that provide community lifeline services which help the community respond to and recover from natural hazards. Consider the type of building (residential, commercial, industrial, etc.) as well as the age and construction type of the structure. In Cambridge, important structures include the hospitals, fire stations, police stations, schools, and universities.
Systems	A collection of components that perform a critical service for the community. These are networks and capabilities of the community. The loss or breakdown of these components due to a natural hazard could increase community vulnerability and damage. Common systems include roadways or transportation systems such as subways or bus routes. In Cambridge, important systems include the MBTA, drinking water, stormwater, and wastewater systems.
Natural, Historic, and Cultural Resources	Features that add value to the community through education, community connection, sense of belonging, connection to nature, and community protection through natural systems. These assets enhance the quality of life in a community. They also help the local economy through agriculture, tourism, and recreation. They support ecosystem services and build the economy. These assets include places of worship, places of recreation, public art, and open space areas. In Cambridge, examples of these include Harvard Square and the Memorial Church of Harvard University.
Economy	After a disaster, economic resiliency is one of the major drivers of a speedy recovery. Economic assets can have direct or indirect losses. For example, building or inventory damage is a direct loss. Functional downtime and loss of wages are indirect losses. Economic assets are defined as entities that produce a financial benefit for the community.
Activities that have value to the community	Assets in place that benefit the community by increasing community morale and well-being. In Cambridge, these include community events, such as the Cambridge Arts Council Dance Party and the River Festival, the Cambridge Jazz Festival, Harvard Square's May Fair, Danehy Park Day, and the Boston Hong Kong Dragon Boat Festival. These also include long-standing traditions such as the Head of the Charles and other activities such as the City of Cambridge Farmers Markets or Community Garden Program.

4.1.2 | FEMA's "Community Lifelines"

"Community Lifelines" is FEMA's term for assets that the community cannot survive without. "A lifeline enables the continuous operation of critical government and business functions and is

essential to human health and safety or economic security" (FEMA, 2020).

For the purposes of hazard mitigation planning and the asset inventory developed for this plan, community lifelines are used to categorize all assets in terms of these critical functions. Not all assets are community lifelines.

A subset of the City of Cambridge's Assets falls into one of eight lifelines that have been classified and described as follows (FEMA, 2019)

Law enforcement and government services, as well as the associated assets that maintain communal security, provide search and rescue, evacuations, and firefighting capabilities, and promote responder safety.

Support systems that enable the sustainment of life, such as water treatment, transmission, and distribution systems; food retail and distribution networks; and wastewater collection and treatment systems.

Infrastructure and service providers for medical care, public health, patient movement, fatality management, behavioral health, veterinary support, and health or medical supply chains.

Service providers for electric power infrastructure, composed of generation, transmission, and distribution systems, as well as gas and liquid fuel processing, transportation, and delivery systems. Disruptions can have a limiting effect on the functionality of other community lifelines.

Infrastructure owners and operators of broadband internet, cellular networks, landlines, cable services, satellite communications services, and broadcast networks (radio and television). Communications systems encompass a large set of diverse modes of delivery and technologies (e.g., translations and meeting accessibility standards, etc.), often intertwined but operating independently. Services include elements such as alerts, warnings, and messages, as well as 911 and dispatch. Also includes accessibility of financial services.

Multiple modes of transportation often serve complementary functions and create redundancy, adding to the inherent resilience in overall transportation networks. Transportation infrastructure includes highways/roadways, mass transit, railway, aviation, maritime, and intermodal systems.

Systems that mitigate threats to public health/welfare and the environment. This includes assessment of facilities that use, generate, and store hazardous substances, as well as specialized conveyance assets and efforts to identify, contain, and remove incident debris, pollution, contaminants, oil, or other hazardous substances.

Systems for Potable Water and Wastewater Management. This includes potable water intake, treatment, storage, and distribution. It also includes wastewater collection, storage, treatment, and discharge (EPA, 2023).

4.2. City of Cambridge Assets

Community assets were identified for the City of Cambridge using the city's most recent geographic information system mapping available publicly on the City's website, assets identified in the Climate Change Vulnerability Assessment work completed in 2015 and 2017, assets identified as critical for continuous power needs, and the latest U.S. Census. Appendix E includes maps showing city assets.

4.2.1 | Critical Facilities in Cambridge

There is a list of critical facilities within the City of Cambridge to which Eversource prioritizes providing electrical power. This prioritization of service includes restoring access to the grid as fast as possible and, when delays are considered too significant, providing emergency on-site backup power in the form of mobile generators. The list of critical facilities may adjust from year to year but as of 2023, includes 32 locations that consist of:

- Major transportation facilities and structures.
- Utility facilities related to gas and telecommunications.
- City buildings such as City Hall, emergency response buildings for police and fire and emergency operations, including public works.
- Public health facilities such as hospitals, assisted living, and rehabilitation.

- Emergency shelter locations.
- Public water supply facilities and structures.

All these assets are considered community lifelines.

4.2.2 | "People" Assets

"People" assets include be populations in that may be less able to prepare, respond and/or recover before, during and after a disaster, and the facilities that serve populations that are more vulnerable to disaster (e.g., elderly, children, visiting populations) and/or serve densely populated areas. Section 4.2.2.1 discusses the populations in Cambridge that are considered "people" assets. Section 4.2.2.2 discusses the physical facilities that serve these populations.

4.2.2.1. Populations

According to the latest U.S. Census, the City of Cambridge has a population of just over 118,000 people, which is a 12.5% increase since the year 2010. The 2020 Census recorded 49,564 occupied housing units, with an average household size of approximately 2.1 persons. Cambridge has a population density of over 18,500 people per square mile and 7,500 housing units per square mile. According to the 2017-21 American Community Survey, as of 2021, Cambridge is the tenth most densely populated city in the United States.

Priority populations are more vulnerable to natural hazards due to factors such as mobility restrictions, emergency communications language barrier, and existing health conditions. It is also more challenging for priority populations to recover from disastrous scenarios due to economic limitations. Examples of priority populations in Cambridge include (United States Census Bureau, 2023):

- Youth (just over 4% of the population is under 5 and just over 12% of the population is under 18, per the 2020 U.S. Census)
- Persons 65 years and older (just over 11 percent of the city's population falls into this category)
- Veterans (approximately 1,500 veterans in the city)
- Foreign born (almost 30% of the population)
- Those who speak a language other than English at home (approximately 35% of the population over 5 years old)
- Renters (almost 2/3 of the population rent)
- Those who do not have a computer (4% of households) and those who do not have an internet subscription (almost 10%)
- Persons in poverty (just over 12%)
- Persons with a disability, under the age of 65 (almost 5%)

The Resilient Cambridge plan included a study of some of the priority population characteristics per neighborhood of the city (Cambridge, 2021). Neighborhoods are shown in Figure 4.1. Table 4.1 summarizes the percentage of the population with a specific population characteristic for each city neighborhood based on the American Community Survey 5-Year Estimates for 2018.

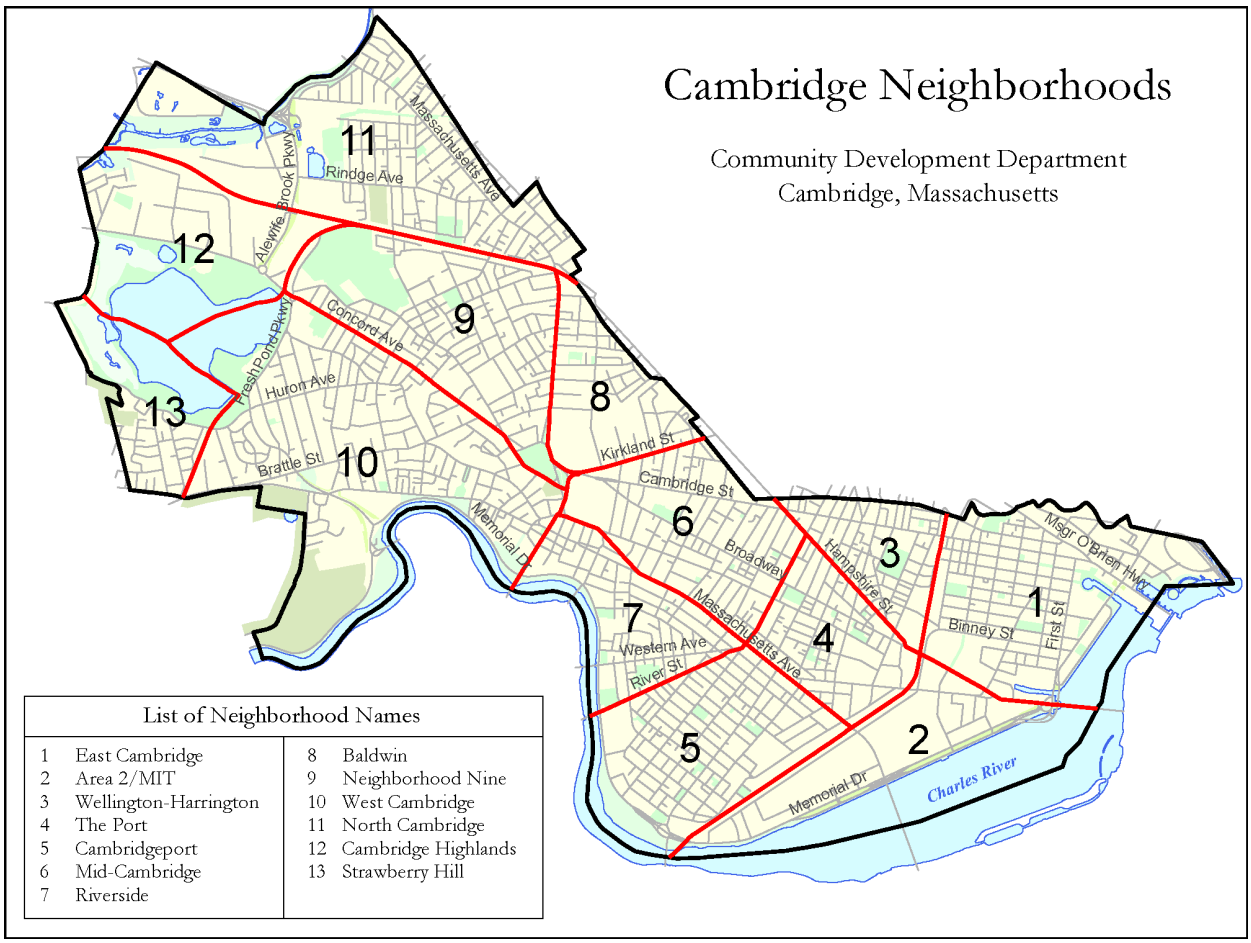

Figure 4.1: Map of Cambridge neighborhoods, by Cambridge CDD

These populations might not be able to recover from one hazard, or might just barely recover from one when there's another, setting them back again, with follow on impacts for ability to remain or be secure in retirement, afford healthcare, age in place, etc.

Table 4.1: Priority Population Characteristics (% of Population) per Neighborhood in Cambridge.

Neighborhood	Percent Renters	Percentage Below the Poverty Line	Percentage without a HS Degree or GED	Percentage with Limited English Capabilities	Percentage with Self-Identified Disability	Percentage Under 5	Percentage Single (Not Married)	Percentage Over 65, Single
East Cambridge	56.6	16.3	6.6	6.1	10.1	5.2	44.0	11.3
Area 2/MIT	75.6	22.5	0.0	7.3	3.5	0.8	36.8	0.0

Neighborhood	Percent Renters	Percentage Below the Poverty Line	Percentage without a HS Degree or GED	Percentage with Limited English Capabilities	Percentage with Self-Identified Disability	Percentage Under 5	Percentage Single (Not Married)	Percentage Over 65, Single
Wellington-Harrington	66.5	15.5	13.8	9.3	6.0	4.8	31.9	5.7
The Port	60.6	16.8	8.0	3.1	6.7	5.1	26.3	6.2
Cambridgeport	58.7	12.9	4.6	4.1	5.3	4.1	37.3	6.9
Mid-Cambridge	53.9	14.6	3.6	2.7	4.2	3.4	43.5	8.2
Riverside	67.7	15.5	5.4	2.7	4.4	3.1	37.5	4.7
Baldwin	59.3	6.9	1.2	2.1	3.2	2.4	35.0	5.9
Neighborhood Nine	51.0	11.5	1.8	2.6	5.4	3.5	44.3	12.4
West Cambridge	35.0	5.0	1.7	1.2	6.0	5.1	34.1	12.6
North Cambridge	63.9	16.4	7.6	8.4	8.1	4.6	31.8	8.5
Cambridge Highlands	56.0	5.3	5.4	1.6	2.0	3.9	36.5	6.9
Strawberry Hill	56.7	9.7	9.1	4.0	8.0	8.6	48.2	15.4

Legend

	0-10%	Low Percentage of Priority Populations
	11%-20%	Moderate Percentage of Priority Populations
	21%-30%	High Percentage of Priority Populations
	31%-100%	Very High Percentage of Priority Populations

**Table 4.1 does not reflect additional priority populations such as*

- *the unhoused and unstably housed populations in Cambridge*

- *those who are economically insecure, more broadly defined than percentage below the poverty line; and*
- *those above the poverty line but economically insecure in Cambridge's housing and cost of living environment.*

4.2.2.2. Facilities that Serve these Populations

Table 4.2 shows the current facilities that serve people assets in Cambridge by type and number. In addition, the relevant community lifeline, previously described in Section 4.1.2, is noted.

Appendix E includes maps showing city assets.

Table 4.2: Number of Assets in the People Category

Sub-type of Asset	Count of Asset	Community Lifeline
Arts and Culture (e.g., language and multicultural arts centers)	7	Should this and other empty categories either have a category or read "N/A"?
Child and Youth Services (e.g., after school programs, guidance, Boys and Girls Club, youth centers, etc.)	10	
Community Resources and Community Centers (e.g., Community legal services, counseling, adult education, community center, American Legion, Veterans of Foreign Wars, Salvation Army, YWCA etc.)	7	
Daycare Facilities	76	
Elderly Facilities (e.g., apartments and housing, rehabilitation centers, senior centers, nursing facilities, etc.)	18	Food, Hydration, Shelter
Health Centers	13	Health and Medical
Health-Related Service	20	Health and Medical
Hospitals	3	Health and Medical
Housing (includes public and private, inclusionary housing, etc.)	139	Food, Hydration, Shelter

Sub-type of Asset	Count of Asset	Community Lifeline
Housing-Related Service (veterans affairs and Cambridge Housing Authority)	2	Food, Hydration, Shelter
Nonprofit, Transitional Housing/Shelters	254	Food, Hydration, Shelter
Playgrounds	60	
Private Schools	34	Food, Hydration, Shelter
Public Schools	18	Food, Hydration, Shelter
Shelter	6	Food, Hydration, Shelter
Waterplay (e.g., parks, schools, and fields with access to natural or manufactured water features)	30	
TOTAL	**697**	

4.2.3 | "Structure" Assets

"Structure" assets are built facilities including residential, commercial, and industrial facilities that may be in harm's way during a hazard event. Many of these structures provide community lifeline services. Cambridge is a highly urbanized and densely developed community where much of the land area is occupied by existing residential neighborhoods, commercial corridors, and districts, open space, and recreational spaces. Some land is protected as conservation land and undevelopable wetlands. Development occurring now and in the future in the city is largely infill development and redevelopment (City of Cambridge & MAPC, 2015). Appendix E includes maps showing city assets.

4.2.3.1. Development Since Previous Hazard Mitigation Plan

While the city is built out, there has been some development since completion of the previous Hazard Mitigation Plan in 2015. Development is tracked for the City of Cambridge to identify buildout trends and determine where new development is feasible, which was identified during the City's planning process called Envision Cambridge, which provides a guide for sustainable development in the city. The Metropolitan Area Planning Council tracks development statistics using its Massbuilds database. Since the end of 2014, 191 buildings were completed across the city. Over 6,100 housing units and nearly 9.5 million square feet of commercial square footage have been built in that time period.

Additionally, the vulnerability of new development has significantly decreased in recent years with the implementation of new zoning, building code, and stormwater management measures. As

identified in Chapter 6.2, building energy use regulations, tree protection ordinances, sewer separation, flooding and heat mitigation building standards, and climate resilient zoning requirements are just a few examples of recently adopted projects and policies that help protect assets and development in Cambridge.

Table 4.3: Recently Completed Development in Cambridge (2015 – Present Day)

Year of Completion	Total Number of Projects[a]	Total Number of Housing Units[b]	Total Commercial Square Footage
2015	15	1,616	1,147,972
2016	12	360	1,300,729
2017	7	319	830,207
2018	8	854	446,062
2018	18	321	2,011,373
2020	13	803	1,000,299
2021	12	524	943,797
2022	13	1,329	1,796,599

Source: (MassBuilds, 2023)

Notes:

a) Housing units include the combined total of single-family, small multi-family, and large multi-family housing units.

b) Commercial square footage includes, but is not limited to, general commercial, retail, industrial, hotel, research and development, office space.

In addition to housing, the development of the commercial and retail sector has grown. Neighborhoods such as Kendall Square have experienced a tremendous amount of technology and R&D growth during the last few years. However, small businesses in Cambridge and the region were deeply impacted by the COVID-19 global pandemic. In neighborhoods such as the Port, there are food deserts with limited eating options and no grocery stores aside from small corner shops. Other areas are more saturated with food options. In addition, the two largest food stores are Whole Foods, which is not affordable for many residents. The city's Food Action Plan provides additional detail.

4.2.3.2. Existing Structural Assets

Table 4.4 shows current structural assets in Cambridge by type and number. In addition, the relevant community lifeline, previously described in Section 4.1.2, is noted. Appendix E includes maps showing city assets.

Table 4.4: Number of Assets in the Structures Category

Sub-type of Asset	Count of Asset	Community Lifeline
Dams	4	Water Systems
Emergency Operations Center	1	Safety & Security
Emergency Shelters (includes schools and other locations that function as emergency shelters)	17	Food, Hydration, Shelter
Fire Stations	8	Safety & Security
Food-Related Services (e.g., food pantry, meal programs, etc.)	22	Food, Hydration, Shelter
Gas Stations	12	Energy
Grocery Stores (includes corner stores, gas stations, bodegas, small markets, etc.)	89	Food, Hydration, Shelter
Hazardous Materials Storage	38	Hazardous Materials
Bridges and Underpasses	3	Transportation
Municipal Buildings	21	Safety & Security
Municipal Parking Lots	10	
Pharmacies	15	Health and Medical
Police Stations	5	Safety & Security
Post Offices	7	
Professional Ambulance Service	1	Health and Medical
Public Libraries	7	
Public Pools	3	

Sub-type of Asset	Count of Asset	Community Lifeline
Snow Emergency – Parking Only (e.g., Galleria Mall, One Kendall Square Garage, First Street Garage, 52 Oxford Garage, 65 Waverly Street Lot)	5	
Snow Emergency – Snow Storage	1	
Tunnels	1	Transportation
University Police Departments	2	Safety & Security
TOTAL	**266**	

4.2.3.3. Dams

Critical infrastructure like dams and levees provide recreation, water supply, floodplain management, energy, and other essential functions. Dam owners and operators can be private, non-profit, or public. These structures and their owners are a vital component of local hazard mitigation.

The Hazard Potential Classification System for Dams provides an indication of the consequences of failure of a dam in the United States. This system contains three classes I – Low, II – Significant, and III – High, each representing the degree of potential damage to downstream life and property (FEMA, 2004).

The Amelia Earhart dam and the New Charles River Dam have the potential to impact the City of Cambridge in the event of a breach or overtopping. These dams are not owned or operated by the City of Cambridge.

- The Amelia Earhart (NID# MA01088) is classified as a Low Hazard Potential Dam (Class III). This dam was last inspected in March of 2017 (USACE). Low Hazard Potential Dam classification signifies that no loss of human life is expected with failure, and there is low or limited economic, environmental, and lifeline losses probable (FEMA, 2004). The top of the Amelia Earhart Dam is 11.76 ft-NAVD88.
- The New Charles River Dam (NID# MA01092) is classified as a Significant Hazard Potential Dam, which was last inspected in February of 2022 (USACE). Significant Hazard Potential classification indicates possible loss of life due to dam failure. Furthermore, dam failure may cause damage to homes, industrial or commercial facilities, secondary highways or railroads, and potential interruption of relatively critical facilities (MA DCR, 2017).

For these two dams, Cambridge staff are in ongoing communications with the dam owners and the region related to planning for potential flanking and overtopping under future climate conditions, as well as potential upgrades and enhancements to minimize impacts due to coastal flooding. Section 3.3.1 of the Natural Hazard Profiles discusses coastal flooding because of dam failure.

The City of Cambridge owns and operates two dams, both located outside of the city limits. These

include the Stony Brook Reservoir Dam and the Cambridge Reservoir Dam, both of which create reservoirs for the city's water supply where the city maintains 7-day coverage of the Reservoirs and Dams from 7am to 3pm.

- The Stony Brook Reservoir Dam (NID# MA00293) is classified as a High Hazard Potential Dam. This dam is in Weston. This earthen dam is 32 feet tall and over 1,200 feet long. The dam is inspected every two years in compliance with state requirements and as of the last inspection was in satisfactory condition.
- The Cambridge Reservoir Dam (NID# MA00750) is classified as a High Hazard Potential Dam. This dam is in Waltham. This earthen dam is 31 feet tall and over 1,600 feet long. The dam is inspected every two years in compliance with state requirements and as of the last inspection was in satisfactory condition.

Both dams are assigned the high hazard potential classification, which means failure or mis-operation will cause loss of human life.

The locations of these four dams are shown in Figure 4.2.

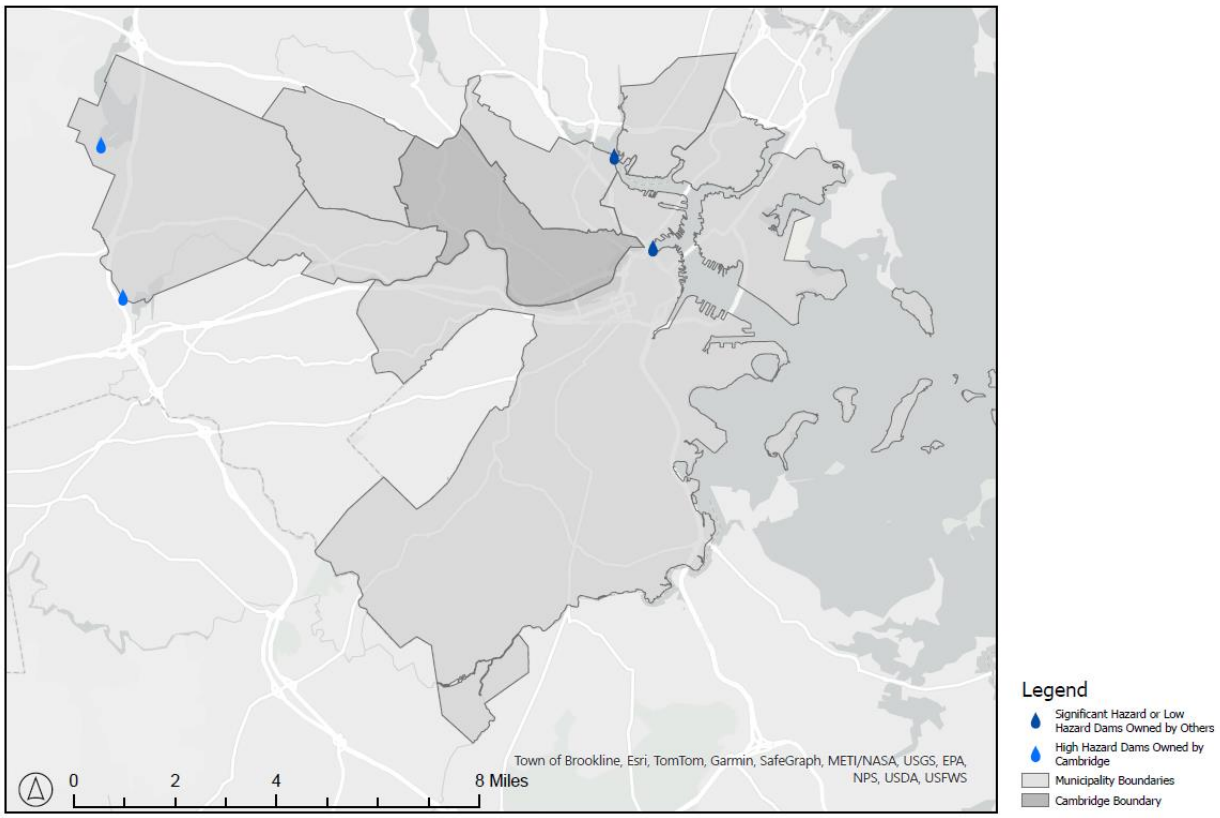

Figure 4.2: Dams identified as impactful to Cambridge.

The City's Water Department's Watershed Division is responsible for the Stony Brook Reservoir Dam and the Cambridge Reservoir Dam, which includes response during periods of adverse weather To comply with state guidance from the Office of Dam Safety, Cambridge has a Dam Emergency Action Plan for each dam and performs dam maintenance activities which include:

- Regular inspections conducted by Watershed Division staff;

- Biyearly (once every two years) inspections conducted by professional engineers in compliance with 302 CMR 10.07 because these dams were identified as high hazard;
- General maintenance of slopes and gates;
- General maintenance of auxiliary spillways; and
- Operation of safe reservoir levels.

Stony Brook Reservoir Dam

The Stony Brook Reservoir Dam is located in Weston and Waltham, Massachusetts, owned and operated by the City of Cambridge. In a detailed inspection report from November 2, 2022, the condition of the dam, as judged by the Massachusetts Office of Dam Safety criteria, was found to be in satisfactory condition. The City's consultant CDM Smith recommended the following actions be taken to address the deficiencies found at the dam during this inspection and evaluation:

Studies and Analyses

- Conduct a study to determine concept measures that can be taken to improve the hydraulic capacity of the dam
- Investigate and evaluate condition/source of seepage at downstream center-left berm toe area.

Recurrent Maintenance Recommendations

- Continue to record reservoir levels (currently performed daily
- Regular mowing/cutting should be performed at least four times a year or as conditions warrant from the Spring to Fall to control and limit growth of vegetation on and adjacent to the dam structures.
- Exercise the gatehouse gates on a semi-annual basis.

Minor Repair Recommendations

- Small animal control and repairs
- Fill small erosion area
- Reposition dislodged riprap stone
- Repair the gaps/missing mortar in the masonry stone

Remedial Modification Recommendations

- Design and implement measures that will improve hydraulic capacity of dam
- Design seepage control measures following investigation and evaluation of downstream center-left berm toe.

Cambridge Reservoir Dam

The Cambridge Reservoir Dam is located in Waltham, Massachusetts, owned and operated by the City of Cambridge. In a detailed inspection report from November 2, 2022, the condition of the dam, as judged by the Massachusetts Office of Dam Safety criteria, was found to be in satisfactory condition. The City's consultant CDM Smith recommended the following actions be taken to

address the deficiencies found at the dam during this inspection and evaluation:

Studies and Analyses:

- Develop an evaluation focusing on the shifting of the granite blocks on the left upstream slope of the dam.

Recurrent Maintenance Recommendations

- Continue to record reservoir levels
- The Water Department should continue visual inspections of the dam
- Regular maintenance activities should be performed at least twice a year or as conditions warrant
- Exercise the gatehouse gates on a semi-annual basis.

Minor Repair Recommendations

- Temporary measures to fill observed depressions, holes, and rills
- Remove woody vegetation and trees a distance of approximately 20 feet beyond toe of right
- downstream slope.
- Fill rodent/animal burrows
- Request City of Waltham to repair potholes in the asphalt on Winter Street along the crest.

Remedial Modification Recommendations

- Fill and re-grade the embankment's downstream slope
- Construct a graded mineral filter berm at the historic seepage location
- Construct repairs to remediate at distinct locations
- Construct repairs for scour/erosion at distinct locations

4.2.3.4. Potential Future Development

The City of Cambridge's Community Development Department (CDD) tracks larger-scale residential and commercial developments. Its Current Development Log database is updated on a quarterly basis and provides detailed information on each of the developments and overall trends. As of October 2023, Cambridge currently has 77 projects anticipated for future development.

These projects are at various stages in the development process, including projected, planned, and already under construction. These projects total more than 16 million square feet and provide an additional 5217 residential units. Most projects are in East Cambridge and consist mainly of office and research and development. However, overall in Cambridge, residential development is slightly more prevalent than office/R&D with approximately 39% of projects being primarily residential and 25% categorized as office/R&D (Cambridge, 2023).

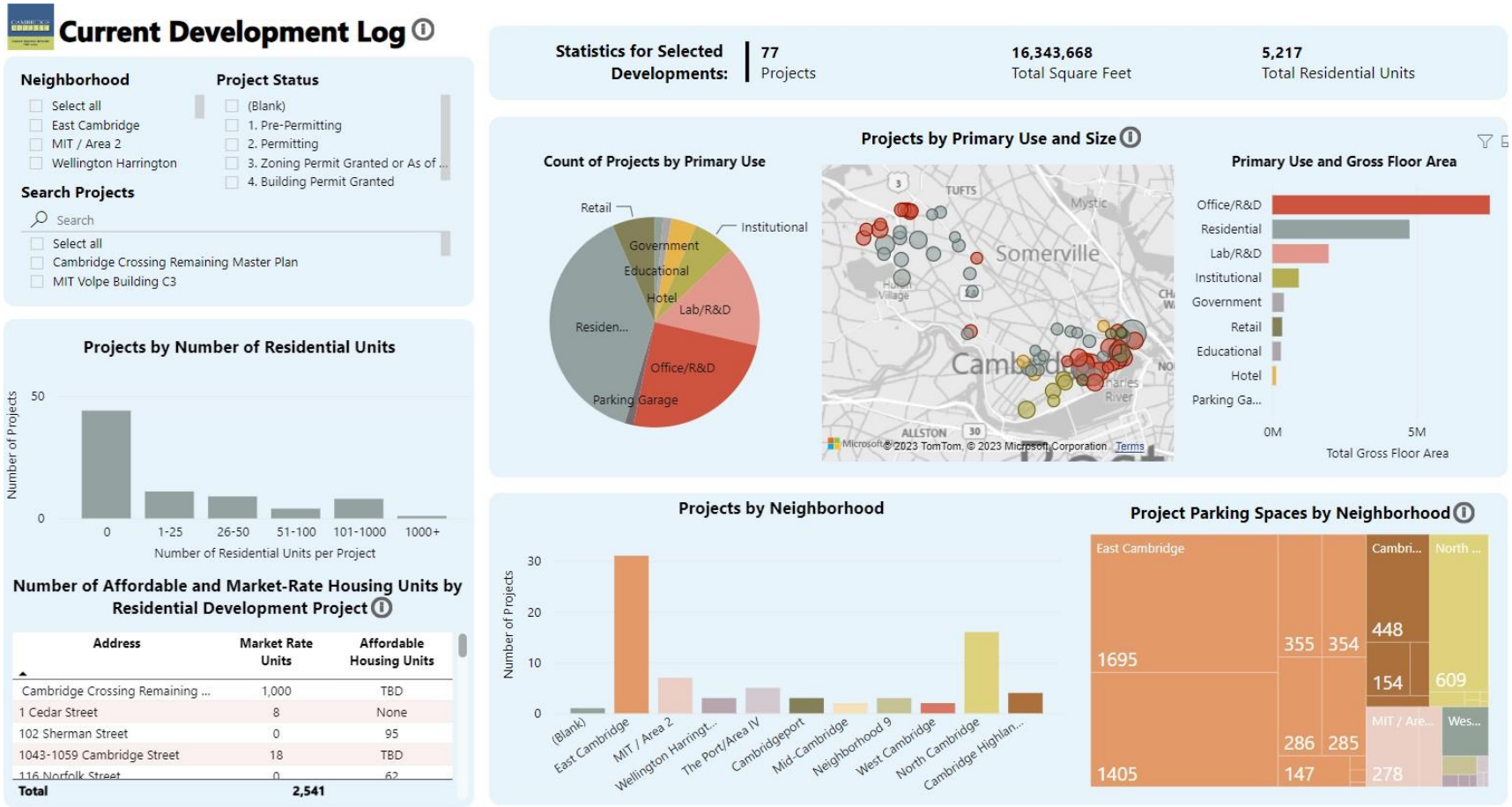

Figure 4.3: Image of the Current Development Log as of October 2023

4.2.4 | "Systems" Assets

"System" assets are defined as a collection of components that perform a critical service for the community. Systems are linear type assets. Systems may include horizontal assets associated with linear type assets. Table 4.5 shows the current systems assets in Cambridge by type and number. In addition, the relevant community lifeline, previously described in Section 4.1.2, is noted. Appendix E includes maps showing city assets.

Table 4.5: Number of Assets in the Systems Category

Sub-type of Asset	Count of Asset	Community Lifeline
Antenna Towers (FCC Registered Private Individual)	3	Communications
Backup Electric Generators	50	Energy
Cell Towers (e.g., Verizon wireless, T- Mobile Northeast)	3	Communications
Data Hub, Colocation Center	2	Communications
Emergency Communications Center	1	Communications
Energy Steam Line	1	Energy
Energy System Power Plant	6	Energy
Gas Distribution System	16	Energy
Major Roads	47	Transportation
Natural Gas Station	2	Energy
NSTAR Electric Substation	20	Energy
Sewer System (separate)	Portions of city	Water Infrastructure
Sewer system (combined)	Portions of city	Water Infrastructure
Sewer & Stormwater Pump Stations	70	Water Infrastructure
Steam Generating Facilities	1	Energy
Stormwater Pump Station	8	Water Infrastructure

Sub-type of Asset	Count of Asset	Community Lifeline
Stormwater system	City-wide	Water Infrastructure
Subway Station	10	Transportation
Telephone Office, Switch	1	Communications
Train Lines (e.g., MBTA Red Line, MBTA Green Line, MBTA Commuter Rail)	3	Transportation
Transmission Line	1	Communications
Utility Facilities	5	Communications, Energy, Food, Hydration, Shelter
Water System	City-wide	Water Infrastructure
Water System Reservoirs (e.g., Hobbs Brook (upper and lower, Stony Brook, Fresh Pond, and Payson Park Reservoir)	5	Water Infrastructure
TOTAL	**255**	

4.2.5 | Natural, Cultural, and Historic Resources Assets

Natural Resources are areas that provide protective function to reduce magnitude of hazard impact and increase resiliency, areas of sensitive habitat that are vulnerable to hazard events, and

/or protection of areas that are important to community objectives, such as the protection of sensitive habitat, provide socio-economic benefits, etc.

Historical and Cultural Resources are assets that possess historical, cultural, archaeological, or paleontological significance, including sites, contextual information, structures, districts, and objects significantly associated with or representative of earlier people, cultures, maritime heritage, and human activities and events.

Table 4.6 shows the current natural, cultural, and historic resources assets in Cambridge by type and number. In addition, the relevant community lifeline, previously described in Section 4.1.2, is noted. Appendix E includes maps showing city assets.

Table 4.6: Assets in the NCHR Category

Sub-type of Asset	Count of Asset	Community Lifeline
Community Assets (defined by city CDD GIS, e.g., museums, galleries, theater, dance facilities, CCTV, music schools, arts associations, etc.)	51	
Community Gardens	14	
Historic Districts (e.g., Fort Washington and Old Cambridge)	2	
Historic Landmarks and Easements	117	
National Reg of Historic Places	226	
Open Space Parcels	221	
Places of Worship	80	
Public Art Installations	206	
Tree Canopy	City-wide	
Water Bodies (e.g., Alewife Brook, Charles River)	2	
TOTAL	**919**	

4.2.6 | Economic

Economic assets are defined as entities that produce a financial benefit for the community.

As described in the Envision Cambridge Economy Plan, the city envisions a more equitable city, where all people, regardless of their background or identity, have access to opportunities. This Plan outlines strategies and actions to create a more inclusive labor market and regulate development to create an environment that will serve the city's economic goals. The city has been working towards the goals of:

1. Shared Community Prosperity: Ensure access to job opportunities and living wages, as well as access to robust education, training, and support services.
2. Equity: Eliminate racial, gender, and other disparities in economic opportunity.
3. Global Economic Center: Maintain Cambridge's centrality in the global knowledge economy.

4. Employment Diversity: Diversify employment opportunities beyond high-skill work in a few industries.
5. Business Diversity: Ensure local businesses of diverse types, sizes, and growth stages are able to start, grow, and remain in Cambridge.
6. Great Commercial Districts: Preserve and enhance the distinctive character of Cambridge's commercial districts, especially its major squares and mixed-use corridors.

The City of Cambridge has twelve vibrant commercial and development districts that offer a healthy retail and services mix to residents, workers, and visitors. These districts provide diverse amenities, commercial spaces, and employment opportunities that play a key role in the city's economic performance and its success. Cambridge's compact geography and population density allow businesses to thrive. Central Square, Alewife/Fresh Pond, East Cambridge, Harvard Square, Huron Village/Observatory Hill, Inman Square, Kendall Square, Lower Massachusetts Avenue, North Point, Osborn Triangle, and Porter Square/North Massachusetts Avenue are the 12 commercial districts in the city (CDD, 2023) – some create arts and cultural hubs and provide diverse nightlife, while others consist of innovation spaces with a mix of small and large retail and service businesses. All these commercial districts bring vibrancy to surrounding neighborhoods. Figure 4-4 shows these districts.

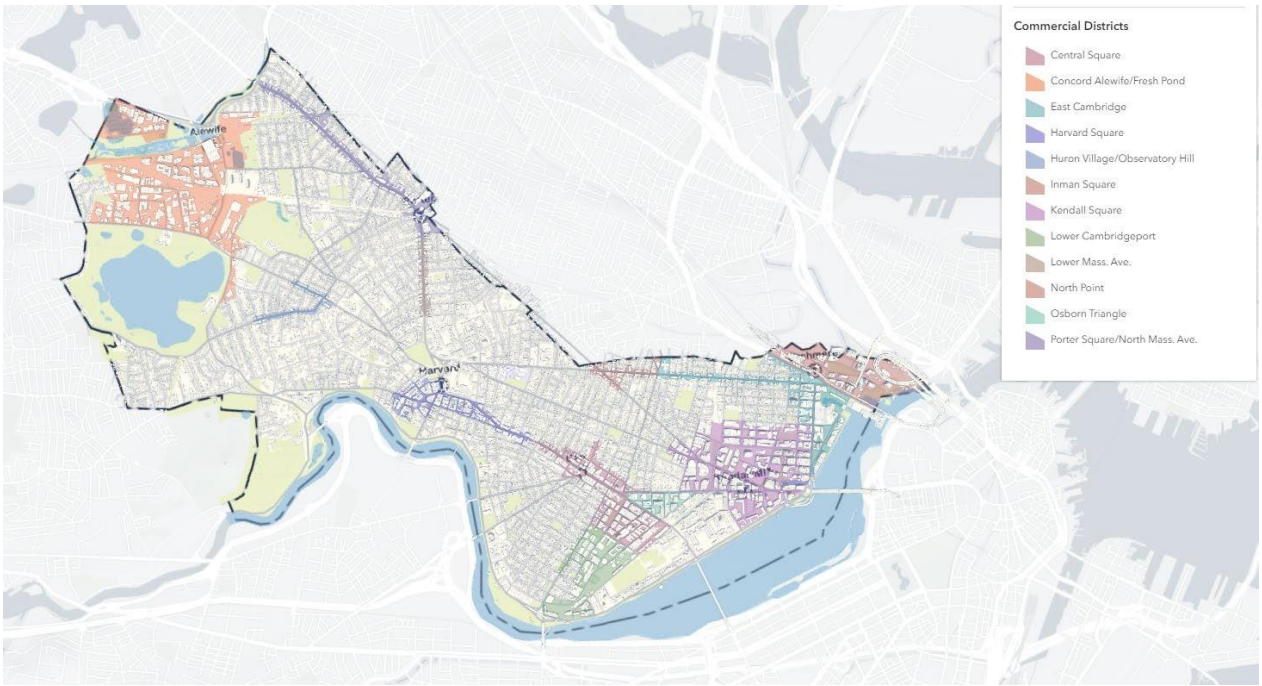

Figure 4.4: Image Cambridge's Commercial Districts (GIS, 2023)

The Cambridge Top 25 employers list provides insight into the overall economic climate in Cambridge. Since the mid-1980s, the Community Development Department (CDD) has collected employment data annually. According to the CDD, Table 4.7 lists the top employers in 2022 (City of Cambridge, 2023).

Table 4.7: Top Employers in Cambridge in 2022

Company	Employees	Type
Harvard University	12,553	Higher Education
Massachusetts Institute of Technology	9,043	Higher Education
Takeda Pharmaceuticals	3,634	Biotechnology
Cambridge Innovation Center	3,499	Start Up Incubator
City of Cambridge	3,480	Government
Novartis Institute for Biomedical Research	2,254	Biotechnology
Sanofi	2,200	Biotechnology
Broad Institute	2,119	Research & Development
Google	2,100	Technology
Phillips North America	2,000	Electronics & Health Technology

4.2.7 | Community Assets

Community assets are activities that benefit the community by increasing community morale and well-being. Activities may include education and knowledge transfer. Table 4.8 shows the current community assets in Cambridge by activity/event, location, organization, and expected guests. Appendix E includes maps showing city assets.

Table 4.8: Assets that have Value to the Community

Activity or Event	Location	Organization	Guests Expected
2023 Dance Party Event	Massachusetts Ave. from Clinton St. to Prospect St.	Cambridge Arts Council	10,000
2023 Susan G. Komen New England 3-Day	Walking Route near BU Bridge	The Susan G. Komen Breast Cancer Foundation, Inc.	800
ADWA Commemoration Parade	Danehy Park to Cambridge Commons	Massachusetts Ethiopian Support Association, Inc.	200
Annual BBN Circus	10 Buckingham St.	Buckingham Browne & Nichols School	700

Activity or Event	Location	Organization	Guests Expected
Annual Juneteenth Celebration Parade	Massachusetts Ave, Western Ave, Riverside	Paragon Society	100
Asian Task Force Against Domestic Violence (ATASK) Lantern Festival	Danehy Park Grounds	Asian Task Force Against Domestic Violence (ATASK)	500
Battle of The Bridge	Hoyt Field	Friday Night Hype / Ink Elite Classic	300
Berklee x Passim Summer in the City Series	Palmer St Alley	Passim	50
Bionic 5K	41 Church St.	Bionic Project, Inc.	750
Birthday celebration of poet Rabindranath Tagore	Harvard Square	Swaralipi	30
Boston Hong Kong Dragon Boat Festival	Charles River	Boston Hong Kong Dragon Boat Festival	20,000
Boston PHA O2Breathe Walk	Cambridge Commons	Boston PHA O2Breathe Walk	100
Broad Institute: Annual BBQ	Timothy Toomey Park	The Broad Institute	750
Cambridge Jazz Festival	Danehy Park	Cambridge Jazz Foundation	8000
Cambridge Montessori School Moving Up Ceremony	St Peter Field	Cambridge Montessori School	350
Cambridge Science Festival	MIT Museum	MIT Museum	Unknown
Cambridge-Somerville Asian Festival	The Foundry	Cambridge Families of Asian Decent	300
Central Square Dumpling Festival	Sidney St. between Green St. and Pacific St.	Central Square BID	4000
Central Square Food Truck Festival	Sydney St. between Green St. and Pacific St.	Central Square BID	4000
Children's Brotherhood Holy Ghost Feast	Saint Anthony Parish	Children's Brotherhood	400
Chinese New Year Celebration	Fitzgerald Theatre, Cambridge Rindge & Latin School	Chinese American Association of Cambridge	100
Chinese/Lunar New Year Rolling Parade	City Hall Lawn	Chinese American Association of Cambridge	100
Community Iftar	Cambridge Street Upper School	Office of Mayor Siddiqui	800
CRLS Graduation Ceremony	Russell Field	Cambridge Public Schools/Cambridge Rindge and Latin School	3500
Danehy Park Day	Danehy Park	Cambridge Recreation	5000

Activity or Event	Location	Organization	Guests Expected
Danehy Summer Concert Series	Danehy Park	Cambridge Recreation	100
Ethiopian American Family Day and Ethiopian New Year Festival	Danehy Park	Massachusetts Ethiopian Support Association	150
Fair Housing for All	Cambridge Public Library on Broadway	Community Development Department (CDD) and housed in Cambridge	100 - 200
Fall Classic 5K	64 Sidney St.	Clark E Promotions	2000
Family Fun Day BBQ	Squirrel Brand Park, corner of Broadway and Boardman	Just A Start Corporation	300
Farmers markets	Varies	Varies	Varies
Festa Junina	Saint Anthony Parish	Saint Anthony Parish Brazilian Apostolate	500
Fresh Pond Day	Fesh Pond	Cambridge Water Dept.	400 - 600
Friday Night Hype	Donelly Field	Friday Night Hype	100
Fusion	State St. between Massachusetts Ave. and Osborne St. Cross Street is Windsor St.	Subcentral & Infra	800
George's Anchor Of Kindness	Central Square. Magazine St. and Green St. Corner of Massachusetts Ave.	Anchor Of Kindness	30
Greek festivals	Saint Constantine & Helen Greek Orthodox Church	Greek Boston	2000
Harvard Square MayFair	Harvard Square	Harvard Square Business Association	50,000
Harvard Wellbeing Week Human & Pet Parent Fun Day	Cambridge Commons	Harvard Student Wellbeing Council	100
Hasty Pudding Woman of the Year Parade	Massachusetts Ave.	Hasty Pudding Theatricals	1,000
Head of the Charles	Charles River	Head of the Charles	400,000
Holy Ghost Feast of the Portuguese-American Civic League of Camb. & Som.	Springfield St. and Cambridge St.	Holy Ghost Feast of the Portuguese-American Civic League of Camb. & Som.	150
HONK! Festival	Varies	HONK! Festival	Unknown
Hoops 'N' Health	Hoyt Field	Men's Health League, Public Health Dept.	Unknown
Inaugural Folk Collective Event	Palmer St. Alley	Passim	50

Activity or Event	Location	Organization	Guests Expected
Inman East & Crafts	Inman Square	East Cambridge Business Association	300
Juneteenth Tournament	Saint Mary Park	Cambridge Youth and Families Connect, Equity Roadmap, Families of Color Coalition	200
Le Grand Prix Elmendorf du Pain	8th St. and Cambridge St.	East Cambridge Business Association	1,000
Loving Day Celebration	Joan Lorentz Park	Citizens Civic Unity Committee	200
Mass Mutual and Boston Red Sox Opening Day Drone Show	Cambridgeside Galleria Parking	EventsPermits LLC	0
Memorial Day	1500 Massachusetts Ave	Veteran Services	200
Mexican Street Food Festival	Sidney St. between Green St. and Pacific St.	Central Square BID	4,000
MLK Day of Service Community Walk	Riverside/Cambridgeport	Many Helping Hands 365	250
MSYEP parties and events	Varies	Mayor's Summer of Youth Employment Program (MSYEP)	Varies
New England Open Market	Church St	Harvard Square Business Association / New England Open Markets	500
Old Time Classic	St. Peters Field	Cambridge Recreation	500
Paddy's Annual Cambridge Classic 5K	260 Walden St.	Paddy's Lunch	600
Patriots Day Celebration	1500 Massachusetts Ave	Veteran Services	200
Play Streets and Block Parties	Varies – Induvial Streets	Community Development Department (CDD)	Varies
Port Arts Fest/Mural Masters	Port Neighborhood	Community Arts Center, Inc.	350
Port Pride Day	Clement Morgan Park	The Margaret Fuller Neighborhood House	Unknown
Pride Brunch	City Hall	Office of the Mayor and Cambridge LGBTQ+ Commission	100 - 300
River Festival	Cambridge Waterfront	Cambridge Arts Council	175,000

Activity or Event	Location	Organization	Guests Expected
Run To Home Base	Massachusetts Ave. from Memorial Drive to Vassar St. and Memorial Drive between Longfellow Bridge and Vassar Street	DMSE SPORTS	2,000
Saint Anthony Feast	400 Cardinal Medeiros Ave.	Saint Anthony Parish	400
Santo Cristo Feast	Saint Anthony Parish	Saint Anthony Parish	500
SerbFest	41 Alewife Brook Parkway	St. Sava Cathedral	1,000
Spring Classic 5K	64 Sidney St.	Clark E. Promotions	2,000
St. John's Brotherhood	Saint Anthony Parish	Saint John's Holy Ghost Brotherhood	400
Summer Boston Celtic Music Festival - Day Event	Palmer St. Alleyway in front of Club Passim	Club Passim	100
Summer Classic 5K	64 Sidney St.	Clark E. Promotions	2,000
Summer Soul Slide Skatepark Series	Lynch Family Skatepark	Right Here Recordings	300
Super Sunday	Kendall Square	RACE Cancer Foundation	1,000
The Encouragement Program, Inc.	St Peter Park	The Encouragement Program, Inc.	25
The Port Park Party	Inside Clement Morgan Park	DPW	100
Wild Rabbit Community Moto Show	Naco Taco, State St, Village State, Windsor St.	Central Square BID	3,000
Wills David Moore youth center annual 7-8th grade basketball tournament	Hoyt Field Basketball Courts	Kevin Moore	60
Winter Classic 5K	64 Sidney St.	Clark E Promotions	2,800
TOTAL	**78**		**Over 720,000**

4.3. Assessing Vulnerability of Community Assets and Identifying Impacts

The vulnerability of the community assets, identified in this chapter, to the natural hazards described in Chapter 3, are presented in Chapter 5.

Chapter 5:
Vulnerability & Impacts Assessment

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5. Vulnerability & Impacts Assessment

5.1. Introduction & Overview

In hazard mitigation planning, risk is the potential for damage or loss when natural hazards described in Chapter 3 interact with assets described in Chapter 4. For Cambridge, assets include people, structures, systems, natural, historic, and cultural resources, the economy, and valued activities. The risk assessment looks at two key factors: vulnerability and impact.

- **Vulnerability** is a description of which assets within locations identified to be hazard prone are at risk from the effects of the identified hazard(s) (FEMA, 2022).
- **Impacts** are the consequences or effects of each hazard on the city's assets identified in the vulnerability assessment (FEMA, 2022).

For each natural hazard described in Chapter 3, this chapter presents an overview of which assets are most at risk from the effects of that hazard and describes the consequences of that vulnerability.

Starting in 2015, Cambridge undertook a detailed climate change vulnerability assessment which evaluated the city's critical assets and infrastructure for the present day and anticipated future climate risks. The vulnerability assessment included inland/riverine flooding, sea level rise, extreme heat, and provided a robust economic analysis. Following the vulnerability assessment, Cambridge developed the Resilient Cambridge Plan which identified broad resilience strategies and actions for neighborhoods, buildings, infrastructure, and overall creating a greener city. The vulnerability assessment in this plan builds upon Cambridge's previously released reports.

5.2. Methodology

5.2.1 | Vulnerability Assessment Overview

Natural hazard profiles presented in Chapter 3 were used to determine which assets identified in Chapter 4 are located within hazard prone areas, presently or in the future. For inland flooding and coastal flooding, GIS mapping of assets and of areas of flooding were utilized as further described in Sections 5.3.1 and 5.3.3. For all other hazards, the identified hazard is not mapped or cannot be mapped and therefore a qualitative analysis that relies on local knowledge and rational decision making was used to identify vulnerability. Because Cambridge has a considerable number of assets that are present city-wide, vulnerability discussions focus on specific assets that are most important and most susceptible to damage or loss from hazards.

5.2.2 | Identification of Potential Impacts

There are three ways to analyze impacts:

- **Historical Analysis:** Historical analysis uses data on the impacts and losses of previous hazard events to predict the anticipated impacts and losses for a similar future event.
- **Exposure Analysis:** An exposure analysis identifies the existing and future assets in known hazard areas. GIS is often used for this analysis and to make maps to visualize the risk. An exposure analysis can quantify the number, type and value of structures, community lifelines and other assets in areas of identified hazards. It can identify any assets exposed to multiple hazards. Exposure analysis can also help a community understand areas that may be vulnerable if and when buildings, infrastructure and community lifelines are built in hazard-prone areas. For Cambridge, an exposure analysis was used for inland and coastal flooding.
- **Scenario analysis:** A scenario analysis asks "what if" a certain event occurs. This kind of analysis uses a hypothetical situation to think through potential impacts and losses. A scenario analysis can be completed narratively by walking through a scenario with the planning team and documenting what could happen. It can also be completed using modeling. FEMA's Hazus program is one of the most common scenario analysis tools for hazard mitigation. For Cambridge, FEMA's Hazus-MH Version 2.2 SP1 was used to estimate potential losses from earthquakes and hurricanes.

Table 5.1, below, discusses general impacts that can be the result of natural hazards affecting Cambridge's assets. These impacts are discussed throughout this chapter.

Table 5.1: Types of Impacts due to Occurrence of Natural Hazards
(Types of impacts are not particularly ranked by severity)

Impact	Examples
Loss of Life	Death
Physical Injuries	Cuts, bruises, broken bones, or amputations.
Public Health	Spread of disease or vector-borne illnesses Respiratory problems arising from air pollution
Property Damage	Damage to physical structures Damage to contents within homes and buildings Damage to vehicles
Economic Impacts	Lost wages Closure of or interruption to businesses Increased insurance premiums

Impact	Examples
	Increased costs for repairs/rebuilding Decreased property values Disruption of industry and the transport of goods and services Decreased tourism revenues
Displacement	Forced abandonment of the home due to unsafe living conditions, either permanently or temporarily
Environmental Impacts- Contamination	Air pollution from dust and debris Transport of toxic chemicals by floodwaters Release of hazardous materials into soil and water Decreased water quality Sewage release into waterways
Environmental Impacts- Ecological	Loss of wildlife Loss or destruction of habitat Disruption to migratory patterns Loss of biodiversity
Environmental Impacts- Geological	Landslides Erosion Removal of topsoil Debris deposit Altered nutrient balance
Psychological Impacts	Trauma Anxiety Stress PTSD
Building Damage	Structural damage to roofs, walls, or foundations Collapse or destruction
Utility Infrastructure Damage	Damage to power lines, communications towers, and water and gas mains resulting in power outages, loss of water or gas, and loss of communication, radio signal, or internet
Transportation Infrastructure Damage	Damage to or debris build-up on roads, bridges, railways, or airports that render them impassable or unsafe to use
Disruption to Lifelines	Medical facilities, emergency services, or transportation networks are unable to provide essential services due to damage or debris
Impacts to Daily Life	Cancellation or postponement of sporting or other events that are important to the community.

Impact	Examples
	Damage to parks, community centers, or public pools inhibits recreation. Destruction of historic or cultural landmarks Interruption of education Limitations to home care providers maintaining service to those in need

Approximately one third of households in Cambridge do not own cars and rely on public transportation. The city has one of the highest walkability scores in the region. It is important to identify support services and assets within reasonable walking distance of owners, renters, and students. According to the U.S. Department of Transportation, "most people are willing to walk for five to ten minutes, or approximately ¼- to ½-mile to a transit stop." Figure 5.1 demonstrates that some areas of Cambridge are well supported by services during or after a natural hazard event but there are areas of Cambridge that are not as accessible due to their distance from services.

Proximity to these assets has a significant impact on Cambridge's people and their ability to adapt to and respond to flooding, winter storms and Nor'easters, hurricanes and tropical storms, and extreme temperatures, as well as other natural hazards encountered less frequently.

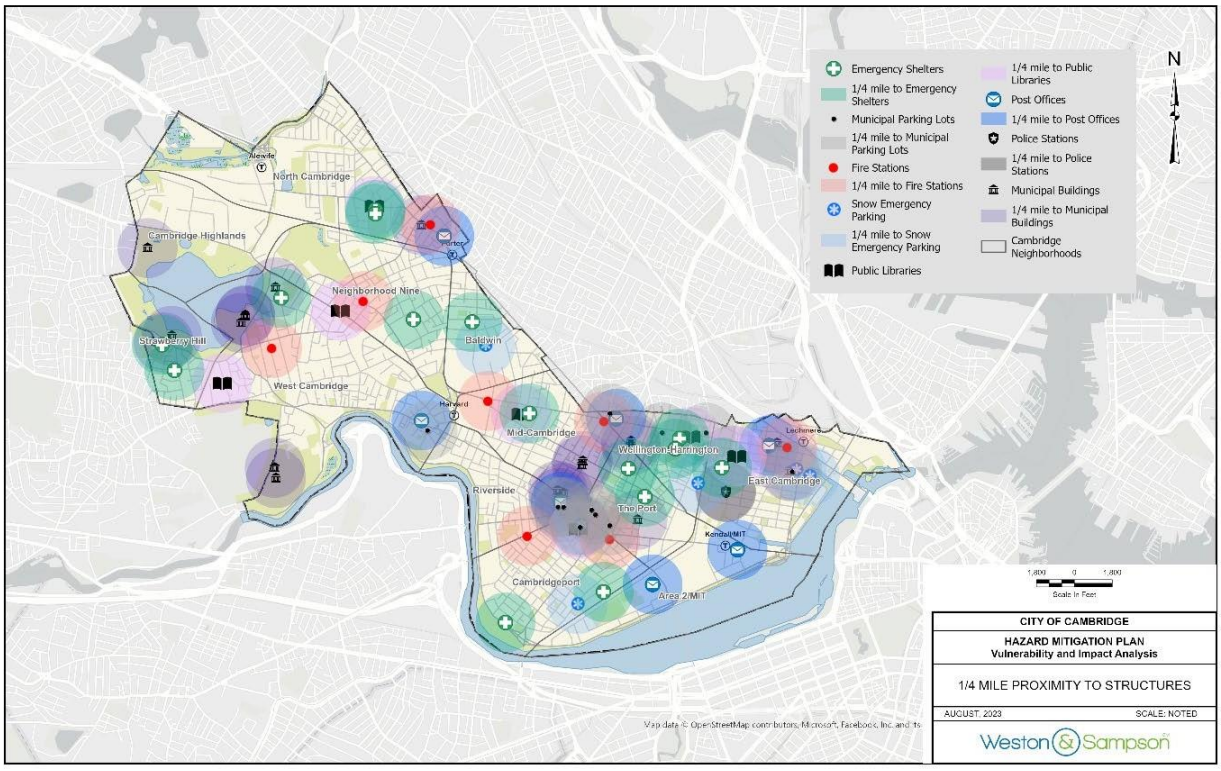


Figure 5.1: Areas of Cambridge well supported by services.

5.3. Assessment

5.3.1 | Changes in Population Patterns & Land Use and Development

The hazard mitigation planning process requires a comprehensive assessment of how various factors may influence a community's vulnerability to natural hazards in the future. A critical component of this assessment involves analyzing the potential impacts of climate change, population shifts, and land use changes on each participating jurisdiction and its key assets. By examining how these dynamic forces may alter hazard risks over time, communities can develop more robust and forward-looking mitigation strategies. Specifically, planners must consider how changing climate patterns could exacerbate existing hazards or introduce new threats. They must also evaluate how population trends, including migration, density changes, and shifts in socially vulnerable groups, may affect a jurisdiction's exposure and adaptive capacity. Additionally, the following analysis includes how evolving land use and development patterns could either mitigate or amplify hazard impacts on structures and infrastructure. The following table summarizes potential changes in population patterns and development with respect to climate hazards and the City's planning efforts.

Table 5.2: Assessment of Changes in Population Patterns & Land Use and Development

Hazards	Changes in Population Patterns	Changes in Land Use and Development
Inland Flooding (Stormwater and Riverine)	Cambridge Highlands, North Cambridge, Strawberry Hill, Neighborhood Nine, Riverside, Cambridgeport, the Port, Area2/MIT, East Cambridge, and Wellington-Harrington have more susceptibility to precipitation-based flooding. North Cambridge, the Port, Riverside, Area 2/MIT, East Cambridge, and Wellington-Harrington also have a higher amount of poverty than other areas of the city (15-22%). Riverside, Wellington-Harrington, North Cambridge, the Port, and Area 2/MIT also have more renters than other areas of the city (60% or more).	Existing basement and first-floor units are particularly vulnerable to inland flood impacts. The city adopted new zoning standards to support flood resilient development, that limits the ability to locate critical uses, such as residential space below the base flood elevation. Cambridge also has stringent stormwater standards and a Green Factor requirement, so new development will help transition Cambridge to development types that limit their impact on inland flooding. However, as of 2019, only 1.25% of the building stock in Cambridge was composed of new buildings, suggesting that this

Hazards	Changes in Population Patterns	Changes in Land Use and Development
	Characteristics of priority populations such as renting or experiencing poverty can make a resident more vulnerable to the impacts of precipitation-based flooding. This is because individuals who rent have less control over adapting their unit to precipitation - based flooding and may be more easily displaced after a flood than a homeowner. Residents who are below the poverty line have less financial and material resources to prepare for such events. **It is possible that other populations will have greater means to move to areas of the city or other communities that are less impacted by precipitation-based flooding. Population patterns may change in these areas to include an even greater amount of renters and individuals experiencing poverty who do not have other housing options.** The university student population in Cambridge causes fluctuations in number of residents throughout the year. These populations may not be aware of flood issues in neighborhoods surrounding the university. The influx in population also puts more strain on critical assets, particularly in emergency events.	transition may take several decades. New development has been happening more quickly in the past five years. Kendall Square is quickly developing with technology and R&D developments. Many of these buildings include the new standards mentioned above. This is an area also more vulnerable to precipitation-based flooding. **This hazard has already resulted in changes to development and redevelopment and land use patterns in the city. As the city continues to track projected flooding areas, additional changes to local requirements/code may be enacted that further change patterns (e.g., no re-build areas, more enhanced stormwater management requirements, etc.)**
Winter Storms and Nor'Easters	Older adults, individuals with health issues, and people with disabilities may be more susceptible to adverse impacts during winter storms and Nor'Easters. This is because these	It may be beneficial to include back-up power supply in new developments to avoid electricity outages during winter storms.

Hazards	Changes in Population Patterns	Changes in Land Use and Development
	residents may be more socially isolated, require special medical services or equipment, or have more limited mobility. The neighborhoods of Strawberry Hill, Neighborhood Nine, West Cambridge, and East Cambridge have the highest percentages of older adults, above the age of 65 who live alone – over 10% of the population. East Cambridge, The Port, North Cambridge, Strawberry Hill have the highest percentage of residents with a self-disclosed disability. Individuals who are experiencing housing insecurity or who are renters may be more vulnerable during these events due to lack of adequate shelter. Electricity and heat outages pose a particular risk to these populations. The U.S. Census Point in Time Count from 2019 documented approximately 550 individuals who were unhoused. The highest percentage of renters are in MIT/Area 2, Riverside, Wellington-Harrington. **An increase in winter storms and Nor'Easters or more sever impacts from such events may cause older adults to consider living in regions with more temperate climates. These populations may need stronger support.** **The number of individuals who experience housing insecurity or who are unhoused may increase if the inability to pay high utility bills caused by cold winer**	State programs exist to help residents winterize their homes, such as MassSaves. **Increases in winter storms and Nor'Easters may change building practices – wood frame constructed residences have less thermal mass than masonry, brick, or concrete dwellings. Currently, wood frame constructed residences are the dominate single and small multi-family housing type in Cambridge.**

Hazards	Changes in Population Patterns	Changes in Land Use and Development
	weather and temperatures results in more evictions.	
Coastal Flooding as a Result of Dam Failure	There are a significant percentage of renters in Cambridge who also live in areas susceptible to sea level rise and storm surge impacts. The neighborhoods that include a high percentage of renters (63% or higher) and are vulnerable include North Cambridge (adjacent to the Alewife Brook), Riverside, and MIT/Area 2. **If real estate prices are driven down in areas vulnerable to sea level rise because they are generally found undesirable and flood insurance is high, there may be an increase in residents who rent in these areas who have less choice in housing than owners or residents who are more affluent.**	Neighborhoods that are susceptible to sea level rise are more susceptible to tsunami impacts. These neighborhoods include Cambridge Highlands and North Cambridge around the Alewife Brook, Riverside, Cambridge Port, Area 2/MIT, East Cambridge. **The City of Cambridge may need to consider more stringent ordinances that limit building in areas prone to flooding related to sea level rise. Regulations may include "no-build" zones.**
Hurricanes and Tropical Storms	There are a significant percentage of renters in Cambridge who also live in areas susceptible to sea level rise and storm surge impacts, which often occur during Hurricanes and Tropical Storms. The neighborhoods that include a high percentage of renters (63% or higher) and are vulnerable include North Cambridge (adjacent to the Alewife Brook), Riverside, and MIT/Area 2. Inland flooding is also prevalent during these types of events. The neighborhoods of North Cambridge, the Port, East Cambridge, and Riverside have a higher percentage of residents living below the poverty	A significant amount of Cambridge's building stock is older, wood construction. Wood frame buildings are more vulnerable to damages from wind during Hurricanes and Tropical Storms. Residents who live in first floor units and basement units may be more vulnerable to flood impacts during such events if the storms cause localized flooding. Cambridge is making efforts to address the safety issues surrounding basement apartments. **If a hurricane or tropical storm were to hit Cambridge and**

Hazards	Changes in Population Patterns	Changes in Land Use and Development
	line (at least 15%) and are vulnerable to inland flood impacts that can occur during Hurricanes and Tropical Storms. Being below the poverty line can impact a person's ability to prepare, respond, and recover from storms due to limited financial resources. **If a hurricane or tropical storm were to hit Cambridge, it is likely that individuals living below the poverty line or who are renters would be displaced for a longer period than residents who are homeowners. This could result in displacement of individuals who are housing insecure to other localities.**	**buildings were substantially damaged, especially those that are older, it is likely that rebuild may occur. Because Cambridge has adopted new zoning standards to encourage resilient buildings, buildings that are reconstructed may be more adapted to future impacts.**
Tornadoes	Older adults, individuals with health issues, and people with disabilities may be more susceptible to adverse impacts during tornadoes. This is because these residents may be more socially isolated, require special medical services or equipment, or have more limited mobility. The neighborhoods of Strawberry Hill, Neighborhood Nine, West Cambridge, and East Cambridge have the highest percentages of older adults, above the age of 65 who live alone – over 10% of the population. East Cambridge, The Port, North Cambridge, Strawberry Hill have the highest percentage of residents with a self-disclosed disability. **If a tornado were to touch ground in Cambridge, it is possible that residents who are older, have**	A significant amount of Cambridge's building stock is older, wood construction. Wood frame buildings are more vulnerable to damage from tornadoes. **If a tornado were to touch ground in Cambridge and cause substantial damage, it is likely that when buildings are rebuilt more resilient materials may be selected that can withstand higher winds. Additionally, the city may consider incorporating new standards into their resilient zoning ordinance.**

Hazards	Changes in Population Patterns	Changes in Land Use and Development
	underlying health conditions, or self-disclosed disabilities that were impacted consider alternate living situations post-event, if they are able. Early warning for storms, mobility support, and places to shelter are critical for these individuals.	
Earthquakes	Residents who live in older buildings may be more vulnerable during the event of an earthquake. Priority populations such as those with self-disclosed disabilities, older adults, or young children may be more vulnerable to earthquake impacts. **Earthquakes may impact the interest of older adults and adults with different abilities or health issues in living in Cambridge, if they have alternate housing options. If they do not, there may be efforts by the Cambridge Public Health department to integrate preparedness exercises at locations such as assisted living facilities.**	New development should incorporate standards for earthquake safety. **If Cambridge were to experience an earthquake, it is possible that local officials and staff look to west coast examples or other areas for examples of how to build more resiliently for this type of event. Recommendations could be integrated into the local zoning, helping to transition the building supply as it is rebuilt or redeveloped.**
Landslides	No documented landslides in Cambridge.	No documented landslides in Cambridge.
Tsunami	Residents who live in neighborhoods that are susceptible to sea level rise are more susceptible to tsunami impacts. These neighborhoods include Cambridge Highlands and North Cambridge around the Alewife Brook, Riverside, Cambridge Port,	Neighborhoods that are susceptible to sea level rise are more susceptible to tsunami impacts. These neighborhoods include Cambridge Highlands and North Cambridge around the Alewife Brook, Riverside, Cambridge Port,

Hazards	Changes in Population Patterns	Changes in Land Use and Development
	Area 2/MIT, East Cambridge. Older adults, individuals with limited English capabilities, and those with self-disclosed disabilities may be more susceptible to impacts if they have limited mobility, underlying health issues, or do not receive warnings about preparedness for a tsunami event. **If a tsunami were to hit Cambridge and impact neighborhoods and properties, this may impact the interest in renters pursuing these locations in the future for housing, which could drive prices down in vulnerable areas.**	Area 2/MIT, East Cambridge. Cambridge's zoning for flood resilience may help newer buildings and developments in terms of their adaptability to sea level rise impacts. However, most of the Cambridge's building supply is older, with only 1.25% of new buildings making up supply in the past decade (as of 2019). **If a tsunami were to hit Cambridge and damage properties, this may impact interest in rebuilding in flood prone areas. Alternatively, buildings that are reconstructed will include resilient standards from the city's zoning.**
Extreme Temperatures	Cambridge has many priority populations, who also live in the hotter areas of the city that experience urban heat island. Neighborhoods with significant UHI and priority populations include: Cambridge Highlands, the Port, and East Cambridge. **Heat-related illness and mortality may increase, particularly in priority populations as extreme temperatures increase.**	Areas of the city with notable UHI and new development or dense development include Cambridge Highlands, Area 2/MIT, the Port, Harvard Square, and East Cambridge. The Cambridge Green Factor, which includes a "cool factor" scoring component is helping Cambridge transition to new development that lowers heat impacts. The Cool Factor encourages development to utilize strategies such as cool, white roofs, green roofs, and low albedo surfaces. The universities in Cambridge contribute to urban heat island due to the size and materiality of their institutional buildings. The city has stringent regulations to

Hazards	Changes in Population Patterns	Changes in Land Use and Development
		protect existing trees and encourage planting new ones, which helps to balance the impacts of how densely settled the city is. **These practices are contributing to a greening of the city and more sustainable development practices that help lower UHI.**
Drought	Increases in population can put stress on water supplies. Cambridge water is supplied from the Stony Brook Watershed, nested within the Charles River Basin, in the towns of Lincoln, Lexington, Weston, and the City of Waltham. The water makes its way through tributaries and a series of reservoirs to its destination in Fresh Pond Reservoir. Therefore, regional population growth may also influence adequate supply in Cambridge, particularly in instances of drought. **Local and regional pressures on water supply could impact where residents choose to live.**	Increases in new development which result in an increase of residential units, and subsequently increase in the population, can put strains on water supply, particularly during drought. New developments can integrate stormwater management practices, such as blue roofs and rainwater collection methods to preserve water during droughts that can be used to water plants, or to flush toilets. **There may be greater water supply protections within development regulations across the region and Commonwealth in the future if there is a deficit of supply. Such regulations would likely limit building near fresh water supply sources.**
Wildfire/Brush Fire	Individuals with asthma, lung disease, heart disease, and other cardiovascular issues may be more impacted by wildfires and brush fires. Older adults and young children are also at greater risk. The neighborhoods of Strawberry Hill, East Cambridge, the Port, and West Cambridge have the most children	Urban wildfires or brush fires can spread more easily in densely developed areas with wood frame construction. 74% of the building stock in Cambridge is small-scale residential units. The majority of these buildings are older buildings with wood framed construction, built between 1850-1950, making them

Hazards	Changes in Population Patterns	Changes in Land Use and Development
	under the age of five. The neighborhoods of Strawberry Hill, Neighborhood Nine, West Cambridge, and East Cambridge have the highest percentages of adults over 65 who live alone. Older housing stock and buildings that are wood-framed construction are also more susceptible to wildfire damage and the spread of fire. Many of Cambridge's residents live in such units, and the increase in population puts greater pressure on aging residential units. **Individuals with underlying health conditions such as asthma, lung disease, heart disease, and other cardiovascular issues may choose to live in areas with lower wildfire risk, if this hazard increases in the northeast and Canada, and causes similar issues with smoke that were experienced in 2023.**	more susceptible to fire impacts. Maintenance requirements for urban tree canopy and private trees can help reduce dead or disease prone species that may propagate brush fire in developed areas of the city. **The city may need to implement maintenance requirements to accompany development standards such as the Green Factor to protect against plants dying or suffering from not having enough water – conditions that perpetuate wildfire risk.**
Invasive Species	With wetter hotter conditions, disease outbreaks, such as the 2019 Eastern Equine Encephalitis (EEE) outbreak, may become more common as average annual temperatures and precipitation increase. The city is exploring how to balance its goal of preserving natural areas and wetlands and managing public health issues that can be propagated by low-lying wet areas. Cambridge Highlands (Alewife), North Cambridge, and neighborhoods adjacent to the Charles River, such as Riverside, Harvard Square, West Cambridge,	Cambridge adopted a Green Factor zoning requirement for new developments and redevelopments. The Green Factor prioritizes the integration of native species in new developments and redevelopments. Proper maintenance of features in new developments such as bioswales and rain gardens can limit the propagation of invasive species. Areas where the city may want to encourage extra care related to this maintenance are in low-lying neighborhoods, neighborhoods with

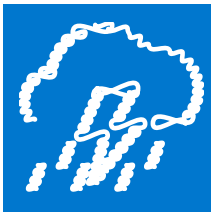
Hazards	Changes in Population Patterns	Changes in Land Use and Development
	and Cambridgeport may be more susceptible to health issues caused by algal blooms, mosquitos, and other pests which cause Zeka virus, and other vector-borne illnesses. **An increase in invasive species, such as insects that carry vector-borne disease, could impact resident's desire to live in low-lying areas and near bodies of water that have larger colonies of these species.**	UHI, and neighborhoods adjacent to the river and Alewife Brook. **An increase in invasive species, could impact willingness or ability to develop low-lying areas and areas adjacent to water bodies due to public health risks.**

5.3.2 | Inland Flooding (Stormwater and Riverine)

The impacts of flooding in Cambridge can include injury or death, property damage, and traffic disruptions. Erosion can also occur due to flooding events, which can compromise water quality, slope stability, and the stability of building foundations. Erosion puts current and future structures and populations at risk if they are in areas near steep slopes and embankments.

Inland flooding includes both stormwater and riverine flooding. Riverine flooding is most likely to impact areas closest to bodies of water, while stormwater flooding can occur all over the city.

Property damage, public health hazards, and impacts to transportation networks are the primary concerns surrounding inland flooding. Stormwater flooding is often concentrated in smaller areas including parking lots and roadways, hindering emergency access, and leaving communities isolated.



My basement has flooded twice when we had storms that dumped 7-8 inches in 48 hours.

- Survey Respondent

Much of the infrastructure in Cambridge, including bridges, tunnels, stormwater systems, roadways, and the subway system, were designed based on historical rainfall events. With increased frequency and severity of storm events, inland flooding could become an increased vulnerability for the city to manage. Noted recently, more frequent occurrences of flood events larger than the historic normal have occurred and put this vital infrastructure at risk. Much of the community in Cambridge relies heavy on the public transportation system and road networks to get from place to place, and damage to any of these systems could impact thousands of people and result in inability for them to get to work, appointments, and other essential locations.

Hazard locations and extent of riverine flooding were determined using the FEMA FIRM for Zone A (100-year floodplain) and Zone X (500-year floodplain). A flood exposure analysis was conducted for assets throughout the city utilizing the most recent assessor's database, FEMA flood maps, and the city's flood viewer. Table 5.3 shows the number of assets likely to be impacted by inland flooding for a variety of flood scenarios. Table 5.4 lists the total number of buildings anticipated to be impacted by inland flooding for a variety of flood scenarios, and their associated assessed value based on the most recent assessor's database.

Table 5.3: Assets Impacted by Inland Flooding

Flood Scenario	Number of Assets Impacted
FEMA 100-year Floodplain	46
FEMA 500-year Floodplain	85
Precipitation Flooding - Present Day 10-year	194
Precipitation Flooding - Present Day 100-year	554
Precipitation Flooding - 2070 10-year	350
Precipitation Flooding - 2070 100-year	735

Table 5.4: Buildings Impacted by Inland Flooding

Flood Scenario	Number of Buildings Impacted	Assessed Value of Buildings
FEMA 100-year Floodplain	201	$3.63 billion
FEMA 500-year Floodplain	768	$6.29 billion
Precipitation Flooding - Present Day 10-year	661	$16.70 billion
Precipitation Flooding - Present Day 100-year	3,570	$31.22 billion
Precipitation Flooding - 2070 10-year	1,816	$22.77 billion
Precipitation Flooding - 2070 100-year	4,987	$37.98 billion

An exposure analysis was utilized to assess potential impacts on the vulnerable assets due to natural hazards. Table 5.5 lists these assets and the impacts. Appendix F includes maps showing community assets and vulnerability to inland flooding under a variety of storm events.

Table 5.5: Vulnerabilities and Impacts from Inland Flooding

Most Vulnerable Assets	Likely Impacts
Transportation Network	Transportation Infrastructure Damage • Disruption to MBTA and roadways • Water and debris block routes, making transportation networks impassable or unsafe. • "Failure of key roadway segments will have cumulative and cascading impacts on multiple critical transportation assets including MBTA bus routes and access to bridges. Major at-risk roads include Alewife Brook Parkway, Massachusetts Avenue, Monsignor O'Brien Highway, and Broadway" (City of Cambridge, November 2015).
Emergency Response (including police, fire, and operating centers)	• Approximately 5 of 9 assets are in an area that is likely to experience present day flooding (100-year storm event) • Approximately 7 of 9 assets are located in an area that is likely to experience future (2070) flooding (100-year storm event)
Power Grid	• "North Cambridge and Putnam electrical substations are the assets at greatest risk for energy system failure due to their vulnerable locations. They also have high consequences of failure, including cascading impacts on other energy infrastructure" (City of Cambridge, November 2015).
Water/Stormwater	• Areas with combined sewer systems may experience flooding which could cause more CSOs and impacts to water quality and public health as a result of increased CSOs (City of Cambridge, November 2015).
Municipal Facilities	• Approximately 6 of 24 assets are located in an area that is likely to experience present day flooding (100-year storm event) • Approximately 9 of 24 assets are located in an area that is likely to experience (2070) future flooding (100-year storm event)
Heath Centers and Health Related Services	• Approximately 5 of 13 assets are located in an area that is likely to experience present day flooding (100-year

Most Vulnerable Assets	Likely Impacts
	storm event) • Approximately 6 of 13 assets are located in an area that is likely to experience future (2070) flooding (100-year storm event)
Daycares and Schools	• Approximately 59 of 137 assets are located in an area that is likely to experience present day flooding (100-year storm event) • Approximately 68 of 137 assets are located in an area that is likely to experience future flooding (100-year storm event)
Emergency Shelters	• Approximately 8 of 15 assets are located in an area that is likely to experience present day flooding (100-year storm event) • Approximately 8 of 15 assets are located in an area that is likely to experience future (2070) flooding (100-year storm event)
Buildings and Structures	Building Damage • Water damage to internal and external of buildings • Damage to historic buildings
Businesses	Economic Impacts, Property Damage • Business interruption and potential job loss • Limited patrons resulting in reduced revenue. • Increased costs of maintenance and repair • Loss of diversity of businesses
All People	Physical Injuries, Loss of Life, Displacement, Psychological Impacts • Displacement due to building damage. • Isolation due to road closures
Public Health	Water and Sewer Impacts • Mold from water damage • Potential sewer overflow • Potential water source pollution
Vulnerable groups, including	Physical Injuries, Loss of Life, Displacement, Psychological

Most Vulnerable Assets	Likely Impacts
unhoused and isolated populations	Impacts • Displacement due to building damage. • Isolation due to road closures
Natural Resources	Environmental Impacts – Contamination, Ecological, Geological • Water pollution • Loss of habitat • Erosion • Changes in river and stream ecology
Activities that have Value to the Community	Impacts to Daily Life • Temporary loss of community activities due to flooding

5.3.2.1. Inland Flooding as a Result of Dam Failure

Dams are vulnerable to various natural hazards that can potentially lead to cascading impacts on upstream and downstream flooding potential. Severe storms, earthquakes, landslides, and wildfires can all pose significant risks to dam infrastructure and operations. For example, intense rainfall from storms may cause rapid reservoir filling, potentially overwhelming spillway capacity and leading to overtopping. Seismic events could damage dam structures or trigger landslides into reservoirs, reducing storage capacity or causing sudden releases of water. Wildfires in upstream watersheds can alter runoff patterns and increase erosion, potentially accelerating reservoir sedimentation or introducing debris that interferes with dam operations. These hazards may occur in combination, amplifying their effects. For instance, a wildfire followed by heavy rains could lead to debris flows that impact multiple dams in a river system. Such cascading events have the potential to cause sudden, large releases of water downstream while also affecting upstream areas through backwater flooding or rapid drawdown. The complex interactions between natural hazards and dam infrastructure underscore the importance of comprehensive risk assessments and emergency planning to mitigate potential flooding impacts both upstream and downstream of dams.

The impact of inland flooding as a result of dam failure can lead to injury, death, property damage, along with other probable impacts mentioned in inland flooding. The City of Cambridge owns two high hazard dams: Stony Brook Dam and Cambridge Reservoir Dam. There are three main classifications of dams, the higher the classification, the more frequently the inspection is conducted and human loss potential. High hazard dams are the highest classification.

When these high hazard dams fail, the City of Cambridge, as the dam owner, is responsible in referring to the Emergency Notification Flowchart and General Notification Flowchart listed in the Cambridge Reservoir Dam and Stony Brook Reservoir Dam Emergency Action Plan. This plan also

includes a model of flooding extents resulting from dam failures at the Cambridge Reservoir and Stony Brook Dams were created using the Army Corps of Engineers Hydrologic Engineering Center River Analysis Stem (HEC-RAS) software (version 5.0.7).

Immediately downstream of the Cambridge Reservoir Dam, the flood failure could cause severe flooding hazards to commercial properties along Sylvan Road in Waltham, with maximum flood depths ranging from 12 to 15 feet and velocities up to 11 ft/s. These impacts could occur within the first hour of failure. The flood wave moves downstream along Hobbs Brook and reaches residential homes in Weston along Page Road and Drabbington Way within 15 minutes of the dam failure with max depths in exceedance of 10 feet and channel velocities as high as 6 ft/s. Just over 1.5 miles downstream of the dam, the flood wave quickly overtops both the North Ave Bridge in Weston and the Fitchburg Commuter Railroad line within the first 50 minutes of the dam failure by as much as 22 feet. Residences immediately upstream of the bridges and along Church Street and Hobbs Brook Road are similarly inundated. Further description of impacts from the reservoir failure are described in the City's Emergency Action Plan for the Cambridge Reservoir Dam and Stony Brook Reservoir Dam.

Failure of Stony Brook Reservoir Dam that coincides with a half probable maximum flood (half PMF) adds some incremental hazard above the flood condition without a failure. The impact of the coincident flood failure of the dam immediately downstream of the dam is an additional 7-foot rise with velocities as high as 20 ft/s along South Street. Flooding follows immediately after the dam breach and crests within 30 minutes of the dam failure. This presents a deadly hazard to occupants of vehicles and the impacted residences and businesses in the vicinity of South Street Bridge in Waltham.

A failure of the Cambridge Reservoir Dam or Stony Brook Reservoir Dam could potentially have severe economic, environmental, and social impacts across multiple jurisdictions in the greater Boston area:

- Economic impacts could include extensive property damage to homes and businesses in downstream communities, disruption of transportation infrastructure, and loss of water supply for residential and commercial use. The costs of emergency response, cleanup, and rebuilding damaged infrastructure would likely be substantial.
- Environmental consequences may involve widespread flooding, erosion, and sedimentation of downstream waterways and ecosystems. Contamination of water resources could harm aquatic life and vegetation. The sudden release of large volumes of water could dramatically alter river habitats.
- Socially, a dam failure could lead to loss of life, displacement of residents, and disruption of essential services like electricity and clean water access. The psychological trauma and community disruption could have long-lasting effects on the population.

Given the dams' locations, impacts would extend across multiple towns and cities in Middlesex County, potentially affecting hundreds of thousands of residents and requiring a coordinated emergency response across jurisdictional boundaries.

Extent of impact is provided in the maps in Appendix F. To determine the flood wave resulting from a failure of either Stony Brook Reservoir Dam or Cambridge Reservoir Dam, CDM Smith

constructed a HEC-RAS model (USACE, 2019) from the best available data including the 2015 USGS LiDAR data, USGS 2008 and 2009 survey of the Cambridge Reservoir and Stony Brook Reservoir Dams, and ESRI World Imagery basemap. The model was run in unsteady mode and represents: (1) Cambridge Reservoir impoundment, (2) Stony Brook Reservoir impoundment, (3) Hobbs Brook Reservoir impoundment, (4) channel downstream of the Cambridge Reservoir Dam connecting all reservoirs and extending downstream into Boston Harbor, (5) four storage areas representing capacity to store flood water, and (6) the outlet representing storage of Boston Harbor. Modeling is based on guidance in "Using HEC-RAS for Dam Break Studies" published by U.S. Army Corps of Engineers (2014).

Table 5.6: Vulnerabilities and Impacts from Inland Flooding

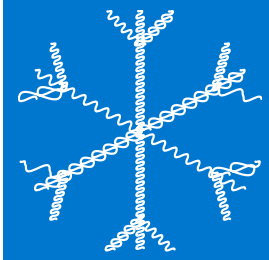
Potential Issues that Can lead to Dam Failure	Typical Causes
Flow Erosion	Poor compaction of silt backfill; lack of riprap or concrete protection at interface between soil embankment and concrete structure; erosion by flow over embankment, spillway, or through outlet
Embankment Leakage, Piping	Poor compaction of soil along interface with concrete structures; lack of seepage control collars around pipel root and rodent holes; inadequate or nonexistent filters between fine and coarse soils; cracks or voids within the concrete structure
Foundation Leakage, Piping	Poor interface with bedrock and concrete structures; excessive seepage at dam toe carrying soil with it
Sliding	Foundation material weak; excessive water pressure in structure or foundation
Deformation	Excessive settlement in foundation, ice jacking (pressure exerted by expending/contracting ice structures)
Blowing of Trees from Embankment	Heavy rain associated with gusty winds and natural agiging and poor root system of the trees on and near the embankments

Potential Issues that Can lead to Dam Failure	Typical Causes
Reduction of Crest Elevation	Poor concrete condition; heavy rain runoff
Dam Overtopping	Heavy rain; blocked or inadequately sized spillway
Cracking	Horizontal or vertical movements and/or settlements of the dam and can allow water to infiltrate the concrete

5.3.3 | Winter Storms & Nor'easters

Cambridge is often subjected to harsh winters. Winter storms and Nor'easters bring with them heavy precipitation, ice, and below freezing temperatures. These storms can immobilize a city and cause significant disruptions to daily life. A citywide event shutting down Cambridge is estimated to cause at least $43 million (in current dollars) in daily economic losses (Cambridge, February 2017). Heavy precipitation and ice can cause road closures, travel delays and cancellations, business and school closures, and generally dangerous conditions. These storms also bring intense winds. High winds can cause structural damage to the built environment and bring down trees and power lines. This can cause severe and lasting power outages, which are especially dangerous during severe winter conditions as citizens may be unable to heat their homes. Below freezing temperatures can cause pipes to burst. Those without shelter or heat are especially vulnerable during these situations and are susceptible to severe life safety issues such as frostbite and hypothermia.

As described in Chapter 3, the City of Cambridge has experienced several severe winter storm events in recent years, most recently in January 2015 (Winter Storm Juno), March 2018 (3 nor'easters within two weeks), and January 2022 (blizzard with high winds). During these winter storm events, the City of Cambridge experienced a multitude of impacts, including a state shutdown, parking bans, closure of the MBTA and cancellation of flights at Logan International Airport, school closures, and loss of power.



Major blizzards have disrupted daily life and work, with power outages, mountains of snow to shovel, digging out the car, difficulty navigating on foot due to relentless ice that is never fully addressed by the community.

- Survey Respondent

Furthermore, these storms can cause dangerous disruptions to emergency operations. First responders may be unable to respond to emergency situations due to adverse travel conditions. First responders themselves are potentially vulnerable to injury due to dangerous travel conditions such as icy roads or low visibility. Evacuation routes may be impassable.

Though nor'easters may not always bring snow, they bring heavy precipitation. Such intense rainfall can overwhelm drainage systems and cause flooding. They also have the potential to create storm surge. Flooding impacts from these storms become particularly dangerous when storms occur during high tide; the combined effect of heavy precipitation, storm surge, and high tide can be extremely severe. The flooding impact from nor'easters is further exacerbated by sea level rise, and the frequency of such storms is expected to increase with climate change, with the potential for more frequent, more intense winter storms in the future.

A scenario analysis was utilized to assess potential impacts on the most vulnerable assets due to winter storms and nor'easters. Table 5.7 lists these assets and the likely impacts.

Table 5.7: Vulnerabilities and Impacts from Winter Storms and Nor'easters

Most Vulnerable Assets	Likely Impacts
MBTA	Utility Infrastructure Damage • Temporary and long-term route closures • Equipment breakdowns
Power Grid	Utility Infrastructure Damage • Power Outages
Emergency Response	Disruption to Lifelines • Adverse travel conditions can inhibit emergency response. • Injury to first responders • Impassable evacuation routes
All people	Physical Injuries, Loss of Life, Displacement, Psychological Impacts

Most Vulnerable Assets	Likely Impacts
	• Slips and falls. • Injuries during snow removal • Isolation due to road closures • Loss of heat during power outages • Vehicular crashes due to poor road conditions
Vulnerable groups, including elderly and isolated populations	Physical Injuries, Loss of Life, Displacement, Psychological Impacts • Slips and falls. • Injuries during snow removal • Isolation due to road closures • Loss of heat during power outages • Lack of accessible routes due to snow and ice • Unavailability of supports such as personal care attendants, and resultant adverse effects
Businesses	Economic Impacts, Property Damage • Business interruption • Limited patrons resulting in reduced revenue. • Increased costs of maintenance
Daycare and schools, impact to residents	Economic Impact • Lack of childcare • Wage loss for working caregivers
Heath centers and health related services	Disruption to Lifelines • Unable to attend scheduled appointments or access emergency care. • Delayed or cancelled prescription delivery services Impacts to those seeking services from health facilities. Delay / disruption to staff traveling to work at facilities.
Snow emergency parking restrictions	Economic Impacts • Inability to find reliable parking. • Additional parking costs • Towing costs for illegally parked vehicles

Most Vulnerable Assets	Likely Impacts
Flat roofed buildings (in particular, triple deckers and older buildings that were not designed for a high snow load)	Building Damage • Building closure • Building collapse
Activities that have value to the community	Impacts to Daily Life • Temporary loss of community activities due to danger for people going outdoors

5.3.4 | Coastal Flooding as a Result of Dam Failure

The Charles River and Amelia Earhart Dams provide coastal defenses between Cambridge and Boston Harbor. As discussed in Chapter 3, there have been no previous occurrences of dam failure at the Amelia Earhart or New Charles River Dams since their establishment in 1965 and 1978, respectively. However, continued increases in sea level rise may result in compromised infrastructure, leading to coastal flooding in previously inland areas which was studied in the Climate Change Vulnerability Assessment and in the Resilient Cambridge Plan. (Cambridge, February 2017). Coastal flooding as a result of dam failure could result in catastrophic impacts to Cambridge and the surrounding area. Cambridge's infrastructure, economy, and the well-being of the community would be at risk. Many of the same risks exist for coastal flooding as they do for riverine flooding, described in Section 5.2.2. For example, both types of flooding may block roadways and cause property damage. As sea level rise and other climate change impacts continue, this infrastructure will be at an even greater risk. A major storm surge, while not something that Cambridge currently experiences due to the existence of the Amelia Earhart and the Charles River dams, would have the potential to inundate multiple modes of transportation, rendering the system unusable for days at a time if either of the dams were to fail.

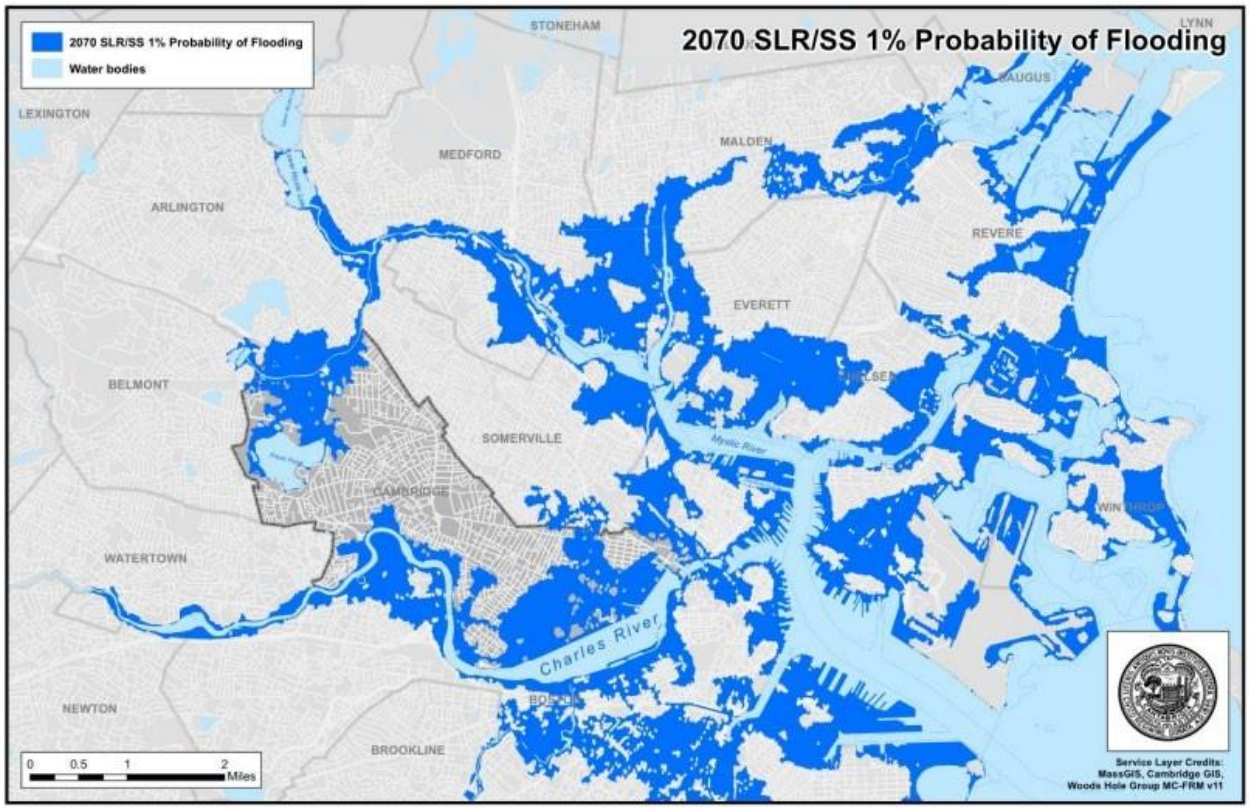


Figure 5.2: Regional flood exposure from 2070 1% SLR/SS event from the Resilient Cambridge Plan

Hazard locations and extents of coastal flooding were assessed using the Massachusetts Coast Flood Risk Model (MC-FRM) for future flooding extents. The MC-FRM utilized inundation predictions based on a combination of sea level rise and storm surge. The model dynamically includes impacts of tides, waves, and storm surge, as well as other parameters in a range of storm conditions to best assess impacts from coastal flooding. The flood analysis was conducted for

assets in Cambridge utilizing this model in addition to data provided by the city. The number of assets impacted by coastal flooding due to dam failure was estimated using the predicted extent of flooding and mapped assets. Table 5.8 shows the number of assets likely to be impacted by coastal flooding under 10 year and 100-year storm events by 2070. Table 5.9 lists the total number of buildings anticipated to be impacted by coastal flooding for these two flood scenarios, and their associated assessed value based on the most recent assessor's database.

Table 5.8: Assets Impacted by Coastal Flooding

Flood Scenario	Number of Assets Impacted
2070 10 year	348
2070 100 year	513

Table 5.9: Buildings Impacted by Inland Flooding

Flood Scenario	Number of Buildings Impacted	Assessed Value of Buildings
2070 10 year	1474	$27.24 billion
2070 100 year	3413	$35.70 billion

An exposure analysis was utilized to assess potential impacts on the most vulnerable assets due to winter storms and nor'easters. Table 5.10 lists these assets and the likely impacts. Appendix F includes maps showing community assets and vulnerability to coastal flooding under a variety of storm events.

Table 5.10: Vulnerabilities and Impacts from Coastal Flooding as a Result of Dam Failure

Most Vulnerable Assets	Likely Impacts
Transportation Network	Transportation Infrastructure Damage • Disruption to MBTA, roadways, and bike routes • Water and debris blocking routes, making transportation networks impassible or unsafe
Emergency Response (including police, fire)	• Approximately 1 of 9 assets are located in an area that is likely to experience 2070 10-year sea level rise and storm surge flooding. • Approximately 3 of 9 assets are located in an area that is likely to experience 2070 100-year sea level rise and storm surge flooding.

Most Vulnerable Assets	Likely Impacts
	• "Three important critical services are at risk of propagated flooding from [coastal flooding]: the Police Department Headquarters, the Professional Ambulance Services, and the Fire Company 2. Given that the city has all police services in the headquarters with no redundancy, this is an asset at elevated risk" (Cambridge, February 2017).
Telecommunications	• "The telecom system is impacted by [coastal flooding] with three critical assets being impacted, including the City Emergency Communication Center housed in the Police Department Headquarters" (Cambridge, February 2017).
Energy Infrastructure	• "The North Cambridge Substation is the largest electric substation by far and is at an elevated risk of flooding. Similarly, all of the natural gas used in the city is transmitted to the city through a single facility, Brookfield Street Take Station, which is also at a high risk from flooding. If both of these facilities were flooded, the economic and social consequences of energy and service disruption would be severe" (Cambridge, February 2017).
Water/Wastewater/Stormwater Infrastructure	Utility Infrastructure Damage • Damage to utility infrastructure resulting in loss of drinking water and wastewater systems, including pipes and pump stations, as well as damage to stormwater system. • "Contamination from salt water or hazardous pollutants could also damage water resources, such the Fresh Pond Reservoir" (City of Cambridge, 2015).
Municipal Facilities	• Approximately 3 of 24 assets are located in an area that is likely to experience 2070 10-year sea level rise and storm surge flooding. • Approximately 5 of 24 assets are located in an area that is likely to experience 2070 100-year sea level rise and storm surge flooding
Heath Centers and Health Related Services	• Approximately 1 of 13 assets are located in an area that is likely to experience 2070 10-year sea level rise and storm surge flooding. • Approximately 2 of 13 assets are located in an area that is likely to experience 2070 100-year sea level rise

Most Vulnerable Assets	Likely Impacts
	and storm surge flooding
Daycares and Schools	• Approximately 28 of 137 assets are located in an area that is likely to experience 2070 10-year sea level rise and storm surge flooding. • Approximately 44 of 137 assets are located in an area that is likely to experience 2070 100-year sea level rise and storm surge flooding
Emergency Shelters	• Approximately 4 of 15 assets are located in an area that is likely to experience 2070 10-year sea level rise and storm surge flooding. • Approximately 5 of 15 assets are located in an area that is likely to experience 2070 100-year sea level rise and storm surge flooding
Buildings and Structures	Building Damage • Water damage to internal and external of buildings • Damage to historic buildings
Businesses	Economic Impacts, Property Damage • Business interruption • Limited patrons resulting in reduced revenue. • Increased costs of maintenance
All People	Physical Injuries, Loss of Life, Displacement, Psychological Impacts • Displacement due to building damage. • Isolation due to road closures
Public Health	• Mold from water damage
Vulnerable groups, including unhoused, older adults, children, people with disabilities, and isolated populations	Physical Injuries, Loss of Life, Displacement, Psychological Impacts • Displacement due to building damage. • Isolation due to road closures
Natural Resources	Environmental Impacts – Contamination, Ecological, Geological • Water pollution

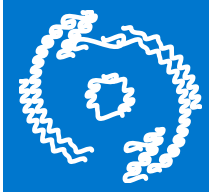
Most Vulnerable Assets	Likely Impacts
	• Loss of habitat • Erosion • Changes in river and stream ecology
Activities that have Value to the Community	Impacts to Daily Life • Temporary loss of community activities due to flooding

5.3.5 | Hurricanes/Tropical Storms

As noted in Chapter 3, the most recent hurricanes and tropical storms to impact Cambridge include Hurricane Henri (2021) Hurricane Ida (2021) and Tropical Storm Elsa (2021). These storms caused significant impacts to Cambridge, including loss of power, downed trees, and flooding (the impacts of which are discussed in Sections 5.3.1 and 5.3.3).

Due to the large spatial extent of hurricanes and tropical storms, Cambridge's population and existing infrastructure, including critical facilities, are at risk. Potential impacts may include damage to buildings from both wind and water, business interruptions, loss of communication, damage to transportation networks, impairment of water supply and wastewater systems, and power failure.

Flooding is a major concern during a hurricane, and slow-moving storms can discharge substantial amounts of rain over an area. Storm surge is also a risk that accompanies hurricanes and tropical storms.



After damage from Hurricane Sandy, I installed a generator running on city gas. Also, my car has been damaged twice by falling tree limbs.

- Survey Respondent

To provide City of Cambridge decision-makers with the best available information for estimating losses from Hurricanes, our team conducted a scenario analysis and utilized the Hazus Hurricane Loss Estimation Methodology to assess the potential impacts of a Category 2 and a Category 4 Hurricane. We used Hazus-generated probabilistic Category 2 and 4 storms to understand direct physical damage (essential facilities, transportation, utility systems, general building stock), induced physical damages (debris), and direct economic/social losses. Hurricane features used in this analysis include wind pressure, windborne debris, rainwater penetration, tree blowdown, and storm surge. Table 5.11 highlights the impacts from Category 2 and 4 storms on assets in the City of Cambridge, and Table 5.12 discusses general impacts that can be the result of hurricanes and tropical storms affecting Cambridge's assets.

Table 5.11: Impacts from a Category 2 and 4 Storm on Cambridge Assets

	Category 2	Category 4
Building Stock		
Estimated total number of buildings	19,000	
Estimated total building replacement value (Year 2014 $) (Millions of Dollars)	$19,826	
Building Damages		
# of buildings sustaining minor damage	1,182.49	3,668.96
# of buildings sustaining moderate damage	299.39	1,380.27
# of buildings sustaining severe damage	8.38	77.67
# of buildings destroyed	0.17	12.8
Population Needs		
# of households displaced	93	493
# of people seeking public shelter	48	266
Debris		
Total debris generated (tons)	14,512	42,514
Tree debris generated (tons)	2,417	5,651
Brick/wood debris generated (tons)	12,095	36,840
Concrete/steel debris generated (tons)	0	23
# of truckloads to clear building debris (@25 tons/truck)	484	1,475
Value of Damage (Thousands of Dollars)		
Total property damage	111,397.76	406,082.87
Total losses due to business interruption	10,680.88	83,725.98

Table 5.12: Vulnerabilities and Impacts from Hurricanes and Tropical Storms

Most Vulnerable Assets	Likely Impacts
Communication Towers	Utility Infrastructure Damage • High winds could knock down communication towers
Power Grid	Utility Infrastructure Damage • High winds can cause power outages
Buildings and Structures	Building Damage • Physical property damage to roofs, walls, and foundations
Tree Canopy	Forests, Environmental Impacts – Ecological • Increase in urban heat island. • Downed trees can block roads and damage infrastructure
All people	Physical Injuries, Displacement, Economic Impacts • Displacement • Physical injuries could occur when leaving the house. • Lost wages when unable to leave the house to work
Vulnerable groups, including unhoused and isolated populations, and those who require medical devices and medication	Physical Injuries, Loss of Life, Displacement, Disruptions to Lifelines • Potential lack of housing if shelters are damaged. • Ability for emergency response to reach vulnerable groups. • Limited access to, and storage for, medical devices and medication
Businesses	Economic Impacts • Business interruption • Limited patrons resulting in reduced revenue. • Increased costs of maintenance
Daycare and schools, impact to residents	Economic Impact • Lack of childcare • Wage loss for working caregivers

Most Vulnerable Assets	Likely Impacts
Heath centers and health related services	Disruptions to Lifelines • Unable to attend scheduled appointments or access emergency care. • Delayed or cancelled prescription delivery services
Natural resources	Environmental Impacts – Contamination, Ecological, Geological • Water pollution • Loss of habitat • Erosion • Changes in river and stream ecology • Disruption of migratory patterns • Loss of biodiversity
Cultural and historic resources	Impacts to Daily Life • Destruction of historic or cultural landmarks
Activities that have value to the community	Impacts to Daily Life • Temporary loss of community activities due to danger for people going outdoors

5.3.6 | Tornadoes

Chapter 3 outlines the previous occurrences of tornadoes impacting Middlesex County. In recent years, three tornadoes have touched down in the county, with the severity of EF1 occurring in 2016 and two EF0 tornadoes occurring in 2021. While there has yet to be a tornado that has touched down in Cambridge, the 2016 tornado in Middlesex County hit near the Cambridge Turnpike in Concord, MA, and headed northeast. This tornado caused roughly $1 million in property damages and one house suffered significant structural damage (NOAA NCEI, 2016).

During a tornado, debris becomes windborne and can cause extensive damage to people and property. If a tornado were to touchdown in or pass through Cambridge, damage would occur both in the tornado path and in the surrounding areas. Due to the high prevalence of older construction and the density of development that exists within the city, the community would be highly vulnerable to impacts, with structures built before current building codes likely more vulnerable. Evacuation, sheltering, debris clearance, distribution of food and emergency supplies, search and rescue, and emergency fire and medical services would be required as part of the emergency response to a tornado event. Critical evacuation and transportation routes may be impassable due to downed trees and debris, and recovery efforts may be complicated by power and communication outages.

A scenario analysis was utilized to assess potential impacts on the vulnerable assets due to tornadoes. Table 5.13 lists these assets and the likely impacts.

Table 5.13: Vulnerabilities and Impacts from Tornadoes

Most Vulnerable Assets	Likely Impacts
Communication Towers	Utility Infrastructure Damage • Tornado winds could knock down communication towers, limiting communication ability between residents and emergency management. • Electromagnetic interference with radio signals • Overload of communications systems
Transportation network	Transportation Infrastructure Damage • Disruption to MBTA and roadways • Debris blocking routes, making transportation networks impassible or unsafe
Buildings and Structure Roofs	Building Damage • Damage to entire buildings, especially those with foundations unable to withstand tornadoes. • Physical property damage
Power Grid	Utility Infrastructure Damage • Tornado winds can cause power outages
Tree Canopy	Environmental Impacts – Ecological • Increase in urban heat island. • Downed trees can block roads and damage infrastructure
All people	Physical Injuries, Loss of Life, Displacement, Economic Impacts, Psychological Impacts • Physical injuries could occur when leaving the house, or sheltering in a house that can't withstand tornadoes. • Lost wages when unable to leave the house to work. • Prohibitive cost of cleanup and repairs following a tornado
Vulnerable groups, including unhoused and isolated	Physical Injuries, Loss of Life, Displacement, Psychological Impacts, Disruption to Lifelines

Most Vulnerable Assets	Likely Impacts
populations	• Potential lack of housing if shelters are damaged. • Ability for emergency response to reach vulnerable groups
Businesses	Economic Impacts • Business interruption • Limited patrons resulting in reduced revenue. • Increased costs of maintenance • Increased insurance premiums
Daycare and schools, impact to residents	Economic Impacts • Lack of childcare • Wage loss for working caregivers
Heath centers and health related services	Disruption to Lifelines • Unable to attend scheduled appointments or access emergency care. • Delayed or cancelled prescription delivery services
Natural resources	Environmental Impacts – Contamination, Ecological, Geological • Damage to trees includes uprooting, removing bark, and stripping leaves and branches. • Soil erosion • Reduction in air quality • Disruption of habitat and food sources for wildlife
Activities that have value to the community	Impacts to Daily Life • Temporary loss of community activities due to danger for people going outdoors

5.3.7 | Earthquake

As discussed in Chapter 3, no earthquakes have ever been recorded as originating within Cambridge's boundaries. Although earthquakes are not common in Cambridge, the historical architecture of the city leaves many assets vulnerable to impacts of earthquakes if one were to occur, although the magnitude, location, and depth of the earthquake would determine the extent of the impact.

A scenario analysis was utilized to assess potential impacts on the vulnerable assets due to earthquakes. The Hazus Earthquake Loss Estimation Methodology was used to assess the potential impacts of a Magnitude 5.0 and a Magnitude 7.0 Earthquake. Specifically, Hazus-generated Magnitude 5.0 and 7.0 Earthquakes were evaluated to understand direct physical damages (essential facilities, transportation, utility systems, general building stock), induced physical damages (debris), and direct economic/social losses. Tables 5.14 and 5.15 show a summary of the likely impacts due to a Magnitude 5.0 and a Magnitude 7.0 earthquake.

Table 5.14: Impacts from a Magnitude 5 and 7 Earthquake

	Magnitude 5.0	Magnitude 7.0
Population Needs		
# of households displaced	4,377	35,300
#of people seeking public shelter	1,984	15,767
# life threatening injuries (depends on time of day)	99	1,442
# deaths (depends on time of day)	180	2,558
Debris		
Building debris generated (tons)	772,000	4,835,000
# of truckloads to clear building debris (@25 tons/truck)	30,880	193,400
Building-Related Economic Loss (Millions of Dollars)		
Income Losses	973.33	4,345.92
Direct Building Losses	3,447	25,540.12
Direct Repairs (transportation and utility)	20.04	152.29

Table 5.15: Impacts from a Magnitude 5 and 7 Earthquake

	Magnitude 5.0	Magnitude 7.0
Building Stock		
Estimated total number of buildings	19,000	

Estimated total building replacement value (Year 2014 $) (Millions of dollars)	19,826	
Building Damages		
# of buildings sustaining slight damage	5,205	940
# of buildings sustaining moderate damage	3,750	3,170
# of buildings sustaining extensive damage	1,472	4,013
# of buildings completely damaged	441	10,595

Earthquakes also have the potential to cause structural destruction. There are an estimated 19,000 buildings within the Cambridge city limits. Approximately 76% of the buildings are associated with residential housing. According to the Hazus model, a Magnitude 7.0 Earthquake has the potential to completely destroy almost 11,000 buildings and create 4.8 million tons of debris. Thousands more buildings would experience extensive or moderate damage. Even a Magnitude 5.0 Earthquake has the potential to destroy more than four hundred buildings. Table 5.16 shows the likeliness of structural damage on critical facilities from a Magnitude 5 and a Magnitude 7 earthquake.

Table 5.16: Structural Destruction from Earthquakes

Facility Type	Total	At Least Moderate Damage (>50%)		Complete Damage (>50%)		With Functionality >50% On Day 1	
		Mag 5	Mag 7	Mag 5	Mag 7	Mag 5	Mag 7
Hospitals	**3**	3	3	0	3	0	0
Schools	**38**	35	38	0	38	3	0
Emergency Op Centers	**2**	2	2	0	2	0	0
Police Stations	**4**	4	4	0	3	0	0
Fire Stations	**8**	7	8	0	8	1	0

An important aspect to consider is the potential damage to critical facilities and lifelines in the community, such as hospitals, schools, and emergency services buildings. The Hazus model shows that Cambridge should expect moderate to complete damage to the vast majority of its

critical facilities in the event of a Magnitude 7.0 earthquake. Table 5.17 lists the most vulnerable assets and the likely impacts.

Table 5.17: Vulnerabilities and Impacts from Earthquakes

Most Vulnerable Assets	Likely Impacts
Communication Towers	Utility Infrastructure Damage • Ground shaking could knock down communication towers, limiting communication ability between residents and emergency management
Buildings and Structures	Building Damage • Damage to entire buildings and structures, especially those with foundations unable to withstand earthquakes. • Maintenance and replacement will be long-term
MBTA	Utility Infrastructure Damage • Damage to entire transit network
Power Grid	Utility Infrastructure Damage • Earthquakes could damage components of the power grid and cause power outages
Tree Canopy	Environmental Impacts - Ecological • Destruction of trees causes an increase in urban heat island. • Downed trees can block roads and damage infrastructure
All people	Physical Injuries, Loss of Life, Psychological Impacts, Property Damage, Economic Impacts, Displacement • Physical injuries could occur when leaving the house, or sheltering in a house that cannot withstand earthquakes. • Lost wages when unable to leave the house to work. • Prohibitive cost of cleanup and repairs following an earthquake
Vulnerable groups, including unhoused and isolated populations	Physical Injuries, Loss of Life, Psychological Impacts, Property Damage, Economic Impacts, Displacement • Potential lack of housing if shelters are damaged. • Ability for emergency response to reach vulnerable groups

Most Vulnerable Assets	Likely Impacts
Businesses	Economic Impacts • Business interruption • Limited patrons resulting in reduced revenue. • Increased costs of maintenance
Daycare and schools, impact to residents	Economic Impact • Lack of childcare • Wage loss for working caregivers
Heath centers and health related services	Disruption to Lifelines • Unable to attend scheduled appointments or access emergency care. • Delayed or cancelled prescription delivery services
Activities that have value to the community	Impacts to Daily Life • Temporary loss of community activities due to danger for people going outdoors

5.3.8 | Landslides

As discussed in Chapter 3, there are no documented previous occurrences of landslides in Cambridge. In addition, the overall flat topography of the city is generally not conducive for a landslide to occur. The City of Cambridge is classified as a stable area with an exceptionally low relative landslide ranking. It is likely that if a landslide were to occur in Cambridge, it would occur as a slow-moving slide rather than a fast-moving rock fall and impact a small area. Climate change has the potential to increase the risk of landslides due to an increase in the frequency and severity of precipitation events, rapid snow melt, and rain-on-snow events.

Depending on the location of a landslide, the assets that could be most vulnerable are roadways, buildings and structures, emergency response systems, the MBTA, the power grid, tree canopy, and people.

A scenario analysis was utilized to assess potential impacts on the vulnerable assets due to landslides. Table 5.18 lists the most vulnerable assets and the likely impacts.

Table 5.18: Vulnerabilities and Impacts from Landslides

Most Vulnerable Assets	Likely Impacts
Roadways	Transportation Infrastructure Damage • Damage to roadways in direct path of landslide

Most Vulnerable Assets	Likely Impacts
Buildings and Structures	Property Damage, Building Damage • Damage to buildings and structures within landslide path
Emergency Response	Disruptions to Lifelines • Damaged roadways could prolong emergency response time
MBTA	Transportation Infrastructure Damage • Damage to localized transit network
Power Grid	Utility Infrastructure Damage • Landslides could damage components of the power grid and cause power outages
Tree Canopy	Environmental Impacts - Ecological • Destruction of trees in landslide path causes an increase in urban heat island
All people	Loss of Life, Physical Injuries, Public Health, Displacement, Psychological Impact, Economic Impacts • Physical injuries could occur if someone is within the landslide path

5.3.9 | Tsunami

As discussed in Chapter 3, there is no documentation that either of the previous two tsunamis that occurred in Massachusetts affected the City of Cambridge. If a tsunami were to occur, the geographic location of the tsunami could potentially result in an impact to a significant part of the city, depending on the runup (NOAA & USGS, 2015). It is more likely that locations within Cambridge likely to experience coastal flooding will be the area impacted. Given the infrequency of tsunami occurrences along the East Coast, the probability of tsunamis affecting Cambridge is exceptionally low. Climate change has the potential to increase the risk of tsunami due to an increase in natural disasters such as melting ice and collapsing glaciers, earthquakes, volcanic activity, and landslides, which trigger tsunamis.

A scenario analysis was utilized to assess potential impacts on vulnerable assets due to tsunami. Table 5.19 lists the most vulnerable assets and the likely impacts due to a tsunami. Note that Hazus-MH can run a tsunami model to estimate economic loss and physical damage to buildings due to depth and force of tsunami waves. However, FEMA's model is only set up to run in five elevated risk states: California, Washington, Oregon, Hawaii, and Alaska.

Table 5.19: Vulnerabilities and Impacts from Tsunamis

Most Vulnerable Assets	Likely Impacts
Hospitals	Disruptions to Lifelines • Hospitals may be unable to provide essential services due to damage. • Access by way of foot, personal vehicle, public transportation, and ambulance may be limited or impossible due to damage, debris, and flooding.
Emergency Response Systems	Disruption to lifelines • Emergency response access may be limited due to impassable roadways. • Emergency response communications could go down
MBTA	Transportation Infrastructure Damage • Damage to localized transit network
Power Grid	Utility Infrastructure Damage • Damage to utility infrastructure resulting in power outages potentially city-wide
Water/Wastewater/Stormwater Infrastructure	Utility Infrastructure Damage • Damage to utility infrastructure resulting in loss of drinking water and wastewater systems, and damage to stormwater system.
Communications Systems	Utility Infrastructure Damage • Damage to communications towers, radio signals, or internet
All People	Loss of Life, Physical Injuries, Public Health, Economic Impacts, Displacement, Psychological Damage • Due to the short warning time, people may not be able to get to a safer location before a tsunami hit

5.3.10 | Extreme Temperatures

As discussed in Chapter 3, it is well documented that extreme heat and extreme cold has occurred within the City of Cambridge. Extreme heat is often more severe in concentrated parts of the city that have less tree canopy, more pavement, and dark surfaces such as roofs that absorb more heat as shown in Figure 5.3. Extreme cold can occur city-wide. Climate change has the potential to increase the extent (severity or magnitude), probability, and location of extreme temperatures.

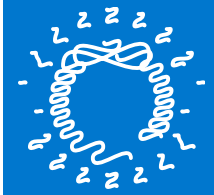
Figure 5.3: 90-degree day relative to streetscape. As the tree canopy increases, the "feels like" temperature decreases - Resilient Cambridge Heat Risk Storymap -2021

A historical analysis was utilized to assess potential impacts on the vulnerable assets due to extreme temperatures. Table 5.20 lists the most vulnerable assets and the likely impacts due to extreme heat or extreme cold.

Temperatures are expected to become more extreme as the climate continues to change. Given Cambridge's distinct four-season climate, it is expected that Cambridge will experience extreme temperatures on both ends of the spectrum, with extreme heat events in the summer and extreme cold events in the winter. Extreme temperatures can have far reaching impacts on infrastructure, transportation, public health, water resources, and energy.

Extreme cold events can create dangerous conditions and are sometimes accompanied by precipitation. They can impact daily commutes and transportation infrastructure. Cold events accompanied by extreme amounts of snow can cause public transportation closures and dangerous driving conditions, resulting in accidents, injuries, or even loss of life. In addition to transportation infrastructure, water infrastructure also has the potential to be severely disrupted during extreme cold events. Power outages can result in loss of heat, causing pipes to freeze and burst. Ground freezing can also result in buried pipes freezing and bursting. A broken water main can have devastating impacts on a large metropolitan area like Cambridge. Furthermore, power outages during wintry weather may result in inappropriate use of combustion heaters, cooking appliances, and generators in poorly ventilated areas, which can lead to increased risk of carbon monoxide poisoning and fires.

Extreme cold also has detrimental impacts on certain vulnerable populations. Those without homes or shelter are susceptible to hypothermia and frostbite. Those with insufficient resources to heat their homes are exposed to the same risk.



I used to live in an apartment without air conditioning, and it could get miserably hot in the summers. Extremes of heat and cold or heavy snow make it difficult and unpleasant for me to get around. I do not have a car, and I still have to walk to or from the bus stop or T station and wait for the bus in bad weather conditions.

- Survey Respondent

Though perhaps less obvious in a place like Cambridge, extreme heat events can and do occur. By 2030, annual days over 90 degrees Fahrenheit (90°F) may triple compared to the 1971-2000 baseline. By 2070, Cambridge may experience nearly three months over 90°F, compared with less than two weeks in the present day (Cambridge, February 2017). Heat waves in Cambridge are expected to be more frequent and of longer duration in the future. The duration and intensity of heat waves have significant public health implications- each passing day of extreme heat decreases a person's ability to cope with the heat stress, thereby making instances of heat stroke or heat-related death more likely (Cambridge, February 2017). Certain populations, such as homeless community members some people with disabilities, and community members without air conditioning are increasingly vulnerable to extreme heat impacts such as heat stress and heat stroke. The City of Cambridge Vulnerability Assessment found that portions of North Cambridge, the Port, and Riverside are more vulnerable to heat impacts than other parts of the City (Cambridge, February 2017). Even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. This is especially true for those with jobs that involve physical labor outdoors, such as landscapers or those who work in construction. Impacts from heat stress can also exacerbate pre-existing respiratory and cardiovascular conditions. Extreme heat has been the number one weather-related cause of death since NOAA began reporting data for heat in 1988 (Cambridge, 2021).

Extremely hot summer days can also worsen air pollution, especially in urban areas. In areas of the Northeast that currently face problems with smog, inhabitants are likely to experience more days that fail to meet air quality standards. This can be especially problematic for individuals with certain respiratory issues, like asthma or allergies. Furthermore, warmer weather can also support the migration of invasive species and lead to an increase in vector-borne diseases. It can also increase the chance of infestation by pests in general, such as the Asian Longhorned Beetle, which could have a significant impact on the City's urban forest (City of Cambridge, 2015).

Table 5.20: Vulnerabilities and Impacts from Extreme Temperatures

Most Vulnerable Assets	Likely Impacts
MBTA	Transportation Infrastructure Damage • Damage to entire transit network • Damage to rails (rail buckling, sun kinks) • Damage to supporting electrical equipment
Critical Services	• Critical services failures "would likely be due to a combination of system-wide stress caused by increased demand for services and asset-level exposure to extreme heat, which could impact occupant health and safety as well as damage heat-sensitive equipment" (City of Cambridge, 2015).
Power Grid	Utility Infrastructure Damage • Power Outages • Outages and heat damage to emergency communications centers could have city- wide impacts, as they serve the entire city and provide critical system-wide and cross-system functions.
Telecommunications	• "Telecommunication assets, such as the City's Emergency Communications Center located at the Cambridge Police Department Headquarters, are main high- risk assets because they service the entire City and provide critical system-wide and cross-system functions" (City of Cambridge, 2015).
Tree Canopy	Environmental Impacts – Ecological • Prolonged extreme heat can damage the tree canopy, increasing urban heat island effect
All people	Physical Injuries, Public Health, Loss of Life • Extreme heat: Heat stress/stroke, dehydration, respiratory distress • Extreme cold: frost bite, hypothermia
Vulnerable groups, including unhoused and elderly populations and people with disabilities	Physical Injuries, Public Health, Loss of Life • Lack of access to air conditioning can exacerbate impacts described under "All people"

Most Vulnerable Assets	Likely Impacts
Activities that have value to the community	Impacts to Daily Life • Temporary loss of community activities due to public health hazard for people going outdoors

5.3.11 | Drought

Chapter 3 discusses the drought levels and previous occurrences of drought in Cambridge. Since 2020, there have been two consecutive months with a critical drought status, and eight months with a significant drought status. Higher drought status and longer time periods will have the greatest impact on the city, and these events are expected to increase into the future with climate change.

Cambridge's main potential vulnerability to a severe long-term drought would be a reduction in the availability of water from the City's local water supplies. The city owns and operates a separate water system, with storage reservoirs on Hobbs Brook and Stony Brook in the towns of Lexington, Lincoln, Waltham, and Weston. In a severe multi-year drought, the yields from these reservoirs would be sharply reduced. This could result in the implementation of water restrictions and use recommendations by the City. However, the City is also a member of the Massachusetts Water Resources Authority and has access to MWRA's regional water supply in the event of an emergency.

Drought also has the potential to increase the risk of brush fires. Increased dry conditions provide the perfect scenario for brush fires. Accidental human ignition or ignition by lightning are especially concerning during times of drought. Firefighting efforts can be impacted during drought conditions due to the low water supply, which can increase the risk of and damage from brush fires.

Other impacts from drought can be felt in aquatic or wetland ecosystems, such as Cambridge's rivers and streams. Drought can severely impact stream flow which can have adverse impacts on wildlife.

A scenario analysis was utilized to assess potential impacts on vulnerable assets due to drought. Table 5.21 lists the most vulnerable assets and the likely impacts due to a drought.

Table 5.21: Vulnerabilities and Impacts from Drought

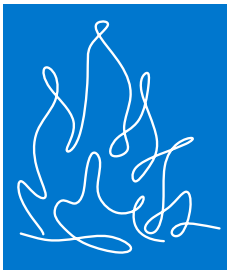
Most Vulnerable Assets	Likely Impacts
Water Supply	Environmental Impacts – Contamination, Utility Infrastructure Damage • Low water levels • Water restrictions
All people	Public Health

Most Vulnerable Assets	Likely Impacts
	• Water use restrictions
Natural resources	Environmental Impacts – Contamination, Ecological, Geological • Vegetation dieback • Tree loss • Stagnant water • Algae blooms

5.3.12 | Wildfire/Brush Fire

As discussed in Chapter 3, there have been previous wildfires/brushfires reported in Cambridge that the Fire Department responded to. Since 2017, 83 fires have impacted a total of 109 acres in Cambridge. Depending on the location of the fire and how quickly it spreads, wildfires and bushfires have the potential to devastate a community like Cambridge.

Wildfires and brushfires can lead to injury, death, property damage and impacts to natural resources. Smoke and air pollution can be a health hazard, especially for those with respiratory conditions such as asthma or allergies. Structures located in brush fire hazard areas are at risk, and closely situated buildings, especially those without fire barriers, increase the risk of brush fires spreading. The most vulnerable members of the population are those who would be unable to evacuate quickly, including the elderly, households with young children, people with mobility limitations, people with limited English proficiency or communication-related disabilities, and people with low socioeconomic status. First responders and firefighters are also at risk.



Recent wildfire smoke affected my health.

- Survey Respondent

Secondary effects from brush fire include contamination of reservoirs and destroyed power, gas, water, broadband, and oil transmission lines. Brush fires can also contribute to erosion and flooding. They strip slopes of vegetation, thereby decreasing soil stability and exposing the slopes to higher rates of runoff which can cause severe erosion, ultimately increasing the chance of flooding. Subsequent rains can worsen this erosion as vegetation and ground cover has been severely reduced and soils remain unstable.

A scenario analysis was utilized to assess potential impacts on the vulnerable assets due to a wildfire or brushfire. Table 5.22 lists the most vulnerable assets and the likely impacts.

Table 5.22: Vulnerabilities and Impacts from Wildfires / Brushfires

Most Vulnerable Assets	Likely Impacts
Buildings and Structures	Property Damage, Building Damage, Disruption to Lifelines • Loss of housing and public facilities • Loss of or damage to critical infrastructure
Utilities	Utility Infrastructure Damage • Destruction to utility lines
MBTA	Transportation Infrastructure Damage • Damage to entire transit network
Power Grid	Utility Infrastructure Damage • Damage to components of the power grid, causing power outages
Tree Canopy	Environmental Impacts – Ecological • Destruction of trees causes an increase in urban heat island. • Loss of structural integrity of trees could result in delayed damage as trees die
All people	Physical Injuries, Loss of Life, Public Health, Displacement, Economic Impacts, Property Damage • Physical injuries and death could occur if evacuation does not occur in time. • Respiratory problems from smoke • Lost wages • Loss of homes and belongings
Vulnerable groups, including unhoused and isolated populations	Physical Injuries, Loss of Life, Public Health, Displacement, Economic Impacts, Property Damage • Potential lack of housing if shelters are damaged. • Inability to evacuate quickly
Businesses	Economic Impact • Business interruption and loss
Daycare and schools, impact	Economic Impact

Most Vulnerable Assets	Likely Impacts
to residents	• Lack of childcare
Heath centers and health related services	Disruption to Lifelines • Unable to attend scheduled appointments or access emergency care. • Delayed or cancelled prescription delivery services
Natural resources	Environmental Impacts – Contamination, Ecological, Geological • Destroy trees and vegetation. • Water contamination • Air pollution • Destruction of wildlife and habitat
Cultural and Historic Resources	Impacts to Daily Life • Damage or destruction of cultural and historic resources
Activities that have value to the community	Impacts to Daily Life • Loss of community activities

5.3.13 | Invasive Species

As discussed in Chapter 3, there are numerous invasive plants, insects, and fungi species that persist in Massachusetts. The extent and growth of these species is predicted to increase in the future with climate change, thus increasing the impact on a community. Invasive species persist town-wide, and it is difficult to predict where they may spread to within the city.

Invasive species pose a great threat to native ecosystems and ecosystem services. Invasive species can often outcompete native species as they have no natural predators in their new range. This allows invasive species populations to grow unchecked, leading to a decrease in biodiversity as the invasive species becomes the dominant species in the area. A decrease in biodiversity also decreases the resilience of the ecosystem; ecosystems depend on a diverse range of organisms carrying out their roles to remain stable. A disruption in diversity can lead to the collapse of the ecosystem or lost ecosystem services. A warming climate adds cause for concern as warmer temperatures may allow for longer breeding seasons or further expansion for some invasive species.

A scenario analysis was utilized to assess potential impacts on vulnerable assets due to invasive species. Table 5.23 lists the most vulnerable assets and likely impacts due to invasive species.

Table 5.23: Vulnerabilities and Impacts from Invasive Species

Vulnerable Assets	Impacts on Assets
Tree Canopy	Environmental Impacts – Ecological • Insects causing destruction of trees causes an increase in urban heat islands. • Loss of structural integrity of trees could result in delayed damage as trees die
All people	Public Health • Vector-borne diseases
Agriculture	Environmental Impacts – Ecological, Economic Impacts • Damage to crops
Natural Resources	Environmental Impacts – Ecological • Destruction of trees and vegetation • Destruction of wildlife and habitat • Water quality degradation

Chapter 6:
Capability Assessment

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6. Capability Assessment

The City of Cambridge has a unique set of capabilities, in the form of laws, policies, programs, staff, funding and other resources, to carry out the NHMP and increase resilience. This chapter reviews the City's capabilities and describes which resources Cambridge has available to accomplish hazard mitigation and reduce disaster losses now or in the future. An aspect of capability is compliance with the National Flood Insurance Program. This program is described in Section 6.1. There are many other capabilities that Cambridge has which are described in Section 6.2

6.1. National Flood Insurance Program (NFIP) Compliance

Communities across the country build their flood management capabilities by participating in the National Flood Insurance Program (NFIP). The NFIP supports flood risk reduction before and after disasters. It helps reduce the socioeconomic impact of floods. The NFIP allows property owners and renters in participating communities to purchase federal flood insurance policies to recover financial losses after a flood. To participate in the NFIP, communities adopt and enforce floodplain management policies to reduce the effects of flooding. The NFIP is a key capability for Cambridge.

6.1.1 | Staff Resources

The City of Cambridge has one Certified Floodplain Manager (CFM) on staff who acts as the Floodplain Administrator. This staff member also serves as the Director of the Conservation Commission and as a Senior Engineer. Staff have been adequately trained through FEMA programs, state programs, and courses from the Association of State Floodplain Managers. The Floodplain Administrator also tracks and compiles any Letters of Map Changes that affect the Cambridge area. Staff adhere to FEMA guidelines regarding matters of substantial damage and substantial improvement.

The City of Cambridge is looking to expand their staff capacity for floodplain management.

6.1.2 | Regulation

Cambridge entered the NFIP on June 21, 1974. The first Flood Insurance Rate Maps (FIRMs) were effective on July 5, 1982 (FEMA, Community Status Book Report, 2023). The current FIRMs for Cambridge are effective as of June 4, 2010. These FIRMs are available digitally in a variety of locations in city mapping, including the Flood Viewer.

Preliminary FIRMs are available on FEMA's Map Service Center and are dated August 13, 2021. These FIRMs are not yet effective. FEMA will notify the city as soon as those maps go from being "preliminary" to "effective." Once FEMA notifies these FIRMs are effective, the city Ordinance and maps need to be updated locally and all new and re-development will be held to the new flood map standard as soon as the new maps become effective.

The city maintains elevation certificates in accordance with Community Rating System requirements and tracks the number of buildings located in the special flood hazard area and reports this number annually during the annual CRS certifications. Staff are working toward a digital database for elevation certificates. There are currently 184 buildings in the Special Flood Hazard Area in Cambridge. The City of Cambridge issues development permits in the SFHA through the Conservation Commission (310 CMR 10.00) in accordance with the Wetlands Protection Act. The Commission and the Floodplain Administrator are responsible for issuing permits in the SFHA. This is a transparent and public process, where the application is publicized, and a public hearing is held on the matter.

The City of Cambridge has not had projects submitted for permits specific to Substantial Damage or Substantial Improvement. Cambridge addresses the substantial damage and substantial improvements by complying with state-mandated building code (780 CMR,) the Massachusetts Wetlands Protection Act (310 CMR 10), Massachusetts Title V regulations (310 CMR 15), Section 20.72 Flood Plain Overlay District as part of Cambridge's zoning ordinance, and the Cambridge Zoning Ordinance for Flood Resilience Standards outlined in Section 22.80.

In the future, when a damaged property qualifies as substantial damage or improvement, it will be flagged by the City and brought up to current floodplain management standards. The City will request a detailed cost estimate for the project, prepared by a licensed general contractor, and will use the market value of the structure to calculate whether or not an improvement is substantial. The City will adhere to the checklist provided in FEMA 480 when calculating the cost of a substantial improvement project. This includes remodeling projects, rehabilitation projects, building additions, and repair and reconstruction projects. If a project is deemed to be a substantial improvement, the applicant will be notified that the project must comply with current floodplain management standards.

Following an emergency incident or natural disaster, the City of Cambridge will monitor properties in its jurisdiction for any substantial damage and will follow FEMA's protocols for substantial damage assessment. Any properties which experience a substantial loss, will be required to obtain and building permit to perform work, which will need to be done to the ordinances above. Any properties that appear to have been substantially damaged during the event will be flagged in the City's online permitting system. Property owners will be notified via a letter from the City that identifies their property as being substantially damaged. When these property owners come to the City for repair permits, City staff will work with them to bring these properties into compliance with current floodplain management standards.

After a permit is issued, the Floodplain Administrator is responsible for monitoring and compliance throughout the construction phase and through the end of the project. The Floodplain Administrator ensures there is proper signage, and erosion and sediment control measures, and conducts a site visit at least every other week. At the end of the permitting process, an Order of Conditions is issued and recorded with the property deed at the Middlesex South Registry of Deeds.

In addition, DPW has a permitting process separate from the Conservation Commission. This is the Stormwater Control Permit, which is related to predicted flooding in the years 2050 and 2070, not FEMA FIRMs. There is coordination between DPW and the Floodplain Administrator in these permits, as well.

The City of Cambridge's largest barrier to an improved floodplain management program is the lack

of technology and digital record-keeping. The city is working toward digital record-keeping while keeping accessibility in mind. The city is moving toward a simple and streamlined electronic permitting process. An additional barrier identified by the City is staff capacity. The City is working to expand their floodplain management staff capacity.

6.1.3 | Community Rating System

Cambridge is a participant in the Community Rating System (CRS) as of October 1, 2015 (FEMA, Community Status Book Report, 2023). The Community Rating System is an incentive-based program that rewards communities for exceeding the minimum standards of floodplain management set by the National Flood Insurance Program. The CRS has 19 creditable activities for which communities can obtain points. These activities include but are not limited to public education and outreach, mapping standards, higher regulatory standards, open space preservation, and stormwater management regulations. Communities that exceed minimum NFIP standards in these 19 activities are rewarded with a discount on flood insurance premiums for citizens of that community. Cambridge's CRS Class Ranking is a 9, which is almost the lowest (10 is the lowest) (FEMA, Community Status Book Report, 2023). This means that citizens of the City of Cambridge will receive a 5% discount on their flood insurance premiums. This discount will grow as the City of Cambridge continues to improve in the program. The city is looking to improve their rating to an 8 but must meet the pre-requisite of adopting a one-foot freeboard requirement within the Special Flood Hazard Area.

6.1.4 | Insurance Summary

There are three residential repetitive loss properties within the city, which is an increase from the two structures identified in the 2015 HMP. FEMA defines a repetitive loss property as "an NFIP-insured structure that has had at least 2 paid flood losses of more than $1,000 each in any 10-year period since 1978." (FEMA, Repetitive Loss Structure, 2020) As of May 15, 2023, building losses have totaled $99,768.39 and contents losses have totaled $83,899.91, totaling $183,668.30 in losses, an increase over the $168,421.73 documented in the 2015 HMP.

The staff is also responsible for conducting public outreach with regard to flood insurance. A paper/physical flyer is distributed annually to each structure in the Special Flood Hazard Area that describes the importance of flood insurance, especially for properties within a flood zone. There are two flyers; one is specific to repetitive loss properties, and one is for all other structures located in the SFHA.

6.1.5 | Compliance History

There are no outstanding compliance issues for the City of Cambridge. The next Community Assistance Visit for the review of Cambridge's Community Rating System participation is scheduled for 2024. Community Assistance Visits occur every five years for the City of Cambridge

6.2. Mitigation Capabilities of Cambridge

There are four key types of mitigation capabilities in accordance with FEMA's Local Mitigation Planning Handbook:

6.2.1 Planning and regulatory capabilities are the codes, ordinances, policies, laws, plans and programs that guide growth and development.

6.2.2 Administrative and technical capabilities are the city's staff, skills and tools.

6.2.3 Financial capabilities are the resources to fund mitigation actions.

6.2.4 Education and outreach capabilities are programs and methods that can communicate about and encourage risk reduction.

Many of the capabilities or gaps in capabilities identified in this chapter are anticipated or have been observed while preparing for, responding to, or recovering from local hazards, which have been identified and outlined in Chapter 3. The capability gaps identified in this chapter were used to inform the development of the mitigation actions in Chapter 7.

6.2.1 | Planning and Regulatory Capabilities

Planning and regulatory capabilities encompass a wide range of tools such as codes, ordinances, policies, laws, plans, and programs that guide growth and development. These capabilities play a crucial role in either supporting risk reduction or creating areas that are more vulnerable to disasters. These strategies are aimed at breaking the cycle of disaster damage and reconstruction. Additionally, effective law and regulation for disaster risk reduction are critical in shaping choices for sustainable development and building resilience to disasters. The following strategies outline the planning and regulatory capabilities to address hazards in Cambridge.

6.2.1.1. Building Code

Cambridge has a multi-century history of development and building throughout many eras of trade practices and editions of codes. A challenge for the capabilities of a community or region can be the use of an updated building code which reflects industry best practices and standard of care.

Currently, the City of Cambridge utilizes the latest Commonwealth of Massachusetts Building Code (Ninth Edition), which is Code of Massachusetts Regulations 780. According to the mass.gov website, "the Massachusetts State Building Code includes international model codes and state specific amendments adopted by the Board of Regulations and Standards (BBRS). The BBRS regularly updates the state building codes as new information and technology becomes available and change is warranted."

The Massachusetts building code addresses natural hazards through elevation requirements aligning with guidance from FEMA, hazard-resistant standards from ASCE 24 and ASCE 7, recognition of floodplain overlay districts, and enforcement.

In addition to the building code, Massachusetts also has the Massachusetts Stretch Energy Code, adopted by Cambridge in 2009, which requires enhanced energy performance above the mandatory base building code. Cambridge adopted the Specialized Stretch Energy Code which builds upon the 2023 Stretch Energy Code update with more restrictive use of fossil fuels and additional net-zero ready requirements for new buildings and qualified renovations. The Specialized Stretch Code went into effect on July 1, 2023, and is aligned with Cambridge's Net Zero Action Plan. On August 7th, 2023 the City adopted an ordinance that will require future buildings to be fossil fuel free as part of the Fossil Fuel Free Demonstration Project, driven by state legislation. Effective date pending state approval. The Stretch Energy Code and Specialized Stretch Energy Code provide Cambridge with additional capabilities to withstand the impacts of extreme temperatures.

6.2.1.2. Land Use / Development Ordinances and Regulations

The following discusses various municipal codes related to natural hazard mitigation and climate change resilience. (City of Cambridge, 2023)

Tree Protection

The City of Cambridge Commissioner for Public Works adopted a Tree Protection Ordinance to regulate removal of "significant trees". Significant trees are identified as trees with a diameter at breast height (DBH) of six inches or greater at four and a half feet above the ground. A Tree Removal Permit is required to remove a significant tree and the city has identified specifications for replacement trees. Trees play a critical role in hazard mitigation and provide cooling through shade and evaporation, help with erosion control, and management of stormwater. Trees also sequester carbon helping to reduce greenhouse gas emissions. (Cambridge, Climate Resilience Zoning, 2023)

Building Energy Use Disclosure Ordinance (BEUDO)

The Building Energy Use Disclosure Ordinance (BEUDO) was enacted by Cambridge City Council on July 28, 2014. The ordinance supports the city's goal of reducing greenhouse gas emissions. Energy use in buildings accounts for approximately 80% of greenhouse gas emissions in Cambridge, particularly large buildings such as commercial, institutional, and mixed-use buildings. The BEUDO ordinance requires owners of large buildings to track and report their annual energy usage. In 2023, Cambridge passed an amendment to this ordinance which requires large non-residential buildings to be net-zero by 2035, and medium-sized non-residential buildings to be net-zero by 2050. (Cambridge, Building Energy Use Disclosure Ordinance, 2023)

Wastewater and Stormwater Drainage System

Cambridge regulation Chapter 13.16 addresses maintenance and management of the wastewater and stormwater drainage systems. The City Engineer is ultimately responsible for construction and administration of activities pertaining to the system.

The city has also adopted a stormwater management program that includes mitigation actions to help control stormwater runoff volume and quality. Guidelines through this program are based on the Municipal Separate Storm Sewer System (MS4) EPA National pollution Discharge Elimination Program. The City of Cambridge holds CSO permits through the NPDES program. Under that permit the city has developed a CSA control plan that over many years will reduce the magnitude/duration of the discharges of combined sewage and stormwater to local water bodies. The City is proactively incorporating future climate projections in to their permitting process.

6.2.1.3. Zoning Code & Local Plans

The following discusses zoning code related to natural hazard mitigation and climate change resilience. (Cambridge, The Zoning Ordinance, 2023)

Climate Resilience Zoning and Building Requirements

The City Council adopted new zoning requirements in February of 2023 that address the long-term impacts of increased flooding and heat from climate change. These requirements apply to new buildings that are over 25,000 square feet, new additions to buildings that increase the square footage by 50%, the creation of occupiable or habitable space in basements that is exempt from Gross Floor Area (GFA) requirements, and surface parking lots. The new zoning uses 2070 projections as a milestone since buildings constructed today are expected to have at least a 50-year lifespan.

Flood Resilience Standards require new developments to protect vulnerable spaces that have a likelihood of flooding based on future climate projections. The city is referring to its elevation requirements for these spaces as “Long-Term Flood Elevations” which are based on 2070 projections. Applicants must review the elevations for precipitation and sea level rise and use the higher of the two. Elevations are accessible on the City’s flood viewer website.

The Green Factor Standard is a new performance-based standard that encourages heat mitigation through site and landscape designs that have a cooling benefit. Sites will need to achieve a “Cool Score” by including features like trees (both preserving mature trees and planting new trees), shrubs and other plantings, green roofs, shade canopies, and cool pavements. Applicants must fill out a “Cool Score Sheet” based on the elements included in site and building design. (Cambridge, Climate Resilience Zoning, 2023). Many of the practices in the Green Factor Standard will also contribute to the reduction of stormwater run-off and flood prevention.

Article 22 Green Building Requirements promotes sustainable and energy efficient design. This article applies to buildings that are 25,000 square feet or more, including new construction and some types of substantial renovation. These requirements include demonstration that the design meets the standards of a Green Building Rating System such as USGBC LEED – Gold Rating, Passive House Institute, or Enterprise Green Communities. While an official rating is not required, a green building professional must verify that the standard has been met. (Development C. o., 2023)These green building requirements increase the capabilities of occupants to withstand extreme temperature changes and disruptions in power.

Local Plans

There are a variety of local plans that informed the NHMP, as previously discussed in Chapter 2. In addition to those plans, several departments have plans to build the capabilities and capacity of the staff to respond to emergencies. These plans include:

- Department Emergency Operations Plan
    - Fire Department
    - Public Health Department
    - Water Department
    - Emergency Communications Department.
- Continuity of Operations Plan
    - Fire Department
    - Public Health Department
    - Water Department
    - Emergency Communications Department
- Archives Emergency Plan
    - Historical Commission
- Succession Plan
    - Public Health Department
- Water Sanitation and Hygiene Emergency Protocol for People Experiencing Homelessness
    - Public Health Department

6.2.2 | Administrative and Technical Capabilities

To assess the City's administrative and technical capacity, the STC identified several departments which play a key role in preparedness, response, and recovery to be surveyed, and key staff provided input on capabilities to prepare for and respond to natural hazard events. Cambridge has over 45 offices, departments, and commissions, all with varying degrees of involvement in natural hazard and climate change planning, mitigation, and adaptation actions. In addition to the capabilities under the purview of the city, Cambridge is also home to non-governmental organizations which provide support to the residents of Cambridge. Representatives from many of these departments were invited to participate in the Local Hazard Mitigation Planning Team workshops to provide input on capabilities of the city. The following sections summarize input from city staff and community members on the administrative and technical capabilities of Cambridge.

The feedback provided in the survey demonstrated that Cambridge has well-rounded departments and has invested both time and funding into addressing natural hazard concerns. Some staff identified that there can be silos of information developed or understood throughout the city and a central person or office should be identified for leading such efforts.

Throughout engagement on this topic, capabilities were identified which reflect the city's robust resources and identified gaps which could be addressed by mitigation actions.

6.2.2.1. Staff Capacity and Training

City staff are often considered to be first responders during an emergency event. From police to public works staff, resources are called to action to protect the assets described in Chapter 4.

However, these resources are only as good as the preparedness training and capacity of the staff to respond.

Existing Capabilities: Due to the wealth and resources in the city, the feedback provided by staff and other stakeholders in the process was that Cambridge was well positioned to respond appropriately to most hazard events which the majority of respondents identified as flooding and extreme heat. Departments including but not limited to Emergency Communications, Fire, Police, Public Works, Water, Inspectional Services, Information Technology, and Historical Commission, have trained staff on hazard mitigation.

Capability Gaps: Staff expressed the city's need for more structure to be able to provide clear command and control, well-articulated roles and responsibilities, disaster scenario planning, interdepartmental training, and drilling. This includes a need for expanding training on hazard mitigation to more departments and staff.

6.2.2.2. Internal and External Communications

Communication during a disaster is crucial for ensuring the safety and well-being of the affected community. Effective communication can include alerts and warnings to the public, but also the ability to effectively message expectations and roles internally amongst city staff.

Existing Capabilities: Several departments within the city have Communications Managers, who meet weekly with the Public Information Office to do resource and info sharing. Information from those meetings is sometimes shared with the Language Access Manager and Community Engagement Teams. In addition to internal communications coordination, the Language Access Manager and Community Engagement have developed mechanisms and relationships to convey information to the public through trusted channels of communication.

Capability Gaps: To further enhance hazard mitigation capabilities, departments recognize the need for organizational coordination policy and cross agency training on disaster and resiliency efforts. In addition to information sharing, hardening communication infrastructure was identified to provide continuity of communication during an event.

6.2.2.3. Regional Coordination & Collaboration

It is crucial for the city to maintain close relationships with regional partners to ensure effective communication and coordination. The city contributes to building regional resilience against natural hazards through collaborating with external partners, stakeholders, organizations, and residents.

Existing Capabilities: Examples of collaboration efforts include the Community Development Department (CDD) and the Public Works Department (DPW) working with the Mystic River Watershed Association to develop a proposal for a needs assessment and implementation plan for communicating with frontline communities during climate emergencies. The DPW is also leading regional work to identify and further the implementation of 9 coastal flood pathways from the Mystic and Charles rivers. The team identified nine flood pathways and secured a FEMA grant to further the development of the coastal intervention plans.

And CDD also works with partners in Cambridge to provide access to cooling shelters during heat waves and implemented the "shade as social justice" project working with artists and communities in three neighborhoods to design and deploy shade structures.

The Department of Human Service Programs has supported community partners by providing space when flooding has impacted their programs. The Traffic, Parking, and Transportation Department works with parking garage owners to make parking available to residents during snow emergency parking bans. The Commission for Persons with Disabilities has an advisory board consisting of people with disabilities, family members of people with disabilities, and representatives of city departments. The Cambridge Water Department is a member of the Massachusetts Water Resource Authority with interconnections to their system as a backup water supply. Several departments, including the Fire and Police departments have mutual aid agreements or MOUs to utilize other agencies' resources in times of need to address various hazards and support other communities. The Cambridge Public Health Department is a member of the state-funded Metro Regional Preparedness Coalition, which fosters regional health and medical readiness for emergency events in 60 communities, including Cambridge.

Table 6.1 below lists some of the collaborating partners that city departments rely on to ensure regional and community resilience:

Table 6.1: City Partners

Department	Resources, other City departments, or external partners that departments identified as a collaborator when providing services related to hazards:
City Manager's Office	Fire Department, Police Department, Department of Public Works Massachusetts Emergency Management Agency, Federal Emergency Management Agency
Commission on Persons with Disabilities	Department of Public Works, Cambridge Public Health Department, Community Development Department, Boston Center for Independent Living, Department of Human Services Program,
Community Development	Department of Public Works, Department of Human Services Program, Community Engagement Team, Health Department, Metropolitan Area Planning Council, Heat Health Working Group, non-profits
Emergency Communications	Fire Department, Police Department, Department of Public Works
Fire Department	Massachusetts Emergency Management Agency, MetroFire & Metro Boston Urban Area Security Initiative (UASI)
Historical Commission	Community Development Department, Inspectional Services, Massachusetts Emergency Management Agency
Human Service Programs	Fire Department, Police Department, Cambridge Public Health Department, Department of Public Works, food pantries, faith-based organizations, public housing entities

Department	Resources, other City departments, or external partners that departments identified as a collaborator when providing services related to hazards:
Police Department	City Manager's Office, Fire Department, Department of Public Works, Cambridge Public Health Department, Police Department, Department of Human Services Program, Massachusetts State Police, Adjacent municipal Police Departments,
Public Health	Fire Department, Cambridge Public Health Department, Department of Human Services Program, food pantries, faith-based organizations, public housing entities, regional health departments, Massachusetts Department of Public Health
Public Schools	State Department of Education, afterschool care providers, Fire Department, Police Department.
Public Works	City Manager's office; Community Development Department, Water Department, Massachusetts Water Resources Authority, Electrical, Fire, Police, Traffic, Parking, & Transportation, Cambridge, MA Department of Conservation and Recreation, and large private property owners, consultants.
Water Department	Department of Public Works, Fire Department, Police Department, Massachusetts Water Resources Authority

6.2.2.4. Local Committees and Task Forces

Cambridge has an engaged population focused on climate resilience. There are many subgroups within departments, independent community organizations and over 50 commissions and boards with diverse goals and purposes that directly or indirectly contribute to the capabilities of the community to adapt or respond to natural hazards.

Existing Capabilities: Robust interest in the topic of climate change in recent years has led to the development and prioritization of this topic for many organizations. The following provides some examples of the committees and task forces involved in natural hazard planning and response:

- The **Cambridge Climate Committee** (formerly the Climate Protection Action Committee) is composed of community members who take an active interest in climate change issues in Cambridge and who live or work in the city. The City Manager appoints the standing committee as an advisory committee to assist in the implementation of greenhouse gas reduction and climate change preparedness and resilience plans. The Committee serves as a conduit between community members and the city, reviews policy and program proposals, and develops recommendations to the City Manager. (Committee, 2023)
- **The Cambridge Community Corps (C3)** is a program led by the Cambridge Public Health Department. Ambassadors inform the public and answer questions on public health messaging topics such as staying safe during a pandemic, vaccines, safety during periods of extreme heat, mosquito-borne diseases and emergency preparedness.

- **The Community Engagement Team** at the Community Development Department is a multi-lingual team of outreach workers. The team represents the American Born Black community and underserved linguistic communities. The team builds deep relationships with community members and community-based organizations. CET@CDD & DHSP works with communities who are underserved, underheard, and historically excluded to do outreach and engagement within their communities on hazard mitigation and climate change preparedness.

Capability Gaps: The city has worked hard to develop materials to educate and inform the community. There is still work to be done to make materials more accessible and understandable by all community members.

6.2.2.5. Assistance from Non-Governmental Organizations

Nongovernmental organizations including community-based organizations, educational, faith, and cultural institutions, and health and safety services help support the needs of residents and priority populations facing the impacts of natural hazards and climate change. Community organizations and institutions play a role in emergency response and recovery; for example, after a storm a church might collect needed items for residents with damaged homes or provide places for people to stay.

Existing Capabilities: Cambridge is fortunate to be the home of many non-governmental organizations providing support to the community at large. A primary way in which the city utilizes the services of these organizations is to disseminate information to communities who are hard to reach or have a lack of trust in information provided by the government. Social capital, or community resilience, is a key indicator of an individual's ability to prepare, respond, or recover from an adverse event.

- **Community-based organizations (CBOs):** Community resilience if often reliant on the connectedness of community members such as those who have friends or family that can check on them during an extreme event may be safer or recover more quickly. Community organizations, community centers, non-profits, community development corporations, job training centers, art centers, and other CBOs provide the venue for residents to build essential bonds and fill the gaps in feeling connected during a time of crisis. They also may provide financial assistance, educational or material resources, and support related to adverse events.
- **Educational facilities and places of faith:** Educational facilities are often the backbone or heart of a community. They are places to meet friends and neighbors and receive information about what is happening in the community. Pre-schools, elementary schools, high schools, colleges, universities, adult learning centers, tutoring centers, and childcare centers provide spaces to enhance the opportunity to meet other Cambridge residents. These spaces also often play roles in disaster relief providing emergency shelter, supplies, or food to those impacted by storms or other events.

Capability Gaps: Distribution of information to these organizations can be difficult. There are many of these entities in Cambridge and it can be challenging to reach all of them. Additionally, materials have not been developed to reflect the needs of each of the organization's constituents.

6.2.3 | Financial Capabilities

The City of Cambridge has invested in the development of resilient infrastructure and programs in the city through a variety of avenues. The following funding sources are identified in Chapter 7 Mitigation Strategy.

Existing Capabilities: Cambridge manages two primary types of budgets: the operating budget and the capital budget. These budgets serve different purposes and cover distinct types of expenses.

- The operating budget covers day-to-day expenses required to deliver services to residents. It includes costs such as staff wages, office supplies, utilities, and other recurring expenses. Some of this money is typically set aside to provide funding for planned events, such as road salt for winter storm response.
- The capital budget is used for long-term investments in infrastructure and facilities, such as road repairs, machinery, and maintenance. It funds major improvements to city facilities and infrastructure and is based on the first year of needs in the five-year Capital Improvements Program (CIP) Plan. An example of how Cambridge has used this money is to make improvements to the city's stormwater infrastructure.

Capability Gaps: The City is unable to always cover the expenses needed to address climate mitigation due to the competing needs to fund other important initiatives in the city. To supplement this need, the city has applied for grants from the state or federal government. Examples of grant programs which have explicitly address climate resilience and hazard mitigation include EEA's Municipal Vulnerability Preparedness Program and MAPC's Accelerating Climate Resilience Grant Program.

6.2.4 | Education and Outreach

Education and outreach capabilities are essential programs and methods that play a crucial role in communicating about and encouraging risk reduction. By providing people with the knowledge, skills, and values needed to understand and address the impacts of natural hazards, education empowers individuals and communities to act. It helps eliminate fear and facilitates preparedness by providing information. Education can also promote climate-smart behaviors, adaptation, and mitigation, making it essential in creating a more resilient Cambridge.

Existing Capabilities: The city has made a concerted effort to develop public education and materials about climate resilience and hazard mitigation. One example of the city's education and outreach effort is a climate focused public health training curriculum and outreach plan that is currently in development for the Cambridge Community Corps and other partners to use. The city has also developed a flood viewer for residents to look up their risk to flooding and homeowner and small business toolkits provide guidance on how to adapt to flood and extreme heat.

Capability Gaps: One of the challenges for Cambridge is providing emergency response to priority populations before, during, and after natural hazard events. The intent of the city is to provide access to emergency management resources and **enhance the education** of first responders to provide services to persons with disabilities and those with language barriers.

Chapter 7:
Mitigation Actions: Past, Present, and Future

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7. Mitigation Actions: Past, Present, and Future

7.1. Overview of Mitigation Actions

The mitigation actions are among the most important components of the Hazard Mitigation Plan. They serve as the blueprint for reducing the potential losses identified in the risk and vulnerability assessment. They can be a measure, project, plan, or activity proposed to achieve the city's mission and goals and reduce current and future vulnerabilities described in the risk assessment (Chapter 5).

There are many distinct types of hazard mitigation actions that generally fall into the following four categories (FEMA, Local Mitigation Planning Handbook, 2023):

Local Plans and Regulations: These actions include government authorities, policies or codes that influence the way land and buildings are developed and built.

Structure and Infrastructure Projects: These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure.

Natural Systems Protection and Nature-based Solutions: This type of action can include green infrastructure and low impact development, and bioengineering to incorporate natural features or processes into the built environment to reduce, treat and store rainwater.

Education and Awareness Programs: These types of actions keep residents informed about potential natural disasters. Many of these types of actions are eligible for funding through the FEMA HMA program.

Through a stakeholder and community engagement process discussed in Chapter 2, mitigation actions and an action plan for implementation were developed to help achieve the mitigation goals (See Chapter 1 Section 1.4). This provides a framework to prioritize and implement actions to reduce risks during hazards. Section 7 reviews the mitigation actions created in 2015 and outlines mitigation actions for Cambridge for the next five years.

7.2. Status of 2015 Mitigation Actions

At the April 24, 2023, meeting of the Steering Committee, city staff reviewed the mitigation measures identified in the 2015 HMP and determined whether measures identified in that plan had been implemented or deferred. Implemented projects were categorized as either complete or in progress, with the latter referring to projects still under development or begun but not yet completed. If measures had been deferred, the STC evaluated whether the measure should be deleted or carried forward into this 2023 NHMP Update. The decision on whether to delete or retain a particular measure was based on the STC's assessment of the continued relevance or effectiveness of the measure and whether the deferral of action on the measure was due to the inability of the city to take action on the measure because it is outside of the city's control. Table 7.1 lists all mitigation actions from the 2015 HMP and their current status.

Table 7.1: Status of 2015 HMP Mitigation Actions

2015 HMP Letter Designation	Action	Geographic Coverage	Priority	Timeframe	Status
A	Complete hydraulic modeling for city	City-wide	High	2014-2018	Complete
B	Complete sewer separation and stormwater management program for areas east of Fresh Pond Pkwy (area #6) and between Concord Avenue rotaries and New Street (area #5)	Area Specific	High	2014-2016	Complete
C	Complete sewer separation and stormwater management program for Kirkland Street, Myrtle Street, Magnolia Street and Cambridge Street (CAM #011, areas 18	Area Specific	High	2014-2018	In progress *Portions of this are complete. Next phase is Kirkland Street Project, scheduled for design in FY25.*

2015 HMP Letter Designation	Action	Geographic Coverage	Priority	Timeframe	Status
	and 19)				
D	Complete sewer separation at Porter Square (CAM 002 CSO area)	Area Specific	High	2014-2018	In progress *Scope of this project is part of the updated CSO Control Plan development with MWRA and City of Somerville.*
E	Improve collection and conveyance system at area east of 2nd Street and north of Charles Street (area #27)	Area Specific	High	2014-2018	Complete
F	Implement additional stormwater management measures: School, Pine, Cherry, and Windsor Streets (area #26)	Area Specific	High	2014-2018	In progress *Part of Port Infrastructure Program currently under design.*
G	Complete Cambridgeport stormwater management program: Newton, Green, Franklin, and Sidney Streets (CAM 017, area #28)	Area Specific	High	2014-2018	In progress Projects currently under design and construction underway on River Street FY24 which are part of these Cambridgeport improvements

2015 HMP Letter Designation	Action	Geographic Coverage	Priority	Timeframe	Status
H	Complete sewer separation and stormwater management program for Irving, Bryant, Crescent, Carver, and Sacramento Streets (CAM011, areas #16 and 17)	Area Specific	High	2014-2017	Complete
I	Complete sewer separation and stormwater management program for Ellery Street and Broadway (CAM011, area #24)	Area Specific	High	2014-2017	Complete
J	Establish funding program for residential structural improvements & floodproofing	City-wide	Medium	2016-2018	Deferred *The City is not allowed to spend money on private property and therefore is working through methods/approaches to fund a program.*
K	Floodplain Management	City-wide	Low	2014-2018	In progress Ongoing compliance
L	Floodplain Mapping	City-wide	Low	2014-2018	In progress *Flood Viewer was developed*

2015 HMP Letter Designation	Action	Geographic Coverage	Priority	Timeframe	Status
					and is starting the process to update the data.
M	Expand program to clear snow and maintain public ROWs (e.g., travel ways for non- vehicular mobility, access for priority populations)	City-wide	Medium	2014-2018	In progress *Always in progress. Biggest challenge is enough equipment and people for bicycle facilities being added and storing of snow.*
N	Determine vulnerability of roadways and utilities to earthquakes in the high liquefaction areas	City-wide	Medium	2016-2018	Deferred *The City is planning to update the vulnerability assessment in coming years and will include this evaluation in that update.*
O	Provide facility for additional priority populations during extreme temperature event	City-wide	Medium	2014-2016	Complete
P	Increase public education on the benefits and proper care of trees on private	City-wide	Low	2015-2017	In progress *Ongoing through Urban Forestry Master Plan.*

2015 HMP Letter Designation	Action	Geographic Coverage	Priority	Timeframe	Status
	property				
Q	Complete Climate Change Vulnerability Assessment	City-wide	High	2014	Complete
R	Complete Climate Change Adaptation Plan	City-wide	High	2014-2015	Complete
S	Encourage installation of solar photovoltaic systems, cogeneration, and other energy supplies	City-wide	Low	2014-2017	In-progress *Always in progress. This action continues to be implemented through the Cambridge Energy Alliance program.*
T	Encourage energy efficiency in buildings through zoning requirements and community outreach	City-wide	Low	2014-2017	In progress/ complete *Zoning ordinance implementation is in progress.*
U	Evacuation Protocol Review	City-wide	High	2015-2016	Complete
V	Develop program for enhanced staffing for disaster recovery	City-wide	Medium	2014-2016	Deferred *The City has recently hired a Chief Climate Officer to manage overall preparedness and resilience in the city and who will be*

2015 HMP Letter Designation	Action	Geographic Coverage	Priority	Timeframe	Status
					evaluating staffing.
W	Ensure generators are located in areas protected from hazards	City-wide	Medium	2015-2017	Complete
X	Conduct maintenance activities to monitor and reduce brushfire risks	Area Specific	Low	2014-2018	In progress *This action is continually ongoing.*

7.3. Mitigation Action and Adaptation Strategy for 2023-2028

The Planning Committee developed an updated natural hazard mitigation action and adaptation strategy for the 2023 NHMP. There are **45 actions** developed from a multi-faceted approach, including the following:

- The goals and objectives endorsed by the Steering Committee; more detail about this is available in Chapter 1.
- Input from stakeholders through the HMPT workshops and the community through public meetings and survey input; more detail about this is available in Chapter 2.
- A hazard and climate change risk and vulnerability assessment; more detail about this is available in Chapters 3 and 5.
- The City's capacity to mitigate and respond to hazard events as described in Chapter 6.
- The progress of actions from the 2015 HMP; more detail about this is available in Chapter 7 Section 7.2.
- Actions included in related plans and reports; more details about this is available in Chapters 2 and 6.
- Vulnerabilities of the city's owned and operated high hazard dams to natural hazards, as described in Chapter 5.3.3.

The actions in Chapter 7 include both specific projects and broader results to be achieved by

implementing a project. The level of specificity differs based on the input received and the currently available data associated with the mitigation action. In some cases, actions are broader because the specific steps to accomplish the result may not be determined at this point in time. These actions will all be tracked and updated during the quarterly plan maintenance and review, discussed in greater detail in Chapter 8.

7.3.1 | Overview of Mitigation Action Characteristics

Based on each mitigation action characteristic, the city will be able to complete the following:

- assign a lead in-house entity.
- understand general cost and benefit of an action, location, and extent of the action's effort.
- understand available funding source(s).
- determine if the action should start in the short, mid-, or longer portion of the 5-year update.
- tie the action to goals and natural hazards.
- confirm consistency with other local plans.
- and consider equity and inclusion co-benefits.

See definitions as follows.

Lead Department: Many hazard mitigation actions and climate adaptation measures will require a multi-department strategy where several departments share responsibility. The designation of implementation responsibility was assigned based on general knowledge of the responsibility of each department. Additionally, some mitigation actions may require cooperation with outside entities, such as Massachusetts state departments, neighboring communities, regional organizations, or private entities. In those cases, the relevant entities are included in additional to the city department.

Cost: Costs listed in the mitigation action spreadsheet are estimated and are based on the cost of similar projects and professional estimates. Actual costs may vary based on the specific site, project, and scope of work. Cost estimates should be verified during the financial planning stage of a project. For the mitigation action spreadsheet, cost was classified into one of four categories:

- High = Over $1M
- Medium = Over $100 - $1M
- Low = Up to $100K

Geographic Coverage: This column pertains to the geographic area over which a mitigation action will be carried out. Geographic coverage can be classified into one of four categories-

- Regional: a regional mitigation action would extend beyond the city limits of Cambridge and involve regional partners
- City-wide: a city-wide mitigation action pertains to the entire City of Cambridge
- Neighborhood specific: a neighborhood-specific mitigation action applies only within the boundaries of a certain neighborhood or smaller area within the city.
- Site-specific: a site-specific mitigation action applies on the smallest, most localized scale at a specific point within the City of Cambridge

Funding Source: The City's general funds or capital budgets are considered a default potential funding source unless the City pursues additional funding. The identification of potential funding sources is preliminary and may vary depending on numerous factors. These factors include but are not limited to changes in grant eligibility criteria, program objectives, and funding availability. The funding sources identified are not a guarantee that a specific project will be eligible for or receive funding. Upon adoption of this plan, the local representatives responsible for implementation should begin to explore potential funding sources in more detail. Potential grants were assigned based on eligibility and competitiveness, but the recommendations may not be comprehensive. Please note that grant eligibility and scoring criteria should also be reviewed prior to applying. Grants may also only be a source of funding for a single stage of a project. In many cases, the actions will require a combination of funding sources.

- Capital budget.
- Operating budget
- Municipal bond
- Grant funding: refers to any monies that come from federal, state, or local grants.
- Staff time: implies that there is no additional cost associated with implementing this mitigation action other than typical staff hours.

Timeframe to Start: This column indicates whether the action is in progress. If the action is not yet in progress, the estimated time remaining until the project starts is listed.

- In progress
- Less than 1 year
- 1-2 years
- 2-5 years

Associated Goals: This column lists which goals the mitigation action aims to accomplish. Some actions contribute toward more than one goal. The five goals of the Hazard Mitigation Plan are as follows:

- Equitably protect health and safety
- Communicate
- Coordinate and collaborate
- Sustainably invest
- Monitor and respond

Hazards: Actions may mitigate a single or multiple hazards, which will be indicated for each action. All the hazards discussed in Chapter 3 were addressed when developing the priority list, and there is at least one action associated with each hazard. Some actions address all hazards and are listed as such.

Consistency with Other Plans: It is crucial that the Hazard Mitigation Plan be aligned with other long-range planning documents for the City of Cambridge. This column demonstrates areas where mitigation actions overlap with the intent of other planning documents.

Inclusion and Equity/Co-Benefits: The City of Cambridge recognizes the importance of equity in hazard mitigation planning. Inclusion and equity are vital so that all voices are heard during the planning and implementation processes. Actions were developed with equity and inclusion in mind. Some actions also have indirect benefits associated with them, also known as "co-benefits." There are many co-benefits associated with the City of Cambridge's mitigation actions. Some include:

- A positive impact on students
- A positive impact on priority populations
- Enhances community education.
- A positive impact on renters
- Equitable implementation

7.3.2 | Prioritization

Actions were prioritized based on based on staff capacity and available funding. Staff capacity was assessed in Chapter 6 – Capabilities Assessment. Priority was given to actions which also have a high likelihood of receiving federal, state, or local funding. The questions to assess likelihood of funding were:

- Does this action contribute to regional resilience?
- Is the action part of other plans?
- Does the action positively impact residents of Low to Moderate Income (LMI) or Environmental Justice (EJ) census block groups (based on EEA's viewer)?
- Is this action a nature-based solution?
- Would the action mitigate economic loss/damage?
- Will the action reduce risk to life/safety?
- Does the action address future climate change projections?
- Does the action leverage innovation/technology?

7.3.3 | Funding Sources

Traditional funding sources within the City of Cambridge, such as funding from capital budgets, operating budgets, municipal bonds, and staff time, should cover the majority of costs associated with the mitigation action items detailed in Table 7-2. This has been noted in the funding source column in Table 7-2.

Grant funding is another option. There are a variety of funding sources available for Massachusetts municipalities, both through the state and federal governments. A full list of funding opportunities can be found on the Community Grant Finder webpage: https://www.mass.gov/lists/community-grant-finder#community-development-. The Community Grant finder provides a streamlined interface where municipalities can easily learn about grant opportunities. Table 7-2 notes where grant funds are a desired source of funding for a mitigation action.

Table 7.2: 2023 NHMP Mitigation Actions

#	Action	Lead Dept	Cost	Geographic Coverage	Funding Source	Timeframe to Start	Associated Goal(s)	Hazards	Consistency with Other Plans	Enhances Inclusion and Equity / Co-Benefits	Priority
			High = $1M Medium = Over $100k up to $1M Low = Up to $100k	regional city-wide neighborhood specific site specific	Capital Budget * Operating Budget ** Municipal Bond Grant Staff Time	In Progress Less than 1 year 1-2 years 2-5 years	1. Equitably Protect health and safety 2. Communication 3. Coordinate and Collaborate 4. Sustainably invest 5. Monitor and Respond			Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students Enhances Community Education Equitable Implementation	
1	Improve collection and conveyance system in the Port Neighborhood.	Department of Public Works	High	Neighborhood specific	Municipal Bond	In progress	#1 Protect, #4 Sustainably Invest	Precipitation Flooding	DPW 10-year Sewer Plan - Goal 4: Manage stormwater quality and quantity	Equitable Implementation	High
2	Identify areas for green stormwater infrastructure and reducing impervious surfaces	Department of Public Works	Medium	City-Wide	Bond/Capital funding (DPW)	In progress	#4 Sustainably Invest	Precipitation Flooding	Resilient Cambridge Handbook -Strategy D3: Reduce Impervious Area - Strategy D4: Seek Green Infrastructure Opportunities		High
3	Upgrade sewer and stormwater infrastructure to reduce flooding (and CSOs)	Department of Public Works	High	City-Wide	Municipal Bond / Grant Funding (FEMA BRIC)	In progress	#1 Equitably protect health and safety	Precipitation Flooding	CSO Control Plan	Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students	High
4	Design and construct updates to metering stations for Combined Sewers	Department of Public Works	Medium	City-Wide	Capital Budget (DPW)	In progress	#5 Monitor & Respond	Precipitation Flooding	DPW 10-year Sewer Plan - Goal 4: Manage stormwater quality and quantity. Resilient Cambridge Handbook - Strategy C5: Upgrade Stormwater Storage		Medium
5	Undertake interventions as a regional collaboration at Charles River and Amelia Earhart Dam to reduce overtopping/flanking	Department of Public Works, Town of Arlington	High	Regional	Grant (FEMA BRIC)	In progress	#3 Coordinate & Collaborate, #4 Sustainably Invest	Coastal Flooding	Resilient Cambridge Handbook - Strategy A7: Enhance Emergency Response Plans	Positive Impact on Priority Populations	High
6	Upgrade deicing / snow removal equipment, including smaller equipment that is able to accommodate bicycle facilities and pedestrian paths	Department of Public Works	Medium	City-Wide	Operating Budget (DPW)	In progress	#5 Monitor & Respond	Winter Storms	Resilient Cambridge Handbook - Strategy A7: Enhance Emergency Response Plans	Positive impact on students, positive impact on Priority Populations	High
7	Complete study to evaluate shade needs (other than trees) referred to as "The Shade Study", and implement recommendations (e.g., adding shade structures)	Community Development Department	Low	City-Wide	Operating Budget (CDD)	In progress	#1 Protect	Extreme Heat	Resilient Cambridge Handbook - Strategy A2: Enhance Resilient Public Amenities	Positive impact on Priority Populations, Equitable implementation	High
8	Install water fountains and cooling features locations along bus/bike routes	Department of Public Works, Community Development Department	Medium	City-Wide	Bond funding and participatory budget	In progress	#1 Protect, #5 Monitor & Respond	Extreme Heat	Resilient Cambridge Handbook - Strategy A2: Enhance Resilient Public Amenities	Positive Impact on Students Positive Impact on Priority Populations	High

#	Action	Lead Dept	Cost	Geographic Coverage	Funding Source	Timeframe to Start	Associated Goal(s)	Hazards	Consistency with Other Plans	Enhances Inclusion and Equity / Co-Benefits	Priority
			High = $1M Medium = Over $100k up to $1M Low = Up to $100k	regional city-wide neighborhood specific site specific	Capital Budget * Operating Budget ** Municipal Bond Grant Staff Time	In Progress Less than 1 year 1-2 years 2-5 years	1. Equitably Protect health and safety 2. Communication 3. Coordinate and Collaborate 4. Sustainably invest 5. Monitor and Respond			Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students Enhances Community Education Equitable Implementation	
9	Update and Improve Floodplain Mapping (Cambridge Flood Viewer)	Department of Public Works	Low	City-Wide	Operating Budget (DPW)	In progress	#2 Communication	Precipitation Flooding, Coastal Flooding	Resilient Cambridge Handbook - Strategy A7: Enhance Emergency Response Plans	Enhances Community Education, Equitable Implementation	High
10	Encourage energy efficiency in buildings through zoning requirements and community engagement and support	Community Development Department	Low	City-Wide	Staff Time (CDD)	In progress	#5 Monitor & Respond	Extreme Heat, Extreme Cold	Net Zero Action Plan. Resilient Cambridge Handbook - Strategy B9: Encourage Resiliency of Building Scale Energy	Positive impact on renters	Low
11	Identify recommendations for municipal facility improvements for resiliency, including an updated flood duration study using MC-FRM	Facilities Department	Low	City-Wide	Municipal Bond	In progress	#3 Coordinate & Collaborate	Extreme Heat, Precipitation Flooding, Coastal Flooding			Medium
12	Implement actions of Cambridge Urban Forest Master Plan	Department of Public Works, Community Development Department	Low	City-Wide	Operating Budget (DPW, CDD)	In progress	#1 Protect, #4 Sustainably Invest	Extreme Heat, Precipitation Flooding, Drought	Cambridge Urban Forest Master Plan - Action #31: Increase current efforts to coordinate and implement community-based tree planting, and other urban forest stewardship activities, across different neighborhoods and land uses in the City.	Positive impact on Priority Populations	High
13	Continue to engage with the Charles River Climate Compact and Mystic River Watershed Association on regional collaboration	Department of Public Works, Community Development Department	Low	Regional	Operating Budget (DPW, CDD)	In progress	#3 Coordinate & Collaborate	Precipitation Flooding, Coastal Flooding, Extreme Heat			Medium
14	Prioritize clean energy solutions for power such as solar, battery, geothermal, etc. where feasible	Department of Public Works, CDD	Low	City-Wide	Capital Budget and Grant funds (EPA Climate Pollution Reduction Grant and Dept. of Energy Public	In progress	#5 Monitor & Respond	All	Resilient Cambridge Handbook - Strategy C6: Support Sustainable Energy Infrastructure		Low

#	Action	Lead Dept	Cost	Geographic Coverage	Funding Source	Timeframe to Start	Associated Goal(s)	Hazards	Consistency with Other Plans	Enhances Inclusion and Equity / Co-Benefits	Priority
			High = $1M Medium = Over $100k up to $1M Low = Up to $100k	regional city-wide neighborhood specific site specific	Capital Budget * Operating Budget ** Municipal Bond Grant Staff Time	In Progress Less than 1 year 1-2 years 2-5 years	1. Equitably Protect health and safety 2. Communication 3. Coordinate and Collaborate 4. Sustainably invest 5. Monitor and Respond			Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students Enhances Community Education Equitable Implementation	
					Access Electric Vehicle (EV) Charger Grants)						
15	Begin to develop a central emergency response plan and centralize emergency response within the city	City Manager	Low	City-Wide	Operating Budget (City Manager)	Less than 1 year	#3 Coordinate & Collaborate	All		Positive Impact on Priority Populations, Equitable implementation	Medium
16	Coordinate with the MBTA their efforts to protect critical regional transit infrastructure in Cambridge	Traffic, Parking, and Transportation; CDD; DPW	Low	Regional	Grant (e.g. RAISE, STIP)	Less than 1 year	#3 Coordinate & Collaborate, #4 Sustainably Invest	All			High
17	Collaborate with energy providers to protect critical community infrastructure	Department of Public Works	Medium	Regional	Operating Budget (DPW)	Less than 1 year	#3 Coordinate & Collaborate, #4 Sustainably Invest	All	Resilient Cambridge Handbook - Strategy C2: Increase the Resiliency of the Electrical Distribution System	Positive impact on Priority Populations, Equitable implementation	High
18	Extend swimming pool operational hours and season	Human Services and DCR	Low	City-Wide	Operating Budget (Human Services, DCR)	1-2 years	#1 Protect	Extreme Heat	Resilient Cambridge Handbook - Strategy A2: Enhance Resilient Public Amenities	Positive impact on Priority Populations, Equitable implementation	Low
19	Perform a study to evaluate the replacement of manually operated components with remote operated components, including the evaluation of cybersecurity vulnerability of the public water supply system	Water Department	High	City-Wide	Operating Budget (Water Dept.)	1-2 years	#5 Monitor & Respond	Loss of Water Supply	DPW 10-year Sewer Plan - Goal 1: Address high-risk infrastructure conditions		Medium
20	Conduct maintenance activities to monitor and reduce brushfire risks	Fire	Low	City-Wide	Staff Time (Fire)	1-2 years	#5 Monitor & Respond	Brushfire			Low
21	Update the climate change vulnerability assessment to include up-to-date climate information	Department of Public Works, Community Development Department	Low	City-Wide	Bond/Capital funding (DPW, CDD)	1-2 years	#3 Coordinate & Collaborate	Extreme Heat, Precipitation Flooding, Coastal Flooding	2015 CCVA		Medium
22	Integrate resiliency strategies and considerations into implementation of open space projects.	Department of Public Works, Community Development Department	Low	City-Wide	Capital Budget (DPW, CDD)	1-2 years	#1 Protect	Extreme Heat, Precipitation Flooding, Drought	Resilient Cambridge D recommendations	Positive impact on Priority Populations	Medium

#	Action	Lead Dept	Cost	Geographic Coverage	Funding Source	Timeframe to Start	Associated Goal(s)	Hazards	Consistency with Other Plans	Enhances Inclusion and Equity / Co-Benefits	Priority
			High = $1M Medium = Over $100k up to $1M Low = Up to $100k	regional city-wide neighborhood specific site specific	Capital Budget * Operating Budget ** Municipal Bond Grant Staff Time	In Progress Less than 1 year 1-2 years 2-5 years	1. Equitably Protect health and safety 2. Communication 3. Coordinate and Collaborate 4. Sustainably invest 5. Monitor and Respond			Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students Enhances Community Education Equitable Implementation	
23	Develop an operations plan for DPW and Police on how to respond to flooding in the roadway	Department of Public Works and Police	Low	City-Wide	Operating Budget (DPW, Police)	1-2 years	#1 Protect, #5 Monitor & Respond	Precipitation Flooding, Coastal Flooding	Resilient Cambridge Handbook - Strategy C3: Enhance the Resiliency of the Transportation System	Equitable implementation	Medium
24	Succession planning should be integrated into the City's Continuity of Operations Plan (COOP) and revisited on a yearly basis by June 30 of every year and updated to reflect staff changes and required trainings for staff identified as part of the planning process	Emergency Management Director, police, fire, health	Low	City-Wide	Operating Budget (Emergency Management Director, Police, Fire, Health)	1-2 years	#5 Monitor & Respond	All	2015 HMP		Medium
25	Develop an emergency community support reference guide which provides a list of health services which are operational during extreme events for community reference(i.e. dialysis centers)	Public Health Dept., Community Development Department	Low	City-Wide	Operating Budget (CPH, CDD)	1-2 years	#1 Protect, #2 Communications	All	Resilient Cambridge Handbook - Strategy A3: Create Support Systems for Populations at Risk	Enhances community education	Low
26	collaborate with Cambridge public housing authority and community centers to identify community rooms to use as cooling centers and shelters during storms	The new emergency management department	Low	Site Specific	Staff Time (new Emergency Management Dept.)	1-2 years	#1 Protect	All	Resilient Cambridge Handbook - Strategy A1: Provide Neighborhood Resilience Hubs	Positive impact on renters, Positive impact on Priority Populations, Equitable implementation	Low
27	Coordinating with adjacent communities for hazard preparation and response	Department of Public Works	Low	Regional	Operating Budget (DPW)	1-2 years	#3 Coordinate & Collaborate	All	Resilient Cambridge Handbook - Strategy A7: Enhance Emergency Response Plans		Medium
28	Create an emergency response higher education and city collaboration plan	emergency management department	Low	Site specific	Staff Time (new Emergency Management Dept.)	1-2 years	#3 Coordinate & Collaborate, #5 Monitor & Respond	All	Resilient Cambridge Handbook - Strategy A7: Enhance Emergency Response Plans	Positive impact on students, Positive impact on Priority Populations, equitable implementation	Low
29	Conduct study to identify how to engage with the disability community during an emergency.	Commission of Persons with Disabilities Cambridge Public Health	Low	City-Wide	Operating Budget (Commission of Persons with Disabilities, CPH)	1-2 years	#1 Protect	All		Positive Impact on Priority Populations, Enhances Community Education	Low

#	Action	Lead Dept	Cost	Geographic Coverage	Funding Source	Timeframe to Start	Associated Goal(s)	Hazards	Consistency with Other Plans	Enhances Inclusion and Equity / Co-Benefits	Priority
			High = $1M Medium = Over $100k up to $1M Low = Up to $100k	regional city-wide neighborhood specific site specific	Capital Budget * Operating Budget ** Municipal Bond Grant Staff Time	In Progress Less than 1 year 1-2 years 2-5 years	1. Equitably Protect health and safety 2. Communication 3. Coordinate and Collaborate 4. Sustainably invest 5. Monitor and Respond			Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students Enhances Community Education Equitable Implementation	
30	Develop an annual media campaign about signing up for code red notifications	Emergency Communications	Low	City-Wide	Operating Budget (Emergency Comms)	1-2 years	#2 Communication	All		Enhances Community Education, Equitable implementation	Medium
31	Provide a central location on the City's website to provide up-to-date notification and items such as extreme weather, air quality alerts, etc.	Emergency Communications City Comms Staff	Low	City-Wide	Staff Time (Emergency Comms)	1-2 years	#2 Communication	All	Resilient Cambridge Handbook - Strategy A4: Strengthen Emergency Communication Systems	Enhances Community Education	Medium
32	Purchase emergency radios for critical staff to utilize when an emergency event is expected where power and cell phone service may be compromised. Develop a plan for distribution and use.	Department of Public Works	Medium	City-Wide	Operating Budget (DPW)	1-2 years	#5 Monitor & Respond	All	Resilient Cambridge Handbook - Strategy A4: Strengthen Emergency Communication Systems		Medium
33	Each department shall ensure identified staff have been trained in ICS and NIMS and continuing education and training shall be determined by each department head or training division	Emergency Management Director, police, fire, health	Low	City-Wide	Operating Budget (Emergency Management Director, Police, Fire, Health)	1-2 years	#1 Equitably protect health and safety	All			High
34	Design and construct sewer separation work for the Baldwin neighborhood	Department of Public Works	medium	Neighborhood specific	Municipal Bond (DPW)	2-5 years	#1 Protect, #4 Sustainably Invest	Precipitation Flooding	DPW 10-year Sewer Plan - Goal 4: Manage stormwater quality and quantity. Resilient Cambridge Handbook - Strategy C5: Upgrade Stormwater Storage.		Low
35	Update and improve the City's HeatViewer with best available information	Department of Public Works, Community Development Department	Low	City-Wide	Operating Budget (DPW, CDD)	2-5 years	#2 Communication	Extreme Heat		Enhances Community Education, Equitable Implementation	Medium
36	Perform a study to identify how to best protect Fresh Pond reservoir from saltwater intrusion	Department of Public Works	Low	Site Specific	Capital Budget (DPW)	2-5 years	#1 Protect, #3 Coordinate & Collaborate, #4 Sustainably Invest	Coastal Flooding	Resilient Cambridge Handbook -Strategy C1: Protect Fresh Pond Reservoir	Equitable Implementation	Low

#	Action	Lead Dept	Cost	Geographic Coverage	Funding Source	Timeframe to Start	Associated Goal(s)	Hazards	Consistency with Other Plans	Enhances Inclusion and Equity / Co-Benefits	Priority
			High = $1M Medium = Over $100k up to $1M Low = Up to $100k	regional city-wide neighborhood specific site specific	Capital Budget * Operating Budget ** Municipal Bond Grant Staff Time	In Progress Less than 1 year 1-2 years 2-5 years	1. Equitably Protect health and safety 2. Communication 3. Coordinate and Collaborate 4. Sustainably invest 5. Monitor and Respond			Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students Enhances Community Education Equitable Implementation	
37	Prepare an Earthquake Emergency Plan	emergency management director, Police Department, CDD, Fire Department	Low	City-Wide	Staff Time (Emergency Management Director, Police, CDD, Fire)	2-5 years	#1 Protect, # Monitor & Respond	Earthquake	Resilient Cambridge Handbook - Strategy A7: Enhance Emergency Response Plans	Positive Impact on Students, Positive Impact on Renters, Equitable Implementation	Low
38	Prepare a Pest Vulnerability Matrix using the most recent tree inventory and develop a management options report	Department of Public Works	Low	City-Wide	Grant (MADFW Mass Wildlife Habitat Management Grant Program)	2-5 years	4. Sustainably Invest, #5 Monitor & Respond	Invasive Species	Cambridge Urban Forest Master Plan - Action #24: Prepare a Pest Vulnerability Matrix or similar pest and disease threat assessment and management options report utilizing 2014 street tree inventory data		Low
39	Create a program that offers support to property owners located in the 2070 10% flood area, as determined by the City's flood viewer, to help them make improvements that increase the resiliency of their properties against flooding.	Department of Public Works	Medium	City-Wide	Grant (FEMA Flood Mitigation Assistance Program)	2-5 years	#1 Protect	Precipitation Flooding, Coastal Flooding	2015 HMPResilient Cambridge Handbook - Strategy B3: Encourage Flood Protection for Existing Buildings	Positive impact on Priority Populations, positive impact on renters	Low
40	Perform a vulnerability assessment of vaults where hard copy records are kept	Department of Public Works	Low	Site specific	Grant (CZM e.g., Coastal Resilience Grant Program, FEMA e.g., Capability & Capacity Building, and Building Resilient Infrastructure and Communities)	2-5 years	#3 Coordinate & Collaborate, #5 Monitor & Respond	Precipitation Flooding, Coastal Flooding	Resilient Cambridge Handbook - Strategy B10: Develop Flood Protection and Operations Planning for Historic and Critical Facilities		Low
41	Develop flood protection and operations planning for historic and critical facilities.	Community Development Department	Low	City-Wide	Grant (FEMA PDM, Mass. Preservation Projects Fund)	2-5 years	#3 Coordinate & Collaborate	Precipitation Flooding, Coastal Flooding, Extreme Heat	Resilient Cambridge Handbook - Strategy B10: Develop Flood Protection and Operations Planning for Historic and Critical Facilities		Medium

#	Action	Lead Dept	Cost	Geographic Coverage	Funding Source	Timeframe to Start	Associated Goal(s)	Hazards	Consistency with Other Plans	Enhances Inclusion and Equity / Co-Benefits	Priority
			High = $1M Medium = Over $100k up to $1M Low = Up to $100k	regional city-wide neighborhood specific site specific	Capital Budget * Operating Budget ** Municipal Bond Grant Staff Time	In Progress Less than 1 year 1-2 years 2-5 years	1. Equitably Protect health and safety 2. Communication 3. Coordinate and Collaborate 4. Sustainably invest 5. Monitor and Respond			Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students Enhances Community Education Equitable Implementation	
42	Develop and update materials to support homeowners in completing retrofits related to flooding & heat (e.g., trainings, & educational materials on funding assistance)	Department of Public Works, Community Development Department	Low	City-Wide	Operating Budget (DPW, CDD)	2-5 years	#1 Protect	Extreme Heat, Precipitation Flooding, Coastal Flooding	Resilient Cambridge Handbook - Strategy B5: Support Building Management for Flood and Heat Protection	Positive impact on Priority Populations, Equitable implementation	Low
43	Evaluate use of Microgrid(s) for critical facilities and implement recommendations	Community Development Department, Capital Building Projects Department, and DPW (Buildings & Electrical)	Medium	Site specific	Grant (EPA e.g., Thriving Communities grant, Solar for All (funding issued to the state, a subgrant would be pursued))	2-5 years	#5 Monitor & Respond	All	Resilient Cambridge Handbook - Strategy C2: Increase the Resiliency of the Electrical Distribution System		Medium
44	Develop an enhanced communication plan and program related natural hazards in collaboration with community groups	CDD, public health, and public safety staff (Police, Fire, and Emergency Communications)	Low	City-Wide	Grant (e.g., MVP Action, MAPC Capacity Building)	2-5 years	#2 Communication	All		Positive Impact on Priority Populations, Enhances Community Education, Equitable implementation	Low
45	Address deficiencies identified in the inspection reports for Cambridge Reservoir Dam and Stony Brook Reservoir Dam.	Cambridge Water Department	High	Regional	Grant Funding (EEA Dam and Seawall Program, FEMA NDSP - National Dam Safety Program (State Assistance Grant Program), and FEMA HHPD - Rehabilitation of High Hazard Potential Dam Program (State Dam Safety Divisions)) to offset costs, Capital Budget	In Progress	#1 Protect & #5 Monitor and Respond	Inland flooding Hurricanes Tropical Storms Earthquake Drought	Cambridge Reservoir Dam and Stony Brook Reservoir Dam Emergency Action Plan	Equitable Implementation	High

Notes:
* The operating budget in Cambridge is the annual financial plan for the city's day-to-day operations, covering expenses for facilities and services.
** The capital budget is the city's investment plan for infrastructure projects, including repairs and renovations to existing assets as well as new assets built or acquired.

Chapter 8:
Plan Maintenance

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8. Plan Maintenance

Hazard Mitigation Plans are intended to serve as living documents. To be impactful, they must be regularly updated to reflect the current state of hazards, vulnerabilities, goals, strategies, and public sentiment. The three main components of plan maintenance are: *monitoring*, *evaluating*, and *updating* the plan.

Included in this chapter is a multi-pronged strategy to always keep the city's Natural Hazard Mitigation Plan as effective as possible. Monitoring, evaluating, and updating the plan will be intertwined with public engagement, integration with other local, regional, and state planning mechanisms, and plan implementation. These processes will all run on an ongoing basis with the expectation there is coordination and collaboration between monitoring, evaluating, and updating the plan.

A representative from the City Manager's Office will take ownership of monitoring, evaluating, and updating the plan.

The representative from the City Manager's Office will:

- Track the progress of the NHMP Mitigation Actions (see Section 8.1).
- Reconvene the Steering Committee in connection with the annual budget process each spring to monitor, evaluate, update, and integrate the plan (see Section 8.1, 8,.2, 8.3, and 8.4).
- Share NHMP progress with the public, every thirty months. (See Section 8.5).
- Make all monitoring information publicly available (see Section 8.1).
- Notify the public when added information has been posted or updated (see Section 8.5; and
- Provide the public opportunities to give input on this information (see Section 8.5).

8.1. Monitoring the Plan

According to FEMA, monitoring means tracking the implementation of the NHMP over time.

Who: The representative from the City Manager's Office will take ownership of monitoring the plan.

How: The representative from the City Manager's Office will monitor the status of mitigation actions (Chapter 8) through an internal tracking system using Excel. This documentation should be made publicly available on a website.

When: Monitoring will take place with the annual budget development process in the spring to formally update the status of Mitigation Actions. In advance of this meeting, the representative from the City Manager's Office will send out notices to the Steering Committee that will include a shared document where all Committee members can collaborate to review status of mitigation actions and identify any new mitigation actions that may be under consideration or in progress as part of ongoing City efforts.

8.2. Evaluating the Plan

According to FEMA, evaluating means assessing the effectiveness of the plan at achieving its stated purpose and goals.

Who and When: The Steering Committee will meet in connection with the annual budget development process in the spring to evaluate the effectiveness of the plan. The Steering Committee may also be called to meet after a major event or storm to evaluate the effectiveness of the plan.

How: The Steering Committee will:

- Review the 2023 NHMP Goals and Objectives presented in Chapter 1; and
- Discuss how mitigation actions are or are not meeting 2023 NHMP Goals and where improvements or adjustments may be needed (e.g., re-prioritization of projects, integrating with other planning processes more effectively, adding new data to climate projections, etc.)

8.3. Updating the Plan

8.3.1 | Plan Updates to Maintain FEMA Funding Eligibility

According to FEMA, updating means reviewing and revising the NHMP at least once every five years.

Hazard Mitigation Plans expire five years from the date approved by FEMA. To maintain eligibility for certain types of non-emergency disaster assistance from FEMA, an entity such as the City of Cambridge must have an approved active Hazard Mitigation Plan.

Hazard Mitigation Plans should be reviewed and updated at least every five years. The representative from the City Manager's Office will initiate the process to complete a comprehensive update to the NHMP. As a best practice, the comprehensive update should be initiated at least 18 months prior to this NHMP's expiration. This process includes:

- Re-engaging the Steering Committee.
- Considering expansion of the Steering Committee.
- Confirming FEMA's and MEMA's most recent requirements and guidance.
- Gathering updated information and relevant documents.
- Defining a list of stakeholders (such as the HMPT discussed in Chapter 2).
- Initiating an outreach and engagement process, as appropriate.
- Undertaking the planning steps to prepare required Plan sections; and
- Completing and reviewing the draft Plan and submitting for approval.

The city may elect to complete this process in-house or with guidance from an outside contractor.

8.3.2 | Plan Updates Due to Major Disaster Events or New Conditions

FEMA recommends that NHMPs also be revisited and updated after a major disaster event (a State or Federally declared disaster) or if new conditions significantly change risk (such as new climate projections or local risk and vulnerability assessment efforts). The representative from the City Manager's Office will initiate the process to complete any updates needed in these circumstances. The decision to update the plan will be based on the annual monitoring and evaluation process.

8.4. Integrating the NHMP

To be impactful, the NHMP must be effectively integrated into other City planning mechanisms. This will increase co-benefits of hazard mitigation projects, streamline planning and implementation activities, and help secure funding for NHMP projects.

Integrating the ideas, information, and strategy of a mitigation plan into other planning mechanisms can be achieved through plan integration. Plan integration involves a two-way exchange of information and incorporation of ideas and concepts between hazard mitigation plans and other planning mechanisms. Some ways Cambridge will integrate the ideas, information, and strategy of a mitigation plan into other planning mechanisms are:

Building and Zoning Regulations: The local hazard mitigation plan can integrate with building and zoning regulations to ensure that new construction and development are designed to withstand potential hazards.

Community Plans: Community planning mechanisms can be integrated into hazard mitigation plans to ensure that community needs and concerns are considered when developing hazard mitigation strategies. As other local plans, such as Envision Cambridge, Resilient Cambridge, the Urban Forest Master Plan, and the Parks & Open Space Plan, are reviewed and updated, relevant information from this NHMP will be incorporated. Funding to undertake mitigation actions described in Chapter 7 will be included in the city's budget process.

Emergency Management Plan: The local hazard mitigation plan can integrate with the relevant emergency management plans led by staff in the Police, Fire, and Health Departments, to ensure that hazard mitigation strategies are coordinated with emergency response efforts. In addition, mitigation actions included in Chapter 7 will be incorporated into the budgeting process for Police, Fire, and Health Departments.

Partnerships: Developing strong partnerships between planners and emergency managers can help to fully integrate land use and hazard planning efforts. For example, staff from CDD work collaboratively with the Cambridge Public Health Department to plan for and employ public health emergency response.

During the annual update process, integration will be a topic of discussion. NHMP goals and mitigation actions will be integrated into other City planning mechanisms. At each annual Steering Committee meeting, there will be an update on the progress of integration of mitigation actions into relevant planning mechanisms and a discussion of other planning mechanisms that should be integrated into the next five-year NHMP update.

8.5. Public Participation throughout Plan Maintenance

Public engagement is a critical part of the plan maintenance process. Public input, education, and support are crucial to ensuring that the plan is effective, equitable, and impactful. During this project, a StoryMap was prepared to document findings and can be updated as a reference point for the public.

A coordinated public engagement effort will be led by the representative from the City Manager's Office, however, should be coordinated or delegated to community engagement staff to ensure alignment with other City outreach efforts.

The City has two Community Engagement Teams (CET) which are solely dedicated to public participation and engagement in City projects, processes, and planning. The CET has developed a thorough and comprehensive set of protocols, norms, activities, and communication channels that result in meaningful and productive public participation. Inclusion, accessibility, translation and interpretation, and an emphasis on vulnerable groups, are key tenants of this approach. For all City projects, including HMP Maintenance, the City has a large staff of outreach workers and thoughtful engagement coordinators who ensure that community events, resources, and participation opportunities are enthusiastically shared with underserved groups, grassroots organizations, community leaders, and all community-members.

Below are four categories of engagement activities that will solicit diverse and meaningful results.

- **Public Education** activities are solely focused on transparency and providing the public with information regarding the monitoring, evaluation, and implementation of the Plan. Additionally, providing supporting general education on how to make individualized hazard preparedness plans for households.
- **Public Input** activities are focused on soliciting feedback, ideas, concerns, and other input. These activities will aim to be as inclusive and accessible as possible. Public input intends to gather feedback from all communities, particularly those who are:
    - most affected by hazards
    - underheard
    - underserved
    - historically excluded.
- **Active Engagement** refers to the steering committee's role to continue monitoring and adjusting to the effectiveness, performance, and equity of the NHMP as it goes through maintenance, implementation, and integration with other planning mechanisms.
- **Reactionary Engagement** refers to activities that directly follow a large storm or event. These activities will be particularly concerned with the safety of residents,

performance of projects, and impacts on priority populations.

Below are activities in each of these categories that the City may undertake, as appropriate for the situation, at the discretion of the representative from the City Manager's Office, and the Steering Committee:

- **Public Education:** Provide website updates, flyers, StoryMaps, presentations, social media posts, up to date GIS maps and data, as appropriate, in multiple languages and with accessibility considerations.
- **Public Input:** Host workshops, distribute surveys, facilitate public meetings, provide a presence at public events, solicit public comments, provide interactive maps, utilize Survey123 App Data Collection (can be ongoing), and/or interview community groups or local experts, all as determined by the Steering Committee in connection with the annual budget development process in the spring. Public input will include translation and interpretation as necessary and center accessibility.
- **Active Engagement:** Re-engage the NHMPT, involve community groups, involve student groups, as appropriate. Training City staff on how to work with residents who are experiencing hazards before an event occurs.
- **Reactionary Engagement:** Initiate surveys, hold public meetings, undertaking door-knocking Incorporate feedback and engagement received to maintain a feedback loop of knowledge on the process and allow for flexibility to pivot ideas when needed.

The city is committed to developing equitable and impactful public participation. This means that greater attention will be paid to those who are most vulnerable to hazards and who do not have as many pathways for making their needs and opinions heard. The following steps will be taken to ensure that the NHMP and its maintenance will be equitable:

- **Population:** Priority populations will be considered as a priority for outreach and engagement.
- **Translation & Interpretation:** Materials will be translated, and interpretation services will be provided for public meetings in accordance with Cambridge policies and procedures.
- **Projects/issues:** Issues or projects that are most valuable to these populations will be identified (through soliciting input or interviewing community groups/local experts).
- **Actions:** Findings will be incorporated into the implementation, monitoring, evaluation, updating of the plan, and integration with other planning processes. The representative from the City Manager's Office will be responsible for incorporating this information with support from the steering committee.

Public engagement activities will occur every thirty months with dedicated planning for those activities considered during the annual evaluation, monitoring, and plan update meetings. Additional public engagement will occur with large storms or events.

Chapter 9:
Plan Adoption

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9. Plan Adoption

Once the draft of the Cambridge Natural Hazard Mitigation Plan is reviewed by the STC, HMPT, and the general public, the Plan is reviewed by MEMA and FEMA. When the Plan is finally approved by FEMA, it enters into the five year "maintenance" phase. This Section describes the timeline for plan adoption and includes documentation of the Plan adoption by the City Council.

9.1. Timeline for Plan Adoption

The timeline for Plan Adoption is as follows:

-----	**12/5/2023**	Recommendation from the City Council's Health and Environment Committee to appear on Council agenda
-----	**12/11/2023**	Preliminary Adoption of the Plan by the City Council.
-----	**12/29/2023**	The Cambridge Natural Hazard Mitigation Plan was submitted to MEMA.
-----	**2/5/2024**	MEMA completed review of the Plan and returned it to the City with required edits.
-----	**5/12/2024**	The Cambridge Natural Hazard Mitigation Plan was re-submitted to MEMA for review with required edits. MEMA provided the plan to FEMA.
-----	**6/23/2024**	FEMA reviewed the Plan and MEMA returned it to the City with required edits.
-----	**12/16/2024**	The Cambridge Natural Hazard Mitigation Plan was re-submitted for review to FEMA.
-----	**1/28/2025**	FEMA issued Approval of the City of Cambridge Natural Hazard Mitigation Plan Pending local Adoption.
-----	**DATE**	City Council completed Final Adoption of the Plan.

9.2. Plan Adoption

The City of Cambridge elected to adopt this Natural Hazard Mitigation Plan following issuance of FEMA's Approval Pending Adoption (APA). This section will be updated following receive of APA.

Glossary

Glossary of Terminology

Terms	Description	Options or Examples
1% Annual Storm or 100-year 24-hour Precipitation Event	A 24-hour storm that has a 1% chance of happening in any year.	
100-year floodplain	Area with a 1% annual chance of flooding (or 1 in 100 chance)[1]. Also known as a 1% Annual Exceedance Probability (AEP) flood event (see definition for Annual Exceedance Probability below).	Flood Insurance Rate Maps (FIRM) show the extent of the FEMA-defined 100-year floodplain. See definition for Flood Insurance Rate Map below.
500-year floodplain	Area with a 0.2% annual chance of flooding (or 1 in 500 chance).[1] Also known as a 0.2% Annual Exceedance Probability (AEP) flood event (see definition for Annual Exceedance Probability below).	Flood Insurance Rate Maps (FIRM) show the extent of the FEMA-defined 500-year floodplain. See definition for Flood Insurance Rate Map below.
Adaptive Capacity	The ability of a system, service, or asset to adapt or prepare for an anticipated hazard or climate impact.	Buildings that have been floodproofed or elevated have a better chance of withstanding impacts from flooding.
Analyzing a comprehensive range	Considering mitigation alternatives spanning all types of solutions. These may include local plans and regulations, structure and infrastructure projects, natural systems protection, and education and awareness programs. This analysis helps a jurisdiction select actions for implementation, based on each jurisdiction's capabilities, as well as the social, technical and economic feasibility of the action.[2]	

1 Federal Emergency Management Agency (FEMA), "Flood Zones." https://efotg.sc.egov.usda.gov/references/public/NM/FEMA_FLD_HAZ_guide.pdf

[2] FEMA Local Mitigation Planning Policy Guide, 2022

Terms	Description	Options or Examples
Annual Exceedance Probability (AEP)	Probability of a flood event being equaled or exceeded in a given year.	The 0.2% AEP flood event has a 1 in 500 chance of being equaled or exceeded in any year (return period of 500 years, "500-year flood").
Approvable Pending Adoption	The plan has met the elements in the Local Plan Requirements but has not yet been officially adopted by the participating communities.[3]	
Assets	Resources, both physical and human, that contribute to a community's well-being and resilience.	People, Structures, Systems, Resources, and Activities
Assets	Determined by the community and include, but are not limited to: people; structures; systems; natural, historic, and cultural resources; and/or activities that have value to the community.[4]	
Biodiversity	Biodiversity is the variety of all forms of life and it is essential to the existence and proper functioning of all ecosystems (see Ecosystem definition below).	
Boston Harbor Flood Risk Model (BH-FRM)	A hydrodynamic model created in 2015 to identify projected flood risk and depth from coastal storms and sea level rise.	
Capability Assessment	An evaluation of the abilities and resources that are already in place in the city to reduce hazard risk.	Laws, policies, programs, staff, funding and other resources, to carry out the HMP and increase resilience.
Capital Improvement	Long-term investments in physical infrastructure and facilities aimed at reducing vulnerabilities to hazards and enhancing overall community resilience.	

[3] FEMA Local Mitigation Planning Policy Guide, 2022
[4] FEMA Local Mitigation Planning Policy Guide, 2022

Terms	Description	Options or Examples
Changes in development	means recent development (for example, construction completed since the last plan was approved), potential development (for example, development planned or under consideration by the jurisdiction), or conditions that may affect the risks and vulnerabilities of the jurisdictions (for example, climate change, declining populations or projected increases in population, or foreclosures) or shifts in the needs of underserved communities or gaps in social equity. This can also include changes in local policies, standards, codes, regulations, land use regulations and other conditions.[5]	
Climate Change	According to the Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) climate change refers to "a change in the state of the climate that can be identified by statistical changes of its properties that persist for an extended period, whether due to natural variability or as a result of human activity."[6]	Temperatures are increasing, rainfall events are becoming more frequent and intense, and sea levels are rising.
Climate Change	Refers to "changes in average weather conditions that persist over multiple decades or longer. Climate change encompasses both increases and decreases in temperature, as well as shifts in precipitation, changing risk of certain types of severe weather events, and changes to other features of the climate system." (U.S. Global Change Research Program, 4th National Climate Assessment).[7]	

[5] FEMA Local Mitigation Planning Policy Guide, 2022
[6] Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 2018. https://www.mass.gov/service-details/massachusetts-integrated-state-hazard-mitigation-and-climate-adaptation-plan
[7] FEMA Local Mitigation Planning Policy Guide, 2022

Terms	Description	Options or Examples
Climate Vulnerable Populations	Climate vulnerable populations are those who have lower adaptive capacity or higher exposure and sensitivity to climate hazards like flooding or heat stress due to factors such as access to transportation, income level, disability, racial inequity, health status, or age.	Climate vulnerable populations could include people with disabilities, people experiencing homelessness, elderly residents, children, and others.
Combined Sewer / Combined Wastewater Systems	A combined sewer system collects rainwater runoff, domestic sewage, and industrial wastewater into one pipe. When the amount of runoff exceeds the capacity of the wastewater treatment plant, untreated stormwater and wastewater flows into nearby waterbodies.	
Community Lifelines	The most fundamental services in the community that, when stabilized, enable all other aspects of society to function. The integrated network of assets, services and capabilities that provide community lifeline services are used day to day to support recurring needs. Lifelines enable the continuous operation of critical government and business functions and are essential to human health and safety or economic security, as described in the National Response Framework, 4th Edition.[8]	
Community Resilience	The ability of a community to prepare for anticipated hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions. Activities such as disaster preparedness (which includes prevention, protection, mitigation, response and recovery), and reducing community stressors (the underlying social, economic and environmental conditions that can	

[8] FEMA Local Mitigation Planning Policy Guide, 2022

Terms	Description	Options or Examples
	weaken a community) are key steps to resilience.[9]	
Community Resources	Community resources can provide places of refuge, help in preparing for climate events, and recovery support. Community resources provide opportunities for residents to bond with one another, which serve as cornerstones of resiliency.	
Critical Facilities and Infrastructure	This is defined by FEMA as a facility where even a low risk of disruption would constitute a severe threat. FEMA includes hospitals, fire stations, police stations, critical record storage facilities, and similar structures within this scope. The American Society of Civil Engineers also includes facilities related to energy, water, transportation, communication systems, and natural and virtual resources within their definition of critical facilities.	
Dam Failure	The sudden breach or collapse of a dam, resulting in the release of stored water and potential downstream flooding.	
Days Per Year With Maximum Temperature > 95°F, >90°F, <32°F	Temperatures above 90°F and above 95°F are considered heat and extreme heat events in New England, respectively. Temperatures below 32°F are considered freezing events. An increase in Number of Days Per Year with Maximum Temperature above 90°F and 95°F may lead to an extended summer season. A decrease in Number of Days per Year with Minimum Temperatures below 32°F may lead to less snowfall and a shorter "traditional" New England winter season.	
Design Storm	The magnitude and temporal distribution of precipitation from a storm event	The present day 10-year 24-hour design storm for

[9] FEMA Local Mitigation Planning Policy Guide, 2022

Terms	Description	Options or Examples
	defined by probability of occurrence (e.g., five-year storm) and duration (e.g., 24 hours), used in the design and evaluation of stormwater management systems.[10]	Worcester, MA is 4.9 inches of rainfall depth according to NOAA Atlas 14.
Duration of Flooding	Duration of Flooding is the length of time from when the tide surpasses the mean higher high water (MHHW) tidal datum to when it recedes below the MHHW. Duration of Flooding is important because it correlates to the level of impact of the flood (e.g., the amount of damage done, the amount of time power is out, etc.).	
Ecosystem	All living things and non living things in an area, as well as the interaction between them.	
Ecosystem Services	The direct and indirect benefits as a result of ecosystems provided by natural resources.	Flood protection, stormwater infiltration, pollution protection, oxygen production, wildlife habitat, etc.
Equity	The consistent and systematic fair, just and impartial treatment of all individuals.[11]	
Evaluating	Means assessing the effectiveness of the plan at achieving its stated purpose and goals.[12]	
Exposure	The extent to which something is in direct contact with climate parameters or their related climate change impacts. Exposure is often determined by examining the number of people or assets that lie within a geographic area affected by a climate parameter, or by	For example, measurements of flood depth outside a building or number of heat waves experienced by a county are measurements of exposure.

[10] Philadelphia Stormwater Management Guidance Manual, Version 3.1., 2018. By the Philadelphia Water Department. https://www.pwdplanreview.org/manual/appendices/a.-glossary
[11] FEMA Local Mitigation Planning Policy Guide, 2022
[12] FEMA Local Mitigation Planning Policy Guide, 2022

Terms	Description	Options or Examples
	determining the magnitude of the climate change impact.	
Extent	The range of anticipated intensities of the identified hazards. The information must relate back to each of the plan participants or the planning area, depending on the hazard. Extent is most commonly expressed using various scientific scales.[13]	
Fauna	A collective term for the animals or animal life of any particular region.	
Flanking and Overtopping Dams	Uncontrolled release of water over parts of the dam that are not designed to pass flow.	
Flood Elevation	The height floodwaters would reach at a particular site during the occurrence of a specific flood.	
Flood Exposure Analysis	A study that examines the extent to which areas and assets are at risk of flooding.	
Flood Insurance Rate Map (FIRM)	Official map of a community on which FEMA has delineated the Special Flood Hazard Areas (SFHAs), the Base Flood Elevations (BFEs), and the risk premium zones applicable to the community, based on historic information.[14] See definitions for 100- and 500-year floodplains, and BFE, above.	FIRMs are available on the FEMA Flood Map Service Center online.
Floodplain	Any land area susceptible to being inundated by floodwaters from any source.	
Floodplain Management	Comprehensive planning and regulations aimed at minimizing flood	

[13] FEMA Local Mitigation Planning Policy Guide, 2022
[14] FEMA National Flood Insurance Program Terminology Index, 2020. https://www.fema.gov/flood-insurance/terminology-index

Terms	Description	Options or Examples
	risks and guiding development within flood-prone areas.	
Floodplain Mapping	The creation of detailed maps that indicate areas susceptible to flooding, aiding in hazard assessment, land-use planning, and emergency response.	
Flora	The plants or plant life of any particular region.	
Goals	Broad, long-term policy and vision statements that explain what is to be achieved by implementing the mitigation strategy.[15]	
Green Stormwater Infrastructure	Sustainable approaches to managing stormwater runoff using natural systems such as vegetated swales, rain gardens, and permeable pavements to reduce flooding and improve water quality.	
Hazard mitigation	Any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards.[16]	
Hazard Mitigation Planning Team (HMPT)	Stakeholders with subject matter expertise and local knowledge and experience.	
Heat Index	The National Weather Service (NWS) Heat Index or the "real feel" is based on temperature and relative humidity. The Heat Index is what the temperature feels like to the human body when relative humidity is combined with the air temperature and is measured in °F. The NWS Heat Index considers shady and light wind conditions but does not account for strong winds or full sun exposure. Exposure to full sunshine can increase Heat Index values by up to 15°F and strong wind of very hot dry air can be detrimental to public health and	

[15] FEMA Local Mitigation Planning Policy Guide, 2022
[16] FEMA Local Mitigation Planning Policy Guide, 2022

Terms	Description	Options or Examples
	safety. The NWS uses the Heat Index to issue warnings and advisories relevant to public health considerations when daytime heat indices is more than 100°F for two or more hours.	
Heat Stress Events	A number of instances when a 3-day moving average of temperature is above 86 °F.	
Hydrologic & Hydraulic Modeling	An engineering analysis studies the movement of water, and is used to evaluate the impact of waterbodies, pipes, culverts, and rainfall on a specific area.	
Impacts	The consequences or effects of each hazard on the participant's assets identified in the vulnerability assessment. For example, impacts could be described by referencing historical disaster damages with an estimate of potential future losses (such as percentage of damage vs. total exposure).[17]	
Inland Flooding	Inland floods can occur after rain falls for many days in a row, as a result of brief periods of intense precipitation, when snowpack melts quickly, or when dams or levees fail. Whenever the volume of water on land overcomes the capacity of natural and built drainage systems to carry it away, inland flooding can result.	
Invasive Species	A type of plant, animal, or other organism that does not naturally live in a certain area but has been introduced there, often by people. An invasive species can spread quickly, hurt native species, and disrupt ecosystems.	
Invasive Species	Non-native plant, animal, or microorganism species that can harm	

[17] FEMA Local Mitigation Planning Policy Guide, 2022

Terms	Description	Options or Examples
	ecosystems, disrupt habitats, and potentially exacerbate natural hazards.	
Location	The unique geographic boundaries within the planning area, or assets outside of geographic boundaries that may be affected by the identified hazard. Maps are an efficient way to illustrate location. However, location may be described through plan narratives or other formats.[18]	
Low Impact Development (LID)	Planning and design strategies that aim to minimize the impact of urban development on the environment by using practices such as reducing impervious surfaces, conserving water, and promoting natural drainage.	
Massachusetts Coast Flood Risk Model (MC-FRM)	The projected sea level rise / storm surge data values provided through the Tool are based on the Massachusetts Coast Flood Risk Model (MC-FRM) outputs as of 9/13/2021, which included GIS-based data for three planning horizons (2030, 2050, 2070) and six return periods (0.1%, 0.2%, 0.5%, 1%, 2%, 5%). These values are projections based on assumptions as defined in the model and the LiDAR used at the time, for a hydrodynamic, probabilistic model that considers hundreds of thousands of historic and simulated storms. For additional information on the MC-FRM, review the additional resources provided on the Start Here page.	
Mitigation action	A measure, project, plan or activity proposed to reduce current and future vulnerabilities described in the risk assessment.[19]	

[18] FEMA Local Mitigation Planning Policy Guide, 2022
[19] FEMA Local Mitigation Planning Policy Guide, 2022

Terms	Description	Options or Examples
Monitoring	Tracking the implementation of the plan over time. For example, monitoring may include a system for tracking the status of the identified hazard mitigation actions.[20]	
Natural hazards	A source of harm or difficulty created by a meteorological, environmental or geological event. Natural hazards, such as flooding and earthquakes, impact the built environment, including dams and levees.[21]	
NOAA Atlas 14	Precipitation frequency estimates data server, provided by NOAA.[22]	
Number of Heat Waves Per Year & Average Heat Wave Duration	A Heat Wave is defined as three or more consecutive days with maximum temperatures of 90°F or above. Number of Heat Waves represents number of events (with one event representing at least three consecutive days with maximum temperatures of 90°F), and Average Heat Wave Duration represents the number of days for the average duration of each event over the year. Heat Waves are a public health and safety threat that may result in heat-related deaths. According to World Health Organization (WHO), Heat Waves, "can burden health and emergency services and also increase strain on water, energy and transportation resulting in power shortages or even blackouts. Food and livelihood security may also be strained if people lose their crops or livestock due to extreme heat."	
Outreach	The proactive and ongoing efforts to engage with individuals, communities,	

[20] FEMA Local Mitigation Planning Policy Guide, 2022
[21] FEMA Local Mitigation Planning Policy Guide, 2022
[22] NOAA Atlas 14 Point Precipitation Frequency Estimates: Northeastern States; NOAA Atlas 14, Volume 10, Version 3

Terms	Description	Options or Examples
	and organizations to raise awareness, educate, and gather input.	
Pests	Pests are any organisms (including plants and animals) that pose health, environmental, economic, or aesthetic risks.	
Plan expiration date	The date after which the participating jurisdiction(s) must update the plan and have it reapproved by FEMA. FEMA sets this date at five years after the plan approval date. For multi-jurisdictional plans, this date is the same for all participating jurisdictions. The plan expiration date is stated on the signed FEMA approval correspondence.[23]	
Planning mechanisms	The governance structures used to manage local land use development and community decision-making, such as budgets, comprehensive plans, capital improvement plans, economic development strategies, climate action plans or other long-range plans.[24]	
Probability of future hazard events	The likelihood of the hazard occurring or reoccurring. It may be defined in historical frequencies, statistical probabilities, hazard probability maps and/or general descriptors (e.g., unlikely, likely, highly likely). If general descriptors are used, they must be quantified or defined in the plan. For example, "highly likely" could be defined as "100% chance of occurrence next year" or "one event every year."[25]	
Protect	Adaptation strategy that blocks/prevents the climate parameter from impact.	Flood barrier, dry floodproofing, reflective roofs, lighter colored paver materials, bio retention

[23] FEMA Local Mitigation Planning Policy Guide, 2022
[24] FEMA Local Mitigation Planning Policy Guide, 2022
[25] FEMA Local Mitigation Planning Policy Guide, 2022

Terms	Description	Options or Examples
		basins, infiltration trenches, underground storage tank.
Public Engagement	Activities that are solely focused on transparency and providing the public with information regarding the monitoring, evaluation, and implementation of the plan.	Providing website updates, flyers, Storymaps, presentations, social media posts, up to date GIS maps and data as appropriate, in multiple languages and with accessibility considerations.
Qualitative Analysis	Assessment based on non-numerical information, such as narratives, descriptions, and expert opinions, to evaluate hazards, vulnerabilities, and mitigation strategies.	
Quantitative Analysis	Evaluation based on numerical data, statistics, and measurable criteria to assess hazards, vulnerabilities, and the effectiveness of mitigation measures.	
Recurrence Intervals	Also known as return period. Please refer to definition of return period.	
Regulatory flood mapping products	Intended to be used as the basis for official actions required by the NFIP.[26]	
Relative Humidity	The percentage of water vapor in the atmosphere that can be retained in the atmosphere without condensation.	
Repetitive loss structure	One covered under an NFIP flood insurance policy that (1) has incurred flood-related damage on two occasions, in which the cost of repair, on average, equaled or exceeded 25% of the value of the structure at the time of each such flood event; and (2) at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage. (44 CFR § 77.2(i))[27]	

[26] FEMA Local Mitigation Planning Policy Guide, 2022
[27] FEMA Local Mitigation Planning Policy Guide, 2022

Terms	Description	Options or Examples
Resilience	The ability to withstand and swiftly recover from an extreme event. Ideally, resilient systems "bounce forward" to create healthier, greener, and more equitable systems and spaces.	
Return Period	Annual probability of occurrence of an event. Also known as recurrence interval. Used in design based on risk tolerance of the asset.	For example, a critical building, such as a hospital that needs to be functioning at all times, has a lower risk tolerance and hence the 0.1% (or 1000-year) recurrence interval is recommended for design. However, a recreational facility, such as a recreation center, has a higher risk tolerance and hence the 20% (or 5-year) recurrence interval is recommended for design.
Risk	According to SHMCAP, risk is defined as "the potential for an unwanted outcome resulting from a hazard event, as determined by its likelihood and associated consequences; and expressed, when possible, in dollar losses. Risk represents potential future losses, based on assessments of probability, severity, and vulnerability."[28]	For example, if a state highway is flooded that also serves as an evacuation route, it will have a high probability of flooding and its consequence of flooding (as measured by its severity, with respect to geographic area and people affected, economic impacts and cascading impacts to other infrastructure) will also be high, which would lead to a high risk rating.
Risk	For the purpose of hazard mitigation planning is the potential for damage or loss created by the interaction of natural hazards with assets, such as buildings,	

[28] Massachusetts Integrated State Hazard Mitigation and Climate Adaptation Plan, 2018. https://www.mass.gov/service-details/massachusetts-integrated-state-hazard-mitigation-and-climate-adaptation-plan

Terms	Description	Options or Examples
	infrastructure or natural and cultural resources.[29]	
Riverine Flooding	Flooding that occurs when rivers, streams, or other bodies of water overflow their banks, often due to heavy rainfall or snowmelt. River flooding primarily results from an extended precipitation event that occurs at, or upstream from, the affected area. River flooding can also occur when traditional flood-control structures, such as levees and dikes, are overtopped.	
Sea level rise (SLR)	The worldwide average rise in mean sea level, which may be due to a number of different causes, such as the thermal expansion of sea water and the addition of water to the oceans from the melting of glaciers, ice caps, and ice sheets; contrast with relative sea-level rise.[30]	
Sensitivity	The impact of a natural hazard due to the existing conditions or characteristics of the asset	An older building with an older roof could have a higher sensitivity to wind damage and may lose its ability to function or keep rain out of a building.
Severe repetitive loss structure	One that is covered under an NFIP flood insurance policy and has incurred flood-related damage (1) for which four or more separate claims have been made under flood insurance coverage, with the amount of each claim (including building and contents payments) exceeding $5,000 and with the cumulative amount of such claims payments exceeding $20,000; or (2) for which at least two separate flood insurance claims payments (building payments only) have	

[29] FEMA Local Mitigation Planning Policy Guide, 2022

[30] NH Coastal Flood Risk Science and Technical Advisory Panel, 2020. New Hampshire Coastal Flood Risk Summary, Part II: Guidance for Using Scientific Projections. Report published by the University of New Hampshire, Durham, NH.

Terms	Description	Options or Examples
	been made, with cumulative amount of such claims exceeding the value of the insured structure. (44 CFR § 77.2(j))[31]	
Severity	Used to evaluate criticality of an asset and is defined as the consequences that are associated from the loss or inoperability of an asset.	For example, a lower severity Public Health and Safety Impact would be that loss of building may result in minor injuries. A higher severity would be that loss of life is expected as a result of loss of building.
Sewer Separation	The process of separating wastewater and stormwater sewer systems to prevent overflow of wastewater during heavy rainfall events, reducing pollution and flooding risks.	
Social vulnerability	The potential for loss within an individual or social group, recognizing that some characteristics influence an individual's or group's ability to prepare, respond, cope or recover from an event. These characteristics can overlap within populations to create heightened vulnerability, which may be compounded by infrastructure deficiencies within communities and historic or existing discriminatory government policies.[32]	
Stakeholders	Individuals, groups, and organizations that have a vested interest in the outcome of hazard mitigation planning and implementation. They often contribute diverse perspectives, expertise, and resources to the process.	
State Hazard Mitigation and Climate Adaptation Plan (SHMCAP)	The SHMCAP for the Commonwealth was adopted on September 17, 2018. This plan, the first of its kind to comprehensively integrate climate change impacts and adaptation	

[31] FEMA Local Mitigation Planning Policy Guide, 2022
[32] FEMA Local Mitigation Planning Policy Guide, 2022

Terms	Description	Options or Examples
	strategies with hazard mitigation planning, also complies with current federal requirements for state hazard mitigation plans and maintains the Commonwealth's eligibility for federal disaster recovery and hazard mitigation funding under the Stafford Act.[33]	
Steering Committee (STC)	A designated group of representatives responsible for guiding the development, implementation, and oversight of the hazard mitigation plan. Members may include key stakeholders, agency officials, and community leaders.	
Storm Surge	An abnormal rise in sea level accompanying a hurricane or other intense storm, whose height is the difference between the observed level of the sea surface and the level that would have occurred in the absence of the cyclone.[34]	Storm surge is usually estimated by subtracting the normal or astronomic tide from the observed storm tide.
Stormwater Flooding	Stormwater flooding can be caused by excessive rainfall that overwhelms drainage systems and leads to water accumulation in low lying areas. It can also be caused or exacerbated by snowmelt. More frequent and intense downpours, projected for all regions of the country, can overwhelm the design capacity of municipal stormwater management systems. Overwhelmed stormwater management systems can lead to backups that cause localized flooding.	
Stormwater Management	Strategies and techniques to control the quantity and quality of stormwater runoff, mitigating flooding and pollution impacts on local water bodies.	

[33] https://resilientma.org/shmcap-portal/index.html#/

[14] Glossary – Storm Surge, 2009. National Weather Service. https://w1.weather.gov/glossary/index.php?word=Storm+Surge

Terms	Description	Options or Examples
Tree Canopy	Tree canopy refers to the part of a city that is shaded by trees.	
Underserved Communities	Populations sharing a particular characteristic, as well as geographic communities that have been systematically denied a full opportunity to participate in aspects of economic, social and civic life. The barriers to opportunity and participation these communities face have been occurring throughout history and continue today.[35]	
Urban Heat Island Effect (UHI)	Dark, paved, and impervious surfaces, such as asphalt roads and buildings with black roofs, contribute to the urban heat island effect. These surfaces absorb more heat than vegetated or light colored surfaces, and they release this heat back into the surrounding environment.	
Vulnerability	A description of which assets, including structures, systems, populations and other assets as defined by the community, within locations identified to be hazard-prone, are at risk from the effects of the identified hazard(s).[36]	
Water Surface Elevation	Water Surface Elevation is the projected elevation for a specific future flood event, considering storm surge, tides, and wave setup. This is provided as a data value output of the Tool from the Massachusetts Coastal Flood Risk Model (MC-FRM).	Water Surface Elevations from the MC-FRM, for an example project site. *Max* = 11.1 ft-NAVD-88 *Min* = 10.8 ft-NAVD-88 *Area Weighted Average* = 10.9 ft-NAVD-88

[35] FEMA Local Mitigation Planning Policy Guide, 2022
[36] FEMA Local Mitigation Planning Policy Guide, 2022

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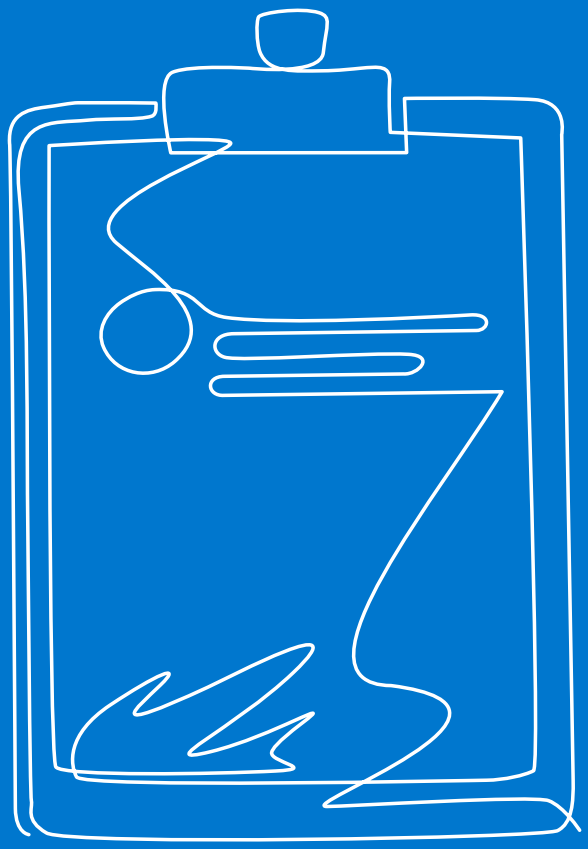

Appendix A

Steering Committee Materials

CITY OF CAMBRIDGE

2023 Hazard Mitigation Plan Update
Kickoff Meeting
February 27, 2023
1:00 to 2:30 PM

KICKOFF MEETING AGENDA

1:00 PM **Welcome & Introductions**

1:05 PM **Overview Hazard Mitigation Planning (HMP)**

- History in Cambridge
- The Gold Standard: Examples from City of Boston HMP
- FEMA and MEMA requirements
- Value of hazard mitigation planning

1:15 PM **Scope & Schedule**

Scope of Work Overview

- Task 1: Project Initiation
- Task 2: Initiation of Engagement
- Task 3: Hazard Profiles
- Task 4: Facility Inventory
- Task 5: Vulnerability Assessment
- Task 6: Mitigation Goals and Capabilities
- Task 7: Mitigation Actions: Past, Present, and Future
- Task 8: Plan Maintenance and Implementation
- Task 9: Public Review
- Task 10: MEMA and FEMA Review, City Adoption
- Ongoing Public Outreach
- Ongoing Project Administration

Critical Path Items

- Asset/Facility Inventory
- Capabilities Assessment
- Request repetitive loss data

Key Changes

- How is this different from last update?
- How are we consolidating relevant planning updates & documents in this HMP?

Schedule

- Screen share of draft schedule

Weston & Sampson℠

CITY OF CAMBRIDGE

2023 Hazard Mitigation Plan Update

Kickoff Meeting
February 27, 2023
1:00 to 2:30 PM

2:00 PM Engagement

- Groups
  - Steering Committee
  - Hazard Mitigation Planning Team
  - Street Team
  - Public
- Roles, responsibilities, and commitments
- Meeting dates & times (Slido poll)

2:10 PM Questions, Discussion, and Action Items

2:30 PM Conclude

Weston & Sampson℠

Hazard Mitigation Plan Update 2023

Kickoff Meeting
February 27, 2023

CITY OF CAMBRIDGE

Weston & Sampson SM

AGENDA

Welcome & Introductions	1:00 PM
Overview of Hazard Mitigation Planning	1:05 PM
Scope & Schedule	1:15 PM
Engagement	2:00 PM
Questions, Discussion, Action Items	2:10 PM
Conclude	2:30 PM

AGENDA

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Overview of Hazard Mitigation Planning	**1:05 PM**
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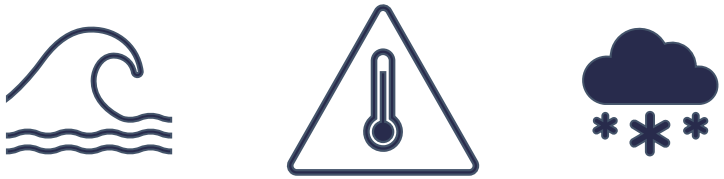
WHAT IS HAZARD MITIGATION?



The effort to reduce impacts from natural hazards such as flooding, extreme temperatures, and winter weather…

…through planning, policy, education, infrastructure projects, and more.

FEMA & MEMA REQUIREMENTS

"The Disaster Mitigation Act of 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (44 CFR Part 201), creating the framework for state, local, tribal and territorial governments to engage in hazard mitigation planning to receive certain types of non-emergency disaster assistance."

FEMA updated *Local Mitigation Planning Policies and Guidance* (released April 2022, effective April 2023)

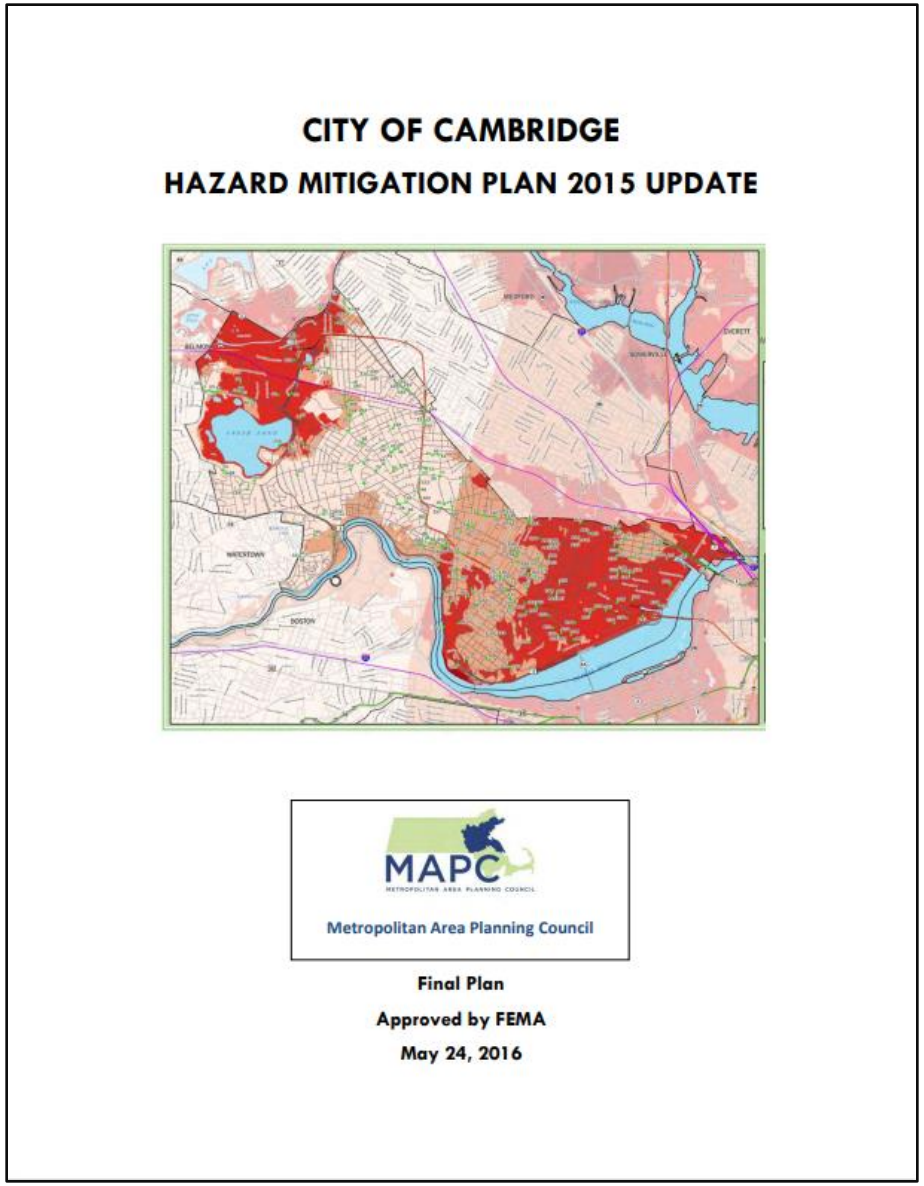
2022 Updates Include:

- ✓ Expanded list of participants required in planning process.
- ✓ Requires consideration of climate change.
- ✓ Recognizes the important role of adopting and enforcing building, land use, and development code
- ✓ Facilitates stronger alignment with other FEMA mitigation programs.

HISTORY IN CAMBRIDGE: 2015 PLAN UPDATE

CITY OF CAMBRIDGE
HAZARD MITIGATION PLAN 2015 UPDATE
Prepared by MAPC

Adopted: 3/21/2016
Approved: 5/24/2016
Expired: 5/24/2021



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HISTORY IN CAMBRIDGE: MITIGATION ACTIONS

Cambridge HMP 2015 Mitigation Actions

Mitigation Action	Measure Type	Implementation Responsibility	Priority	Time Frame	Potential Funding Sources
Flood Hazard Mitigation Measures					
A) Complete hydraulic modeling for the city	Prevention	DPW	High	2014–2018	City of Cambridge
B) Complete sewer separation and stormwater management program for Kirkland Street, Myrtle Street, Magnolia Street and Cambridge Street (CAM #011, areas 18 and 19)	Structural Projects	DPW	High	2014-2016	City of Cambridge
C) Complete sewer separation and stormwater management program for areas east of Fresh Pond Pkwy (area #6) and between Concord Avenue rotaries and New Street (area #5)	Structural Projects	DPW	High	2014-2016	City of Cambridge
D) Complete sewer separation at Porter Square (CAM 002 CSO area)	Structural Projects	DPW	High	2014–2018	City of Cambridge
E) Improve collection and conveyance system at area east of 2nd Street and north of Charles Street (area #27)	Structural Projects	DPW	High	2014–2018	City of Cambridge
F) Implement additional stormwater management measures: School, Pine, Cherry and Windsor Streets (area #26)	Structural Projects	DPW	High	2014–2018	City of Cambridge
G) Complete Cambridgeport stormwater management program: Newton, Green, Franklin and Sidney Streets (CAM 017, area #28)	Structural Projects	DPW	High	2014–2018	City of Cambridge
H) Complete sewer separation and stormwater management program for Irving, Bryant, Crescent, Carver and Sacramento Streets (CAM011, areas #16 and 17)	Structural Projects	DPW	High	2014–2017	City of Cambridge
I) Complete sewer separation and stormwater management program for Ellery Street and Broadway (CAM011, area #24)	Structural Projects	DPW	High	2014–2017	City of Cambridge
J) Establish funding program for residential structural improvements and flood proofing	Prevention/ Property Protection	CDD, DPW	Medium	2016-2018	City of Cambridge, FEMA
K) Floodplain Management	Prevention	Conservation Commission	Low	2014-2018	City of Cambridge
L) Floodplain Mapping	Prevention	CDD, Conservation Commission	Low	2014-2018	City of Cambridge
Winter Storm Hazard Mitigation Measures					
M) Expand program to clear snow and maintain public ROWs (e.g., travel ways for non-vehicular mobility and access for vulnerable populations)	Prevention	DPW	Medium	2014-2018	City of Cambridge, DCR, MassDOT
Geologic Hazard Mitigation Measures					
N) Determine vulnerability of roadways and utilities to earthquakes in the high liquefaction areas	Prevention	EMD, DPW, Inspectional Services	Medium	2016-2018	City of Cambridge
Extreme Temperature Mitigation Measures					
O) Provide facility for additional vulnerable populations during extreme temperature event	Prevention/ Public Education & Awareness	DHSP, EMD	Medium	2014-2016	City of Cambridge
Wind Mitigation Measures					
P) Increase public education on the benefits and proper care of trees on private property	Public Education & Awareness	Inspectional Services, EMD	Low	2015-2017	City of Cambridge, MEMA
Climate Change Mitigation Measures					
Q) Complete Climate Change Vulnerability Assessment	Prevention	CDD	High	2014	City of Cambridge
R) Complete Climate Change Adaptation Plan	Prevention	CDD	High	2014-2015	City of Cambridge, EOEEA
S) Encourage installation of solar photovoltaic systems, cogeneration, and other energy supplies	Prevention	CDD	Low	2014-2017	City of Cambridge
T) Encourage energy efficiency in buildings through zoning requirements and community outreach	Prevention	CDD	Low	2014-2017	City of Cambridge
Other Hazard Mitigation Measures					
U) Evacuation Protocol Review	Emergency Services Protection	EMD	High	2015-2016	City of Cambridge
V) Develop program for enhanced staffing for disaster recovery	Prevention/ Emergency Services Protection	Inspectional Services, CPHD	Medium	2014-2016	City of Cambridge

KEY CHANGES

Federal

FEMA updated Local Mitigation Planning Policies and Guidance (released April 2022, effective April 2023)

State

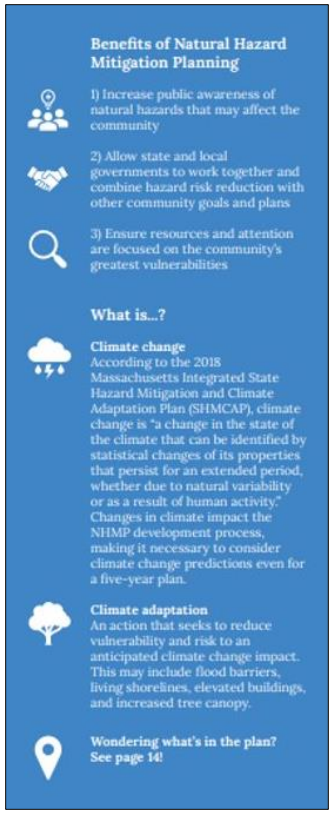
State adopted Massachusetts Integrated State Hazard Mitigation and Climate Adaptation Plan (September 2018)

Local

CCVA Reports (Parts 1 & 2)
CCPR/Neighborhood Plans for Alewife and The Port
Resilient Cambridge
Cambridge Flood Viewer
Cambridge Heat Viewer
Cambridge Urban Forest Master Plan
Envision Cambridge
Sustainability Dashboard and Net Zero Action Plan
Climate Resilience Zoning Petition

RECENT EXAMPLE: BOSTON

Publicly Accessible:
Easily understandable for people without a technical or planning background



Benefits of Natural Hazard Mitigation Planning

1) Increase public awareness of natural hazards that may affect the community

2) Allow state and local governments to work together and combine hazard risk reduction with other community goals and plans

3) Ensure resources and attention are focused on the community's greatest vulnerabilities

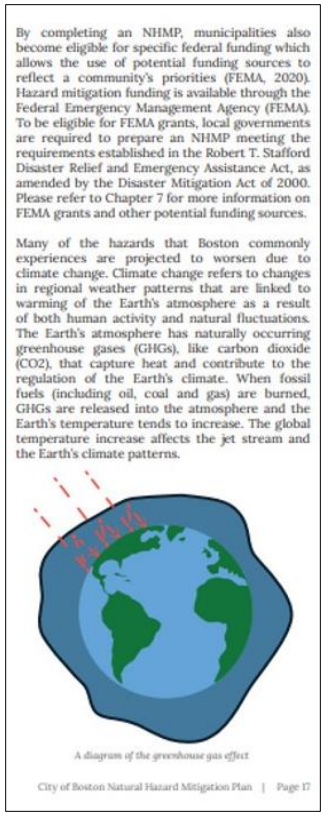
What is...?

Climate change
According to the 2018 Massachusetts Integrated State Hazard Mitigation and Climate Adaptation Plan (SHMCAP), climate change is "a change in the state of the climate that can be identified by statistical changes of its properties that persist for an extended period, whether due to natural variability or as a result of human activity." Changes in climate impact the NHMP development process, making it necessary to consider climate change predictions even for a five-year plan.

Climate adaptation
An action that seeks to reduce vulnerability and risk to an anticipated climate change impact. This may include flood barriers, living shorelines, elevated buildings, and increased tree canopy.

Wondering what's in the plan?
See page 14!

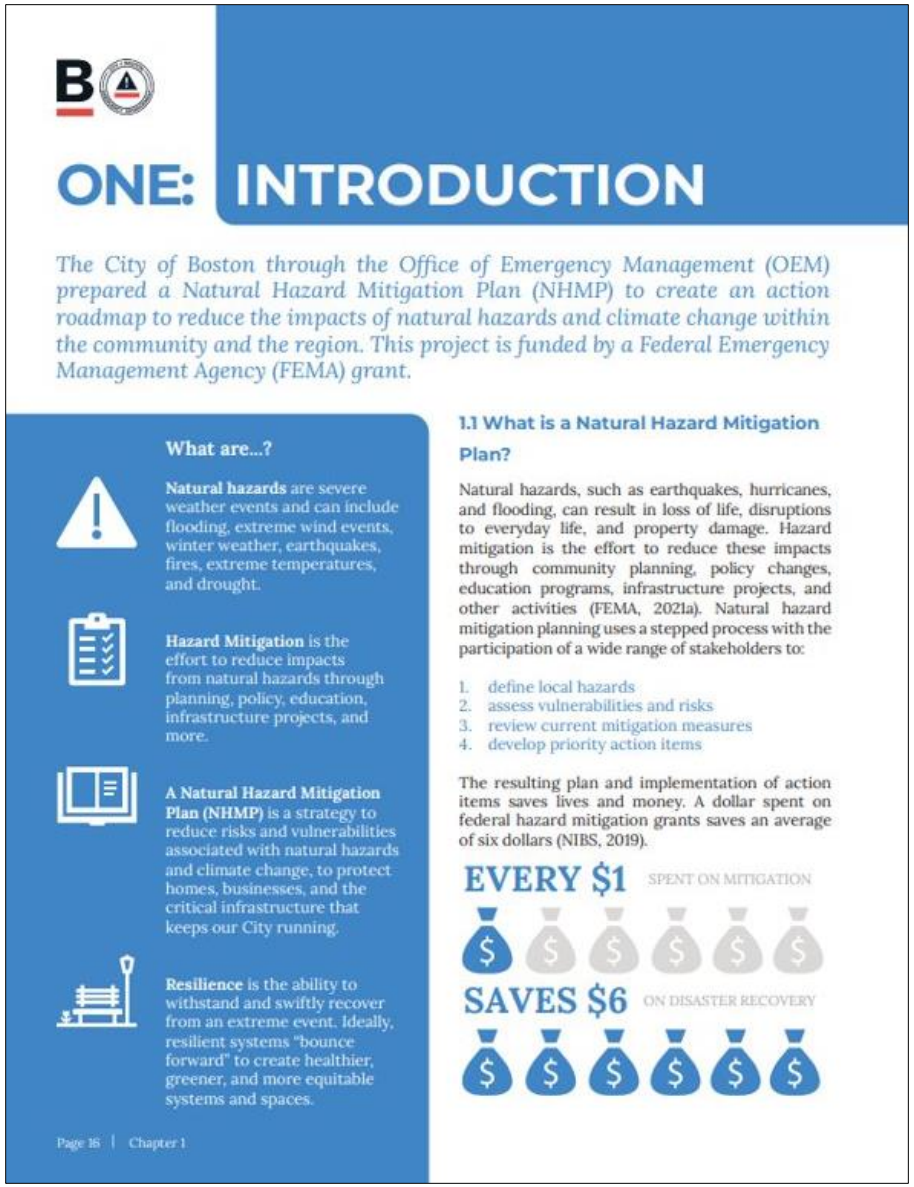
	BOSTON		MASSACHUSETTS	
AGE				
	15.8% Under Age 18	11.5% Over Age 65	19.6% Under Age 18	17% Over Age 65
EDUCATION				
	49.7% Bachelor's degree or higher		45.0% Bachelor's degree or higher	
DISABILITIES				
	11.9% With a disability		11.5% With a disability	
ENGLISH SPEAKING SKILLS				
	17.4% Limited English-speaking skills		9.2% Limited English-speaking skills	
INCOME				
	$71,115 Median household income	18.9% Poverty rate	$85,843 Median household income	9.4% Poverty rate
HOUSING				
	294,418 Housing units	32.1% Owner-occupancy rate	2.9 M Housing units	62.2% Owner-occupancy rate
	40% Burdened by housing costs* (renter)	16% Burdened by housing costs* (mortgage)	40% Burdened by housing costs* (renter)	15% Burdened by housing costs* (mortgage)
TECHNOLOGY				
	91.0% With a computer	85.4% With a broadband internet subscription	93.5% With a computer	88.9% With a broadband internet subscription



By completing an NHMP, municipalities also become eligible for specific federal funding which allows the use of potential funding sources to reflect a community's priorities (FEMA, 2020). Hazard mitigation funding is available through the Federal Emergency Management Agency (FEMA). To be eligible for FEMA grants, local governments are required to prepare an NHMP meeting the requirements established in the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by the Disaster Mitigation Act of 2000. Please refer to Chapter 7 for more information on FEMA grants and other potential funding sources.

Many of the hazards that Boston commonly experiences are projected to worsen due to climate change. Climate change refers to changes in regional weather patterns that are linked to warming of the Earth's atmosphere as a result of both human activity and natural fluctuations. The Earth's atmosphere has naturally occurring greenhouse gases (GHGs), like carbon dioxide (CO_2), that capture heat and contribute to the regulation of the Earth's climate. When fossil fuels (including oil, coal and gas) are burned, GHGs are released into the atmosphere and the Earth's temperature tends to increase. The global temperature increase affects the jet stream and the Earth's climate patterns.

A diagram of the greenhouse gas effect



ONE: INTRODUCTION

The City of Boston through the Office of Emergency Management (OEM) prepared a Natural Hazard Mitigation Plan (NHMP) to create an action roadmap to reduce the impacts of natural hazards and climate change within the community and the region. This project is funded by a Federal Emergency Management Agency (FEMA) grant.

What are...?

Natural hazards are severe weather events and can include flooding, extreme wind events, winter weather, earthquakes, fires, extreme temperatures, and drought.

Hazard Mitigation is the effort to reduce impacts from natural hazards through planning, policy, education, infrastructure projects, and more.

A Natural Hazard Mitigation Plan (NHMP) is a strategy to reduce risks and vulnerabilities associated with natural hazards and climate change, to protect homes, businesses, and the critical infrastructure that keeps our City running.

Resilience is the ability to withstand and swiftly recover from an extreme event. Ideally, resilient systems "bounce forward" to create healthier, greener, and more equitable systems and spaces.

1.1 What is a Natural Hazard Mitigation Plan?

Natural hazards, such as earthquakes, hurricanes, and flooding, can result in loss of life, disruptions to everyday life, and property damage. Hazard mitigation is the effort to reduce these impacts through community planning, policy changes, education programs, infrastructure projects, and other activities (FEMA, 2021a). Natural hazard mitigation planning uses a stepped process with the participation of a wide range of stakeholders to:

1. define local hazards
2. assess vulnerabilities and risks
3. review current mitigation measures
4. develop priority action items

The resulting plan and implementation of action items saves lives and money. A dollar spent on federal hazard mitigation grants saves an average of six dollars (NIBS, 2019).

EVERY $1 SPENT ON MITIGATION

SAVES $6 ON DISASTER RECOVERY

RECENT EXAMPLE: BOSTON

Opportunity to streamline goals:
Consider goals designed to be easily communicated and consistent with other local planning initiatives.

Cambridge HMP 2015 Goals

- Ensure that evacuation can happen in an organized and efficient manner.
- Minimize secondary impacts from hazards, such as the release of pollutants.

2. Goal: Protect existing properties and structures.
   - Provide resources for residents and businesses to make their buildings and properties more disaster resistant.
   - Educate the public on measures they can take to protect their property.
   - Maintain existing mitigation structures.
   - Ensure that future development / redevelopment does not make existing properties more vulnerable to hazards.
   - Ensure that critical facilities are protected from hazards.
   - Complete separation of combined sewers
3. Goal: Ensure that essential services can function during and after a hazard event.
   - Ensure that critical infrastructure is protected from natural hazards.
   - Ensure that people (key service providers and employees) can get into the city to provide services.
   - Build resiliency into the system for faster recovery, e.g., electricity distribution system.
4. Goal: Avoid chaos and confusion with good communication.
   - Have an effective communication plan.
   - Perform outreach to non-English speakers and other vulnerable populations before, during and after hazard events
   - Coordinate efforts with the private sector and institutions and with neighboring communities.
5. Goal: Work regionally to mitigate impacts from natural hazards and to respond and recover from hazard events.
   - Continue to participate in regional efforts.
   - Cooperate with other agencies, communities, and private entities.
   - Understand priorities and capabilities of other entities to allow for resource-sharing, mutual aid, and entering into memoranda of understanding (MOU).
6. Goal: Determine priorities for directing resources for hazard mitigation and response.
   - Prioritize mitigation projects.
   - Continue to program mitigation projects in the 5 and 10 year CIP.
   - Pursue various funding sources.
   - Encourage private property-owners to implement measures to protect their own property.
7. Protect natural resources
   - Identify mitigation strategies that preserve or restore the function of natural systems.
   - Protect indigenous wetland areas, undeveloped floodplains and other natural features that provide mitigation of natural hazards.
   - Introduce green infrastructure elements, where possible, to reduce impervious surfaces and introduce natural systems.
8. Create capacity to monitor existing changes
   - Identify and understand how climate change many alter where and how the City is vulnerable to natural hazards.
   - Review and update current mitigation activities to anticipate future changes in vulnerabilities.
   - Review and update current emergency preparedness and response activities to anticipate future changes in vulnerabilities.

Hazard Mitigation and Climate Adaptation Goals

Fundamentally, the NHMP intends to equitably support Boston's neighborhoods by protecting public health and safety, increasing awareness of steps to mitigate damages from natural hazards, and promoting preparedness for climate change. The Executive Steering Committee, representing the City of Boston, endorsed, the following set of hazard mitigation and climate adaptation goals. Each goal was assigned a set of objectives, which can be found in Chapter 2. These goals informed the selection and prioritization of future adaptation and mitigation actions.

1. Equitably protect the health and safety of the public through awareness, preparedness, and connections.
2. Increase resilience by protecting and enhancing natural resources.
3. Implement hazard mitigation and climate adaptation projects that meet strategic priorities.
4. Invest in protecting properties and structures.
5. Ensure that essential services and infrastructure will function during and after a hazard event and prepare essential services for projected climate change impacts.

Boston HMP 2021 Goals

RECENT EXAMPLE: BOSTON

Prioritized to be Implemented:
Practical, integrated, and proactive mitigation actions.

Action Prioritization - A prioritization designation of high, medium, or low priority was assigned to each mitigation measure. This designation was based on a cumulative rating from the ten categories listed below:

- **Life Safety** - Will this action protect lives and prevent injury?
- **Property Protection** - Will this action eliminate or reduce damage to structures and infrastructure?
- **Technical** - Is the mitigation action technically feasible?
- **Political** - Does the public support the mitigation action?
- **Legal** -Does the City have the authority to implement the action?
- **Environmental** - Will the action protect and preserve Boston's natural resources?
- **Social** - Will the action have a positive impact on the community and vulnerable populations?
- **Administrative** - Does the City have the capabilities to implement and maintain the action?
- **Local Champion** - Is there a strong advocate for the project with the City?
- **Other Community Objectives** - Does the action advance other objectives in Boston, such as capital improvement, economic development, environmental quality, or open space preservation?

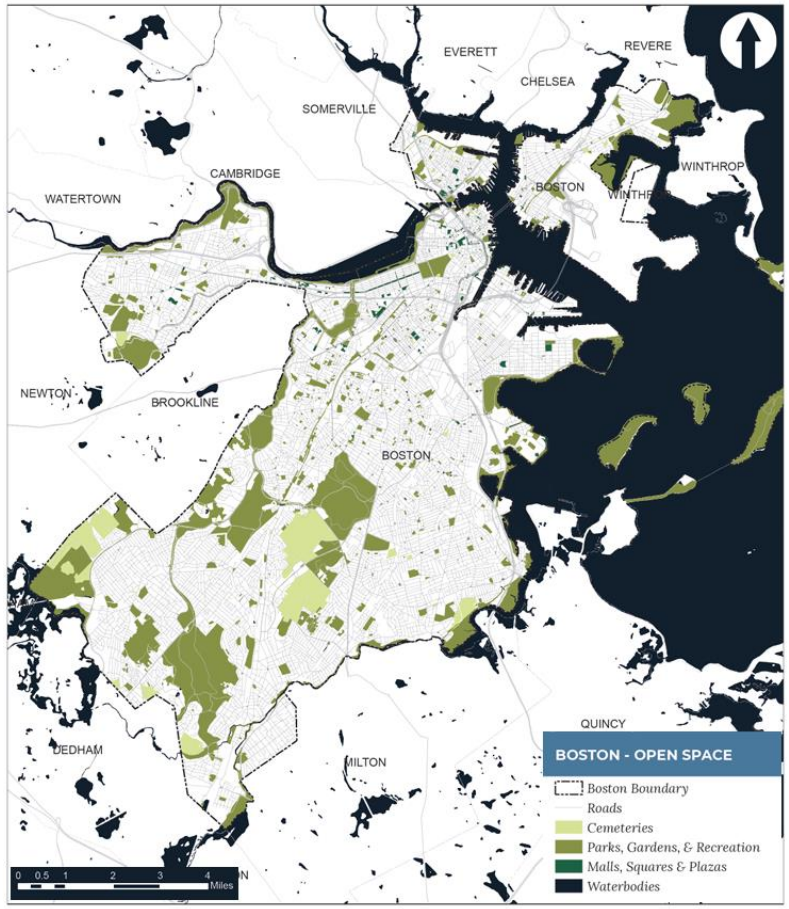


Figure 3-5. Open Space in Boston

VALUE OF HAZARD MITIGATION PLANNING

- Eligibility for grant funding
- Preparedness planning
- Building public consensus for implementation
- Creating equitable outcomes

EVERY $1 SPENT ON MITIGATION

SAVES $6 ON DISASTER RECOVERY

AGENDA

Welcome & Introductions	1:00 PM
Overview of Hazard Mitigation Planning	1:05 PM
Scope & Schedule	**1:15 PM**
Engagement	2:00 PM
Questions, Discussion, Action Items	2:10 PM
Conclude	2:30 PM

HMP OVERVIEW

Project Tasks align with the Final Document Chapters:

Task 1: Project Initiation

Task 2: Initiation of Engagement

Task 3: Hazard Profiles

Task 4: Facility/Asset Inventory

Task 5: Vulnerability Assessment

Task 6: Mitigation Goals and Capabilities

Task 7: Mitigation Actions: Past, Present, and Future

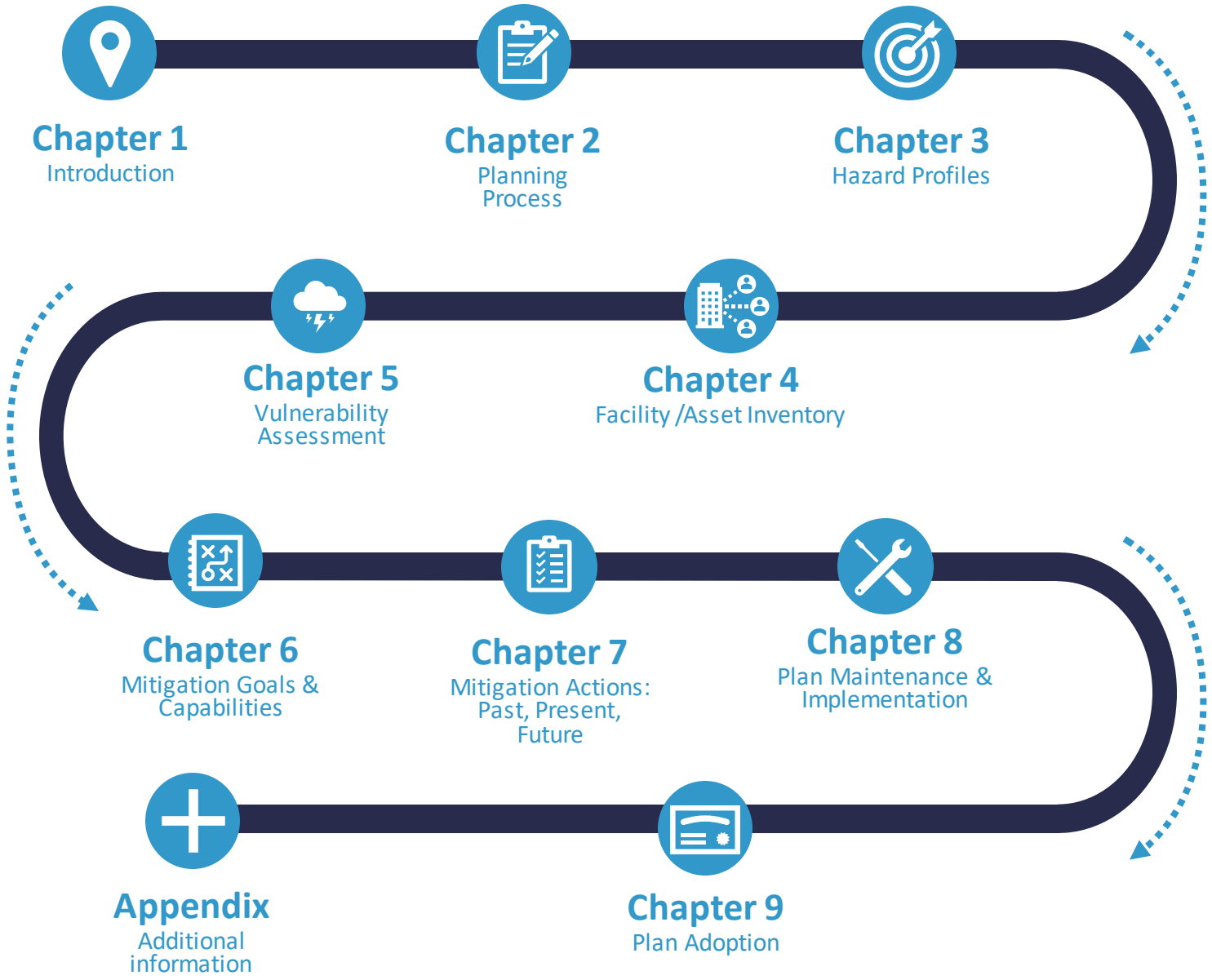
Task 8: Plan Maintenance and Implementation

Task 9: Public Review

Task 10:]

Ongoing Public Outreach

Ongoing Project Administration



TASK 1

Project Initiation

"A successful planning effort includes active participation and buy-in from community leaders, stakeholders, and the public."

- Defining engagement groups (Steering Committee, SHTP, Stakeholders)
- Confirming logistics
- Project initiation meeting to facilitate understanding & vet questions/concerns
- Data gathering, review, consolidation, and integration
- Ongoing coordination

TASK 2

Initiation of Engagement

Create a shared understanding of risk due to natural hazards

Provide opportunities to be actively participating in the development of the hazard mitigation plan

Engage community lifelines, which are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function

Community Lifelines:

- Safety and Security
- Food, Water, Shelter
- Health and Medical
- Energy
- Communications
- Transportation
- Hazardous Material

City Staff

Stakeholders

Outreach

Public

TASK 2

FEMA's new engagement requirements

Local + Regional Agencies

- Public Works
- Emergency Management
- Local Floodplain Administration
- GIS Departments

Agencies that have the authority to regulate development

- Zoning
- Planning
- Community and economic development departments
- Building officials
- Planning commissions
- Other elected officials

Neighboring Communities

- Adjacent local governments, including special districts, such as those that are affected by similar hazard events or may share a mitigation action or project that crosses boundaries
- Neighboring communities may be partners in hazard mitigation and response activities, or may be where critical assets, such as dams, are located.

Representatives of businesses, academia, and other private organizations

- Private utilities or major employers that sustain community lifelines

Stakeholders

Representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations, among others

- Housing, healthcare or social service agencies

TASK 2

Outreach

Engagement Materials

- Website Information
- Social Media Posts
- E-blasts
- Project Video
- Public Survey(s)
- FAQ Section
- Interactive Map
- ESRI Storymap
- Flyers
- Fact sheets

Consistent Visual and Tonal Branding

Public

Groups to Focus On

- People with lower incomes
- People of color
- Infants + Youth
- Older adults
- People experiencing homelessness
- Non-English speakers + Immigrants
- People with physical or developmental disabilities
- People who are currently or formerly incarcerated + their families
- People with a physical or mental illness
- People with undocumented status

Considerations will be made for each group and each engagement activity.

Translation and interpretation services to be provided by City of Cambridge

PRELIMINARY CONTENT FOR DISCUSSION

TASK 3

Hazard Profiles

Identifies the hazards that can affect the City of Cambridge and associated Risk:

Location: Where each hazard might affect the planning area

Extent: Potential intensities

Previous Occurrence: How often events have happened in the past?

Future Probability: How likely they are to occur in the future?

TASK 4

Facility / Asset Inventory

Assets are determined by the community and include, but are not limited to:

- People (including underserved communities and socially vulnerable populations).
- Structures (including facilities, lifelines and critical infrastructure).
- Systems (including networks and capabilities).
- Natural, historic, and cultural resources.
- Activities that have value to the community

Example Critical Facilities

- Energy
- Transportation
- Water, wastewater, stormwater
- Telecommunication
- Emergency Response
- Hospitals and health care
- Municipal Buildings
- Community Resources
- Etc.

Repetitive Loss Structures

Land Use Changes & Future Potential Development

TASK 5

Risk & Vulnerability Assessment

"Vulnerability is a description of which assets, including structures, systems, populations and other assets as defined by the community, within locations identified to be hazard prone, are at risk from the effects of the identified hazard(s).

Use information from Hazard Profiles (Task 3) and Facility/Asset Inventory (Task 4)

Define what parts of the community are most likely to be affected (vulnerability) and the potential consequences (impacts).

TASK 6

Mitigation Goals and Capabilities

Intent: Revisit and refine goals & assess current capabilities to support plan implementation. Critical steps in developing specific hazard mitigation actions and projects.

Goals

Long-term policy statements and global visions that support the mitigation strategy.

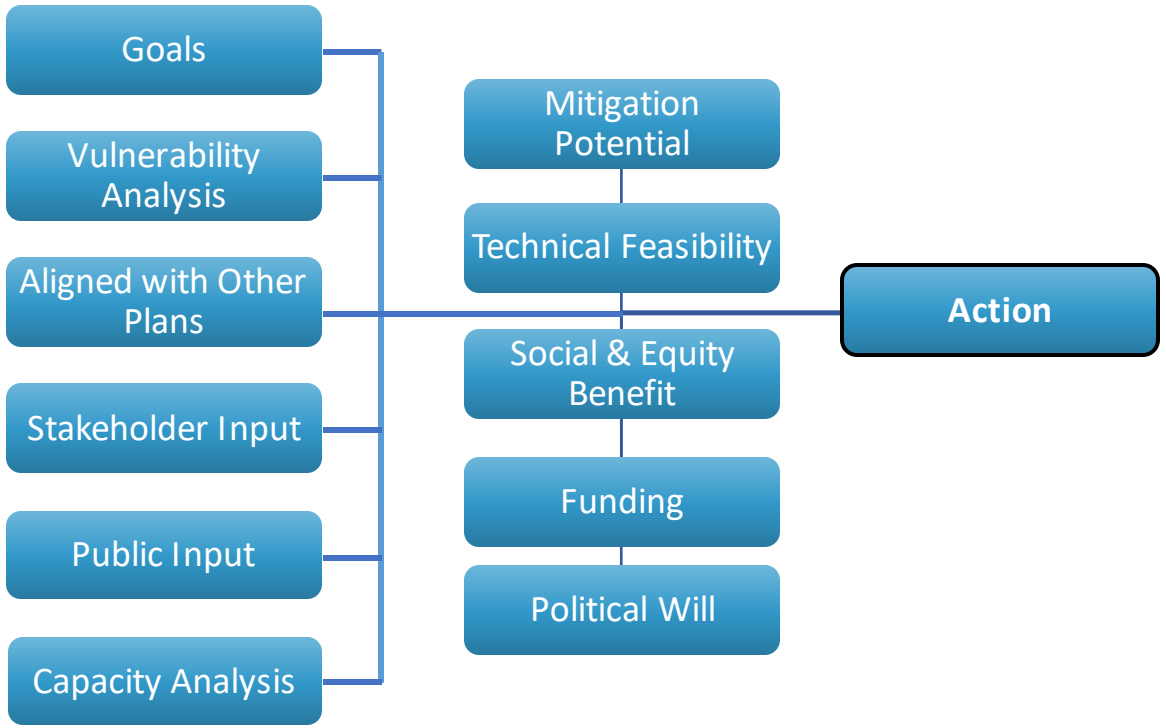
Capabilities Assessment

Identify and assess existing authorities, policies, programs, and resources and capabilities to use or modify local tools to reduce losses and vulnerability from profiled hazards.

TASK 7

Mitigation Actions: Past, Present, and Future

Intent: The mitigation strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment.



Mitigation actions fall into the following categories:

- Life Safety
- Property Protection
- Technical
- Political
- Legal
- Environmental
- Social
- Administrative

TASK 8

Plan Maintenance and Implementation

- **Intent:**
  - **Living document** that guides actions over time. Having a process for maintaining the plan reflects the recognition that things change.
  - **Track progress** on implementing the mitigation strategy.
  - **Revisit** at regular intervals to keep it relevant.
- **Schedule** with procedures for ensuring the plan's implementation, updating, and revision.
- Identify a **Champion** to organize future meetings and to track progress.
- Identify potential **future** planning and budgeting efforts that will **require coordination**.
- Incorporate into **next MVP Planning Phase.**

DRAFT

TASK 9

Public Review

Public Review

- Website Information
- Social Media Posts
- E-blasts
- Public Comment Period
- Public Survey(s)
- FAQ Section
- Public Meeting
- Flyers
- Fact sheets

Translation and Interpretation Services to be provided by City of Cambridge

TASK 10

MEMA and FEMA Review, City Adoption

"Adoption by the local governing body demonstrates Cambridge's commitment to the hazard mitigation goals and actions outlined in the plan.

Adoption authorizes responsible agencies to perform.

Without adoption, Cambridge has not completed the mitigation planning process and will not be eligible for certain FEMA assistance, such as HMA or HHPD grant program funding for mitigation actions."

CRITICAL PATH ITEMS

	Facility/ Asset Inventory	Capabilities Assessment	Repetitive Loss Data
Requirement	Community must determine assets (people; structures; systems; natural, historic, and cultural resources; and/or activities that have value to the community).	Document local mitigation capabilities (existing authorities, policies, programs, and resources that reduce hazard impacts or that could be used to implement hazard mitigation activities).	Address repetitively flooded NFIP-insured structures by including the estimated numbers and types (residential, commercial, institutional, etc.) of repetitive/severe repetitive loss properties.
Starting Point	CCVA Critical Assets & Community Resources (November 2015)	2015 HMP & Institutional Knowledge	2015 HMP: There were 2 repetitive loss structures, an increase from the one structure identified in the 2008 plan.
Tools	Institutional Knowledge & Assessor's Database	FEMA worksheet	Email template for request

SCHEDULE OVERVIEW

	TASK	February	March	April	May	June	July	August
1	Project Initiation							
2	Engagement							
3	Hazard Profiles							
4	Facility/Asset Inventory							
5	Vulnerability Assessment							
6	Mitigation Goals & Cap.							
7	Develop Actions							
8	Plan Implementation							
9	Public Review							
10	Adoption							
Admin. & Outreach								

PRELIMINARY CONTENT FOR DISCUSSION

AGENDA

Welcome & Introductions	1:00 PM
Overview of Hazard Mitigation Planning	1:05 PM
Scope & Schedule	1:15 PM
Engagement	**2:00 PM**
Questions, Discussion, Action Items	2:10 PM
Conclude	2:30 PM

GROUPS

City Staff

Steering Committee

Group of key City staff responsible for making final planning decisions. Steering Committee Meetings will guide the planning process, endorse draft Goals, and members will participate in Hazard Mitigation Planning Workshops.

6 Monthly Meetings & 3 Workshops

Stakeholders

Hazard Mitigation Planning Team (HMPT)

Group of stakeholders bringing a wide range of local expertise and perspectives. The group will include advocates, residents, business-owners, state and local agency representatives, and people from various other organizations.

3 Workshops

Outreach

Street Team

Subset of the HMPT who can help with in-person and virtual outreach and engagement events. This could include activity at local community organizations, schools, events, door-to-door outreach, and others engagement.

Ongoing

Public

Public Engagement

Public Meetings will be an opportunity to educate about the HMP, share progress, and gather feedback and ideas. Results from these meetings and other feedback will be integrated into the final report. The group will include advocates, residents, business-owners, state and local agency representatives, and people from various other organizations.

3 Meetings

PRELIMINARY CONTENT FOR DISCUSSION

ROLES, RESPONSIBILITIES, COMMITMENTS

City Staff

Steering Committee

Group of key City staff responsible for making final planning decisions. Steering Committee Meetings will guide the planning process, endorse draft Goals, and members will participate in Hazard Mitigation Planning Workshops.

Proposed Participants:

- DPW
- CDD
- Public Health
- Emergency Mgmt. Manger (Fire Chief)

6 Monthly Meetings (1 hour each) & 3 Workshops (1.5 hours each)

Stakeholders

Hazard Mitigation Planning Team (HMPT)

Group of stakeholders bringing a wide range of local expertise and perspectives. This includes a broader range of City staff and can include targeted individuals from organizations that have influence and/or serve a large group.

Proposed Participants:

- Traffic, Parking, and Transportation
- Inspectional Services
- Historic Commission
- Finance Department
- Housing Authority
- School Department
- Immigration Affairs
- Human Services
- City Manager's Office
- Police?

3 Workshops (1.5 hours each)

PRELIMINARY CONTENT FOR DISCUSSION

slido

What days and times would you be able to attend a monthly Steering Committee Meeting?

ⓘ Start presenting to display the poll results on this slide.

AGENDA

Welcome & Introductions	1:00 PM
Overview of Hazard Mitigation Planning	1:05 PM
Scope & Schedule	1:15 PM
Engagement	2:00 PM
Questions, Discussion, Action Items	**2:10 PM**
Conclude	2:30 PM

Hazard Mitigation Plan Update 2023

Thank you!

CITY OF CAMBRIDGE

Weston & Sampson SM

HAZARD MITIGATION PLAN 2023 UPDATE KICKOFF MEETING NOTES

February 27, 2023

Attendees

City of Cambridge

- Leila Mekias, CDD
- Susanne Rasmussen, CDD
- Seth Federspiel, CDD
- Catherine Woodbury, DPW
- Deputy Chief Colin Walsh, Fire Dept.
- Sandra Clark, CDD
- John Nardone, DPW
- Brian McLane, DPW
- Marlees Owayda, CDD
- Nick Stoutt, DPW
- Jim Wilcox, DPW
- Crystal Rosa, Human Rights Commission
- Nancy Rihan-Porter, CPHD
- Sam Lipson, CPHD

Weston & Sampson

- Robin Seidel, Project Manager
- Indrani Ghosh, Climate Resilience Technical Lead
- Jennie Moonan, HMP Technical Lead

Discussion items

Hazard Mitigation Planning Team (HMPT)

- Organizations and groups for consideration on the HMPT: Disabilities Commission, Cambridge Housing Authority.
- Additional recommendations for HMPT to be collected through survey to kick-off meeting attendees

Engagement

- City's Community Engagement Team to support and provide input on community contacts for stakeholder list.
- Develop engagement plan to consider migrant and climate vulnerable population groups
- Develop guidelines with City's Community Engagement team to avoid bias in determining stakeholder groups, and the creation of HMPT and Steering Committee (STC).
- Engage public for meaningful input on the plan and provide clear expectations on how community input will be used to inform the plan ad how we are integrating language access in the Plan.
- Public Health has a Community Core that could help with Street Team duties.

- Identify how Resilience Hub in the non-profits and CBOs can be utilized in the plan.
- Include Rachel from the Disability Commission to be part of the STC

Technical Input

- Public health – jurisdictional resiliency and hazard analysis and data can be provided by Public Health Dept.
- Note on considering solutions – re-evaluating the City's policies related to basement apartment may be a potential mitigation action identified as part of the Updated Plan

Schedule and Scope

- Schedule for engagement and meetings will need to be carefully planned and coordinated with the City to meeting project schedule.
- Already scheduled public events should be considered for incorporation in engagement program to prevent planning fatigue.
- Poll used to identify Steering Committee Monthly meeting time. 1 to 2 PM on Mondays was selected in poll and based on discussion.

Action Items

1. WSE draft and send survey and email to Leila re documents/reports/plans, steering committee, stakeholders, etc.
2. WSE to send dates/times to Leila for
    a. Outreach and engagement meeting with the City's Community Engagement Team to finalize the Engagement Plan. This meeting will be used to formalize the list of committee members in STC, HMPT, Street Teams, larger community members, etc.
    b. Ongoing PM meetings
3. WSE to coordinate information request on update critical facilities inventory from DPW (Nick S)
4. WSE to give Leila access to SharePoint
5. WSE to organize for capabilities assessment & follow up with Leila
6. WSE to organize asset update & follow up with Leila
7. Leila to send out survey post kickoff
8. Leila to coordinate with City staff to form the City's Community Engagement Team and get dates lined up for meeting between Weston & Sampson and City's Engagement Team. This meeting should ideally occur before the March Steering Committee meeting.
9. Leila to schedule month STC meetings fourth Monday of every month

Next Steering Committee Meeting Agenda (tentative)

- Overview of Work in Progress
- Presentation of Hazard Profiles and review deadline
- Update on Stakeholder Engagement Plan
- Update on Capabilities Assessment
- Next Steps

City of Cambridge
2023 Hazard Mitigation Plan Update
Steering Committee Meeting
March 27, 2023
1:00 to 2:00 PM

STEERING COMMITTE MEETING #1: MARCH

AGENDA

1:00 PM **Overview of Work in Progress**

- Project timeline
- Tasks underway

1:05 PM **Chapter 3: Hazard Profiles**

- Overview of FEMA requirements
- Process to develop chapter and data sources
- Review process & deadline

1:20 PM **Update on Stakeholder Outreach and Engagement Plan & Next Steps**

1:30 PM **Capabilities Assessment**

- Overview
- Input needs and schedule

1:50 PM **Next Steps**

- Asset Inventory
- Initiate Capabilities Assessment
- Review Chapter 3
- Reminder to take survey https://forms.office.com/r/4v395ZZJ5Y
- Next Meeting April 24, 2023 1 to 2 PM

2:00 PM **Conclude**

Hazard Mitigation Plan Update 2023

Steering Committee Meeting #1
March 27, 2023

CITY OF CAMBRIDGE

Weston & Sampson SM

AGENDA

Work in Progress	1:00 PM
Chapter 3: Hazard Profiles	1:05 PM
Outreach and Engagement Plan	1:20 PM
Capabilities Assessment	1:30 PM
Next Steps	1:50 PM
Conclude	2:00 PM

AGENDA

Work in Progress	1:00 PM
Chapter 3: Hazard Profiles	1:05 PM
Outreach and Engagement Plan	1:20 PM
Capabilities Assessment	1:30 PM
Next Steps	1:50 PM
Conclude	2:00 PM

WORK IN PROGRESS

Project Tasks align with the Final Document Chapters:

Task 1: Project Initiation

Task 2: Initiation of Engagement

Task 3: Hazard Profiles

Task 4: Facility/Asset Inventory

Task 5: Vulnerability Assessment

Task 6: Mitigation Goals and Capabilities

Task 7: Mitigation Actions: Past, Present, and Future

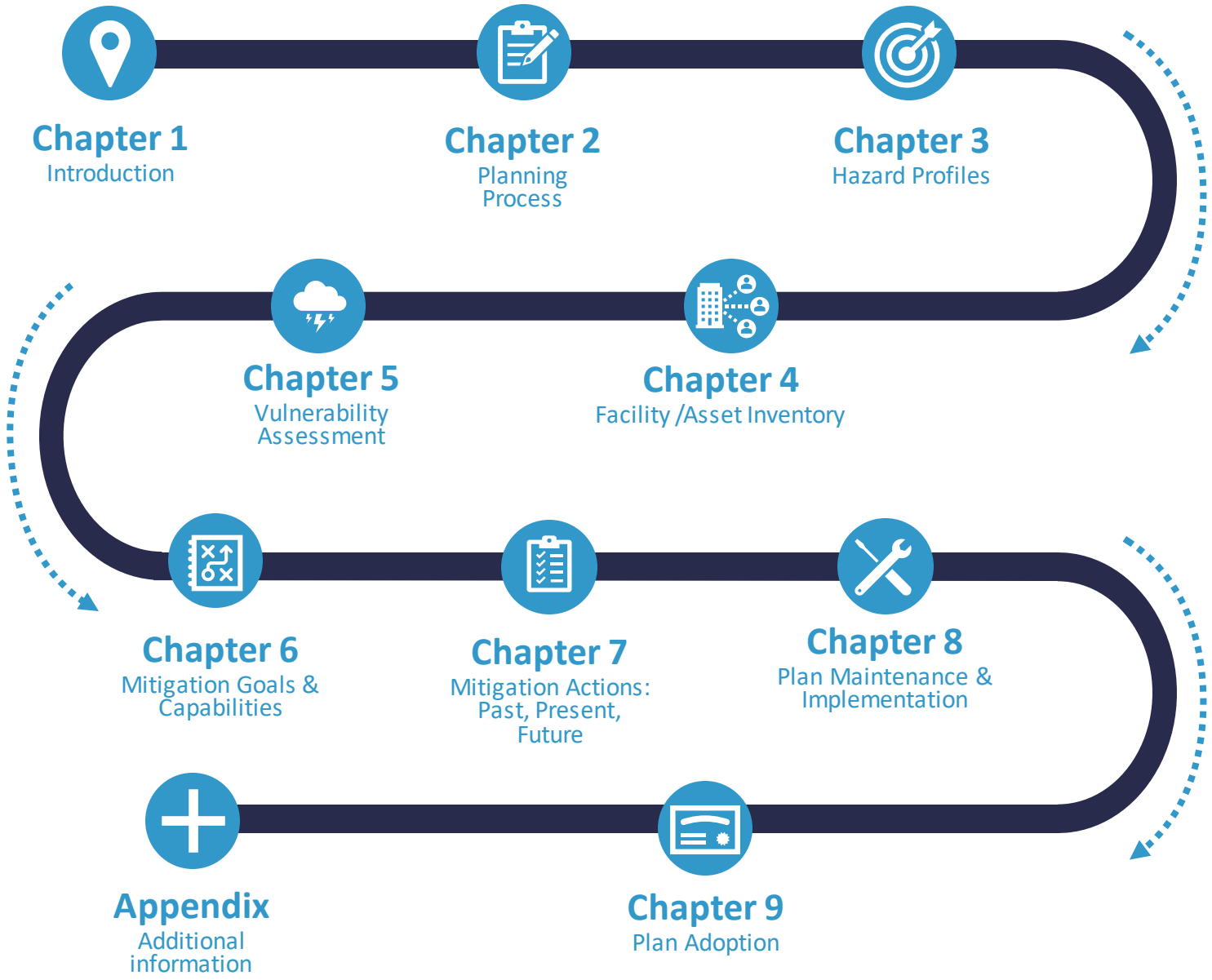
Task 8: Plan Maintenance and Implementation

Task 9: Public Review

Task 10: MEMA and FEMA Review, City Adoption

Ongoing Public Outreach

Ongoing Project Administration



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Project Tasks align with the Final Document Chapters:

Task 1: Project Initiation

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Ongoing Public Outreach

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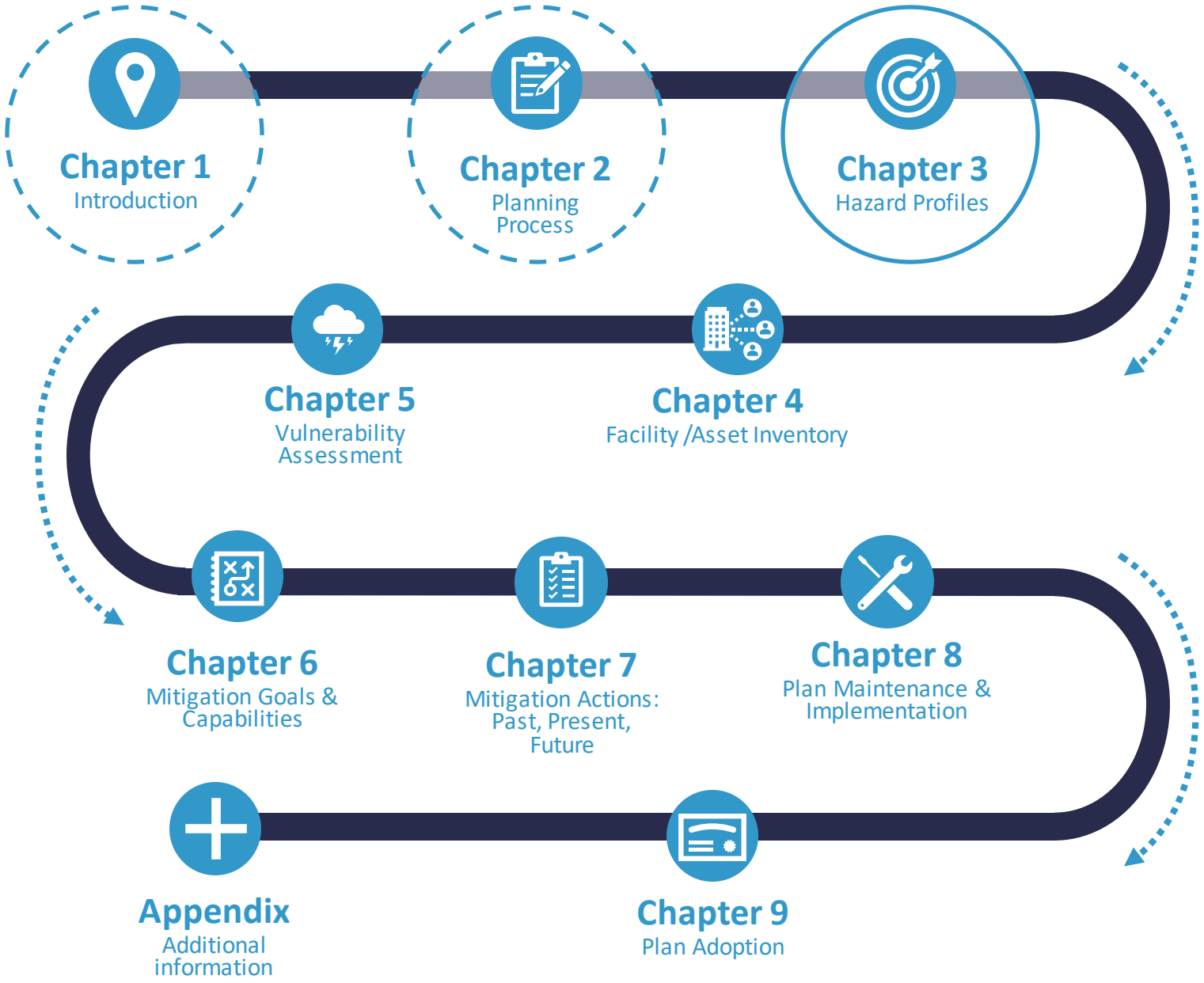

WORK IN PROGRESS

	TASK	February	March	April	May	June	July	August	Sept.
1	Project Initiation								
2	Engagement								
3	Hazard Profiles								
4	Facility/Asset Inventory								
5	Vulnerability Assessment								
6	Mitigation Goals & Cap.								
7	Develop Actions								
8	Plan Implementation								
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10	Adoption								
Admin. & Outreach									

AGENDA

Work in Progress	1:00 PM
Chapter 3: Hazard Profiles	1:05 PM
Outreach and Engagement Plan	1:20 PM
Capabilities Assessment	1:30 PM
Next Steps	1:50 PM
Conclude	2:00 PM

CHAPTER 3

Hazard Profiles

Identifies the hazards that can affect the City of Cambridge and associated Risk:

Location: Where each hazard might affect the planning area

Extent: Potential intensities

Previous Occurrence: How often events have happened in the past?

Future Probability: How likely they are to occur in the future?

Note: This exercise uses existing best available data.

CHAPTER 3

Hazard Profiles

How to decide on what natural hazards affect Cambridge?

Starting Point: City of Cambridge Hazard Mitigation Plan 2015 Update

- Flooding
- Dam Failures
- Thunder Storms
- Winter Storms
- Hurricanes
- Nor'easters
- Tornadoes
- Brushfire
- Earthquakes
- Landslides
- Extreme Temperatures
- Drought

Updates from: Massachusetts 2018 State Hazard Mitigation and Climate Adaptation Plan (SHMCAP)

- *Separate* flooding (inland and coastal)
- *Integrate* dam failure into flooding discussion
- *Add* Tsunami
- *Add* Invasive species
- *Add* Tropical storms

CHAPTER 3

Hazard Profiles

HURRICANES / TROPICAL STORMS

INLAND FLOODING

EXTREME TEMPERATURES

SEVERE WINTER WEATHER / NOR'EASTERS

COASTAL FLOODING

TSUNAMI

DROUGHT

WILDFIRE

EARTHQUAKES

TORNADOES

LANDSLIDES

INVASIVE SPECIES

CHAPTER 3

Data Sources for Hazard Profiles

State-Wide Data

- Massachusetts 2018 State Hazard Mitigation and Climate Adaptation Plan (SHMCAP)
- MA Climate Change Assessment
- Greater Boston Research Advisory Group Report (GBRAG)
- MA Climate Resilience Design Standards Tool

National Data

- FEMA
- NOAA
- USGS

Local Data

- City of Cambridge Hazard Mitigation Plan 2015 Update (prepared by MAPC)
- Climate Change Vulnerability Assessment (CCVA) Reports (Parts 1 & 2)
- Climate Change Preparedness and Resilience (CCPR)/Neighborhood Plans for Alewife and The Port
- Resilient Cambridge
- Cambridge Flood Viewer
- Cambridge Heat Viewer
- Cambridge Urban Forest Master Plan

AGENDA

Work in Progress	1:00 PM
Chapter 3: Hazard Profiles	1:05 PM
Outreach and Engagement Plan	**1:20 PM**
Capabilities Assessment	1:30 PM
Next Steps	1:50 PM
Conclude	2:00 PM

OUTREACH AND ENGAGEMENT

Key Takeaways: City Community Engagement Team

Meeting on Wednesday March 22, 2023

- **Prioritize simplification of language and messaging**
- **Developing a plan to advertise opportunities for feedback that inform the HMP**
- **Creation of Street Team to equitably engage**

City Staff

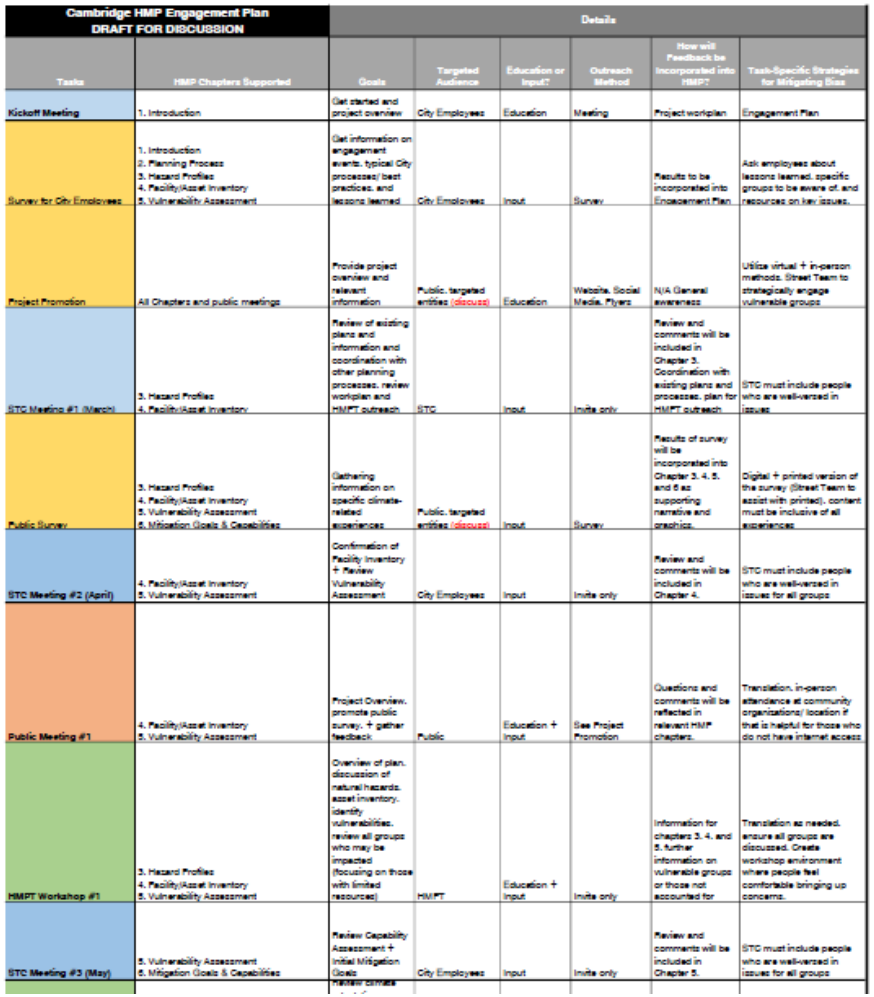
Stakeholders

Outreach

Public

OUTREACH AND ENGAGEMENT PLAN

- **Public Meeting #1** (May)
- **HMPT Workshop #1** (May)
- **HMPT Workshop #2** (June)
- **HMPT Workshop #3** (July)
- **Public Meeting #2/#3** (September)
- **Survey** (Ongoing)
- **Stream Team Outreach** (Ongoing)



Cambridge HMP Engagement Plan DRAFT FOR DISCUSSION		Details					
Tasks	HMP Chapters Supported	Goals	Targeted Audience	Education or Input?	Outreach Method	How will Feedback be Incorporated into HMP?	Task-Specific Strategies for Mitigating Bias
Kickoff Meeting	1. Introduction	Get started and project overview	City Employees	Education	Meeting	Project workplan	Engagement Plan
Survey for City Employees	1. Introduction 2. Planning Process 3. Hazard Profiles 4. Facility/Asset Inventory 5. Vulnerability Assessment	Get information on engagement events, typical City processes/ best practices, and lessons learned	City Employees	Input	Survey	Results to be incorporated into Engagement Plan	Ask employees about lessons learned, specific groups to be aware of, and resources on key issues.
Project Promotion	All Chapters and public meetings	Provide project overview and relevant information	Public, targeted entities (discuss)	Education	Website, Social Media, Flyers	N/A General awareness	Utilize virtual + in-person methods. Street Team to strategically engage vulnerable groups
STC Meeting #1 (March)	3. Hazard Profiles 4. Facility/Asset Inventory	Review of existing plans and information and coordination with other planning processes, review workplan and HMPT outreach	STC	Input	Invite only	Review and comments will be included in Chapter 3. Coordination with existing plans and processes, plan for HMPT outreach	STC must include people who are well-versed in issues
Public Survey	3. Hazard Profiles 4. Facility/Asset Inventory 5. Vulnerability Assessment 6. Mitigation Goals & Capabilities	Gathering information on specific climate-related experiences	Public, targeted entities (discuss)	Input	Survey	Results of survey will be incorporated into Chapter 3, 4, 5, and 6 as supporting narrative and graphics.	Digital + printed version of the survey (Street Team to assist with printed), content must be inclusive of all experiences
STC Meeting #2 (April)	4. Facility/Asset Inventory 5. Vulnerability Assessment	Confirmation of Facility Inventory + Review Vulnerability Assessment	City Employees	Input	Invite only	Review and comments will be included in Chapter 4.	STC must include people who are well-versed in issues for all groups
Public Meeting #1	4. Facility/Asset Inventory 5. Vulnerability Assessment	Project Overview, promote public survey, + gather feedback	Public	Education + Input	See Project Promotion	Questions and comments will be reflected in relevant HMP chapters.	Translation, in-person attendance at community organizations/ location if that is helpful for those who do not have internet access
HMPT Workshop #1	3. Hazard Profiles 4. Facility/Asset Inventory 5. Vulnerability Assessment	Overview of plan, discussion of natural hazards, asset inventory, identify vulnerabilities, review all groups who may be impacted (focusing on those with limited resources)	HMPT	Education + Input	Invite only	Information for chapters 3, 4, and 5, further information on vulnerable groups or those not accounted for	Translation as needed, ensure all groups are discussed, Create workshop environment where people feel comfortable bringing up concerns.
STC Meeting #3 (May)	5. Vulnerability Assessment 6. Mitigation Goals & Capabilities	Review Capability Assessment + Initial Mitigation Goals	City Employees	Input	Invite only	Review and comments will be included in Chapter 5.	STC must include people who are well-versed in issues for all groups

AGENDA

Work in Progress	1:00 PM
Chapter 3: Hazard Profiles	1:05 PM
Outreach and Engagement Plan	1:20 PM
Capabilities Assessment	**1:30 PM**
Next Steps	1:50 PM
Conclude	2:00 PM

CAPABILITIES ASSESSMENT

Local mitigation capabilities are existing authorities, policies, programs, and resources that reduce hazard impacts or that could be used to implement hazard mitigation activities.

Planning and Regulatory

- Plans
- Building Code, Permitting, and Inspections
- Land Use Planning and Ordinances

Administrative and Technical

- Administration
- Staff
- Technical

Financial

- Funding Resource

Education and Outreach

- Program/Organization

CAPABILITIES ASSESSMENT

Who Has Capabilities?

Agencies, stakeholders, organizations, groups, and individuals can all have capabilities.

Examples:
Sectors, Agencies and Stakeholders

- Emergency management.
- Economic development.
- Land use and development.
- Housing.
- Health and social services.
- Infrastructure (including transportation).
- Natural and cultural resources.
- Community lifelines (safety/security, food/water/shelter health/medical, energy, communications, transportation, hazardous material storage/transport/management)

Examples:
Organizations, Entities, and Groups

- All levels of government
- Faith-based organizations
- Nonprofit organizations
- Private/corporate entities
- Advocacy groups
- Community associations
- Academia
- Professional groups
- Neighbors

CAPABILITIES ASSESSMENT

Existing Capabilities & Capacity for Future Improvement

Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement 44 CFR § 201.6(c)(3))

EXISTING	Does the plan describe how the existing capabilities of each participant are available to support the mitigation strategy? Does this include a discussion of the existing building codes and land use and development ordinances or regulations?
FUTURE	Does the plan describe each participant's ability to expand and improve the identified capabilities to achieve mitigation?

Next Steps: Leila will be coordinating a survey and discussions over the coming months

AGENDA

Work in Progress	1:00 PM
Chapter 3: Hazard Profiles	1:05 PM
Outreach and Engagement Plan	1:20 PM
Capabilities Assessment	1:30 PM
Next Steps	**1:50 PM**
Conclude	2:00 PM

NEXT STEPS

Asset Inventory

Capabilities Assessment

+ Review Chapter 3 Hazard Profiles

+ Take Survey by End of Today

+ Next Meeting April 24 at 1PM

ASSET INVENTORY

Assets are determined by the community and include, but are not limited to:

People (including underserved communities and socially vulnerable populations).

Structures (including facilities, lifelines and critical infrastructure).

Systems (including networks and capabilities).

Natural, historic, and cultural resources.

Activities that have value to the community

Example Critical Facilities

- **Energy**
- **Transportation**
- **Water, wastewater, stormwater**
- **Telecommunication**
- **Emergency Response**
- **Hospitals and health care**
- **Municipal Buildings**
- **Community Resources**
- **Etc.**

Repetitive Loss Structures

Land Use Changes & Future Potential Development

Hazard Mitigation Plan Update 2023

Questions?

CITY OF CAMBRIDGE

Weston & Sampson SM

HAZARD MITIGATION PLAN 2023 UPDATE STEERING COMMITTEE MEETING #1 (MARCH) NOTES

March 27, 2023

Attendees

City of Cambridge

- Leila Mekias, CDD
- Susanne Rasmussen, CDD
- Seth Federspiel, CDD
- Catherine Woodbury, DPW
- Deputy Chief Colin Walsh, Fire Dept.
- Brian McLane, DPW
- Marlees Owayda, CDD
- Nick Stoutt, DPW
- Jim Wilcox, DPW
- Crystal Rosa, Human Rights Commission
- Nancy Rihan-Porter, CPHD

Weston & Sampson

- Robin Seidel, Project Manager
- Jennie Moonan, HMP Technical Lead

Invitees *Not* Present

- Sandra Clark, CDD
- John Nardone, DPW
- Sam Lipson, CPHD

Discussion items

Hazard Profiles

- Should Wildfire be included as a natural hazard in the plan?
    - There are concerns about brush fires around the reservoir
    - A fire could start in another area and become a risk to Cambridge
    - Limited data available for wildfires
    - Impacts include negative air quality, ash. An example of this occurred in the recent years when there was a fire in Canada.
- What about pandemic as a natural hazard?
    - Let's include introductory narrative in the chapter about the connection between pandemics and climate change but not have it be an individual hazard
    - Presently, Pub. Health has planning documents related to pandemic/flu protocols, but not coordinated with larger planning efforts in the City.

Engagement

- Focus on plain language.
- Crystal recently attended roundtable on disabilities and access – will share information. Share best practices checklist.
- Give public three weeks of notice – date on invite should be three weeks if there will be the request to accommodate for ASL. For interpretation it can be shorter (two weeks).

Goals (not on agenda – see attached for Cambridge's 2015 HMP Goals)

- Recommend removing "Identify at-risk populations and keep up to date list of locations" under Goal #1 (Protect the health and safety of the public.)
- On Goal #4 (Avoid chaos and confusion with good communication), recommend adding "improve internal communications." City's experience from COVID pandemic found that communication occurred with Department heads but in cases this information did not trickle down, such that a direct service person giving information to the public was not aware of decisions/most updated information. This applies to natural hazards as well.

Action Items

1. WSE to follow up with Leila regarding capabilities assessment
2. WSE to provide draft of Chapter 3; Leila to circulate for STC members to comment (two week comment period)
3. Leila to provide "plan language guide" to STC and WSE

Next Steering Committee Meeting Agenda (tentative)

- Overview of Work in Progress
- Endorsement of Mitigation Goals
- Presentation of Asset Inventory and review deadline
- Review of 2015 Mitigation Actions
- Next Steps

City of Cambridge
2023 Hazard Mitigation Plan Update
Public Outreach and Engagement
April 24, 2023
1:00 to 2:00 PM

STEERING COMMITTE MEETING #2: APRIL AGENDA

1:00 PM **Overview of Work in Progress**
- Project Timeline
- Tasks Underway

1:05 PM **Mitigation Goals**
- Review of FEMA Requirements
- Proposed Update Goals
- Discussion
- Follow up survey

1:20 PM **Mitigation Actions: Past**
- Review of FEMA Requirements
- Review of Past Actions List – who can provide update if not today?

1:45 PM **Outreach & HMPT Meetings**
- Public Meeting #1: Week of May 22nd 6:00 PM to 8:00 PM?
- HMPT Workshop Scheduling
- Distribution of public survey

1:55 PM **Next Steps**
- Review Chapter 3
- Take follow up survey on mitigation goals
- Support input on update on Past Mitigation Actions
- Initiate Capabilities Assessment
- Next Meeting 5/22/2023 1 to 2 PM

2:00 PM **Conclude**

Hazard Mitigation Plan Update 2023

Steering Committee Meeting #2
April 24, 2023

CITY OF CAMBRIDGE

Weston & Sampson SM

AGENDA

Work in Progress	1:00 PM
Mitigation Goals	1:05 PM
Mitigation Actions: Past	1:20 PM
Outreach & HMPT Meetings	1:45 PM
Next Steps	1:55 PM
Conclude	2:00 PM

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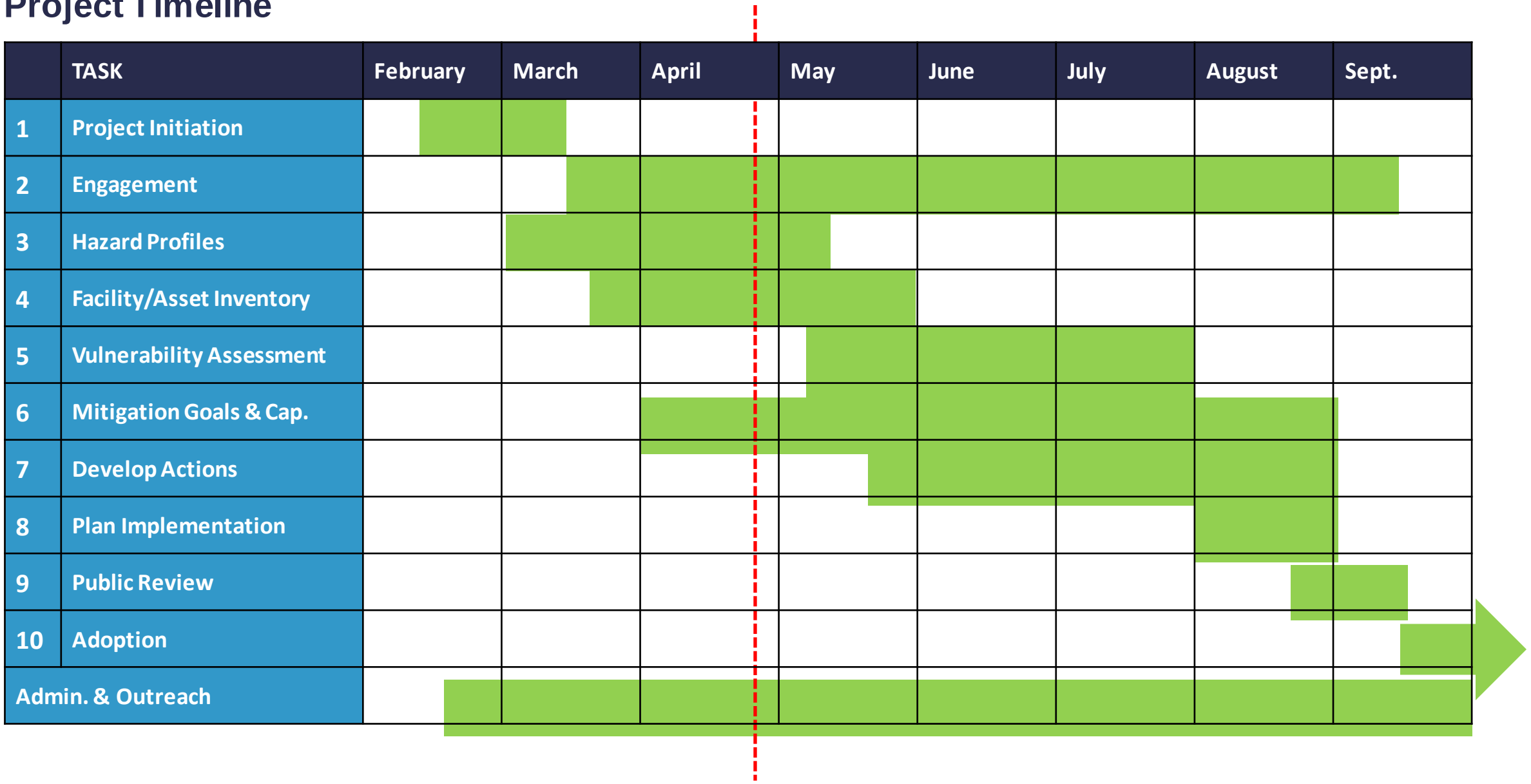
WORK IN PROGRESS

Project Timeline



WORK IN PROGRESS

Project Tasks align with the Final Document Chapters:

Task 1: Project Initiation

Task 2: Initiation of Engagement

Task 3: Hazard Profiles

Task 4: Facility/Asset Inventory

Task 5: Vulnerability Assessment

Task 6: Mitigation Goals and Capabilities

Task 7: Mitigation Actions: Past, Present, and Future

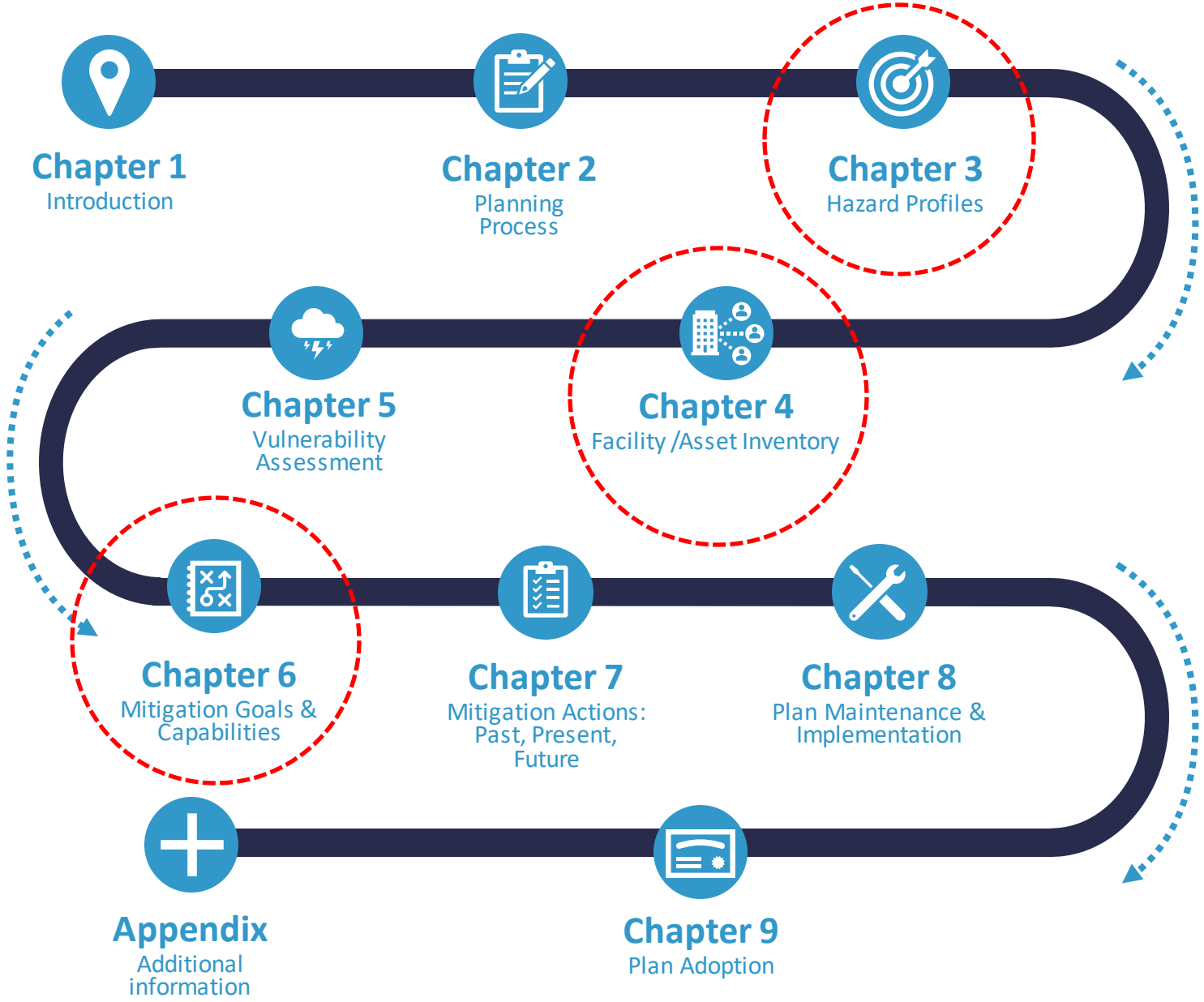
Task 8: Plan Maintenance and Implementation

Task 9: Public Review

Task 10: MEMA and FEMA Review, City Adoption

Ongoing Public Outreach

Ongoing Project Administration



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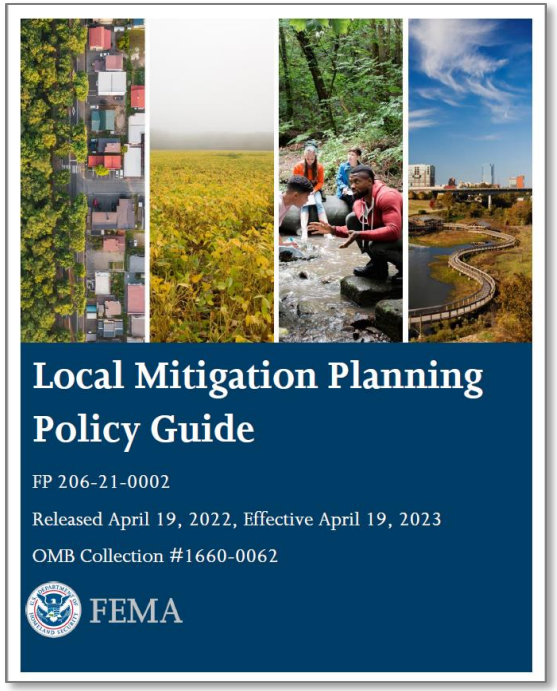
MITIGATION GOALS

FEMA Requirements



C3-a. The plan must include goals to reduce the risk of the identified hazards. The goals must be consistent with the hazards identified in the plan. Goals may be presented as general statements applying to more than one hazard, or they may be itemized to each of the identified hazards.

Goals are broad, long-term policy and vision statements that explain what is to be achieved by implementing the mitigation strategy.

MITIGATION GOALS

2015 Goals

1. Protect the health and safety of the public
2. Protect existing properties and structures
3. Ensure that essential services can function during and after a hazard event
4. Avoid chaos and confusion with good communication
5. Work regionally to mitigate impacts from natural hazards and to respond and recover from hazard events
6. Work regionally to mitigate impacts from natural hazards and to respond and recover from hazard events
7. Protect natural resources
8. Create capacity to monitor existing changes

Recommended 2023 Goals

1. Equitably ***Protect*** Health and Safety of the Community
2. Promote Public Awareness and Resilience through ***Communication***
3. ***Coordinate and Collaborate*** in Hazard Mitigation Planning and Climate Adaptation
4. ***Invest in and Plan for*** Priority Hazard Mitigation Implementation
5. Improve Capacity to ***Monitor*** Existing Changes

MITIGATION GOALS

1

Equitably ***Protect*** Health and Safety of the Community

a. Identify and reduce the health and safety impacts from hazards on vulnerable populations. <-- *from NYC HMP Goals*
b. **Provide resources for residents and businesses to make their buildings and properties more disaster resistant.**
c. **Ensure critical infrastructure, facilities, and services are protected from natural hazards** and incorporate resiliency, to facilitate efficient recovery, evacuation, public health, and safety.
d. **Ensure that future development / redevelopment does not make existing properties more vulnerable to hazards.**
e. **Identify mitigation strategies that preserve or restore the function of natural systems** and **minimize secondary impacts from hazards.**

Bold = 2015 objectives

MITIGATION GOALS

2

Promote Public Awareness and Resilience through *Communication*

a. Improve **outreach to non-English speakers and other vulnerable populations before, during and after hazard events.**
b. Encourage people to be prepared before, during and after hazard events.
c. Increase awareness and provide information for hazard mitigation and climate resilience to businesses and residents through outreach and education, including promoting community-based mitigation strategies

Bold = 2015 objectives

MITIGATION GOALS

3

Coordinate and Collaborate in Hazard Mitigation Planning and Climate Adaptation

a. Develop internal strategies to **review and update current emergency preparedness,** outreach, **and response activities to anticipate future changes in vulnerabilities.**
b. **Encourage private property-owners,** institutions, and local businesses **to implement measures to protect their own property.**
c. **Work regionally** with state, regional and federal agencies, and surrounding communities **to mitigate impacts from natural hazards and to respond and recover from hazard events.**

Bold = 2015 objectives

MITIGATION GOALS

4

Invest in and Plan for Priority Hazard Mitigation Implementation

a. **Continue to program mitigation projects in the Cambridge Capital Improvement Plans.**
b. Identify and seek funding for priority measures to mitigate or eliminate significant hazards and impacts.

Bold = 2015 objectives

MITIGATION GOALS

5 Improve Capacity to ***Monitor*** Existing Changes

a. **Identify and understand how climate change may alter where and how the City is vulnerable to natural hazards.**
b. Ensure City departments, committees, and boards have adequate data, guidance, staff, training, and equipment to respond to natural hazard events, maintain preparedness, and anticipate future changes in vulnerabilities.

Bold = 2015 objectives

MITIGATION GOALS

Please provide input in the Mitigation Goals Survey

Recommended 2023 Goals

1. Equitably ***Protect*** Health and Safety of the Community
2. Promote Public Awareness and Resilience through ***Communication***
3. ***Coordinate and Collaborate*** in Hazard Mitigation Planning and Climate Adaptation
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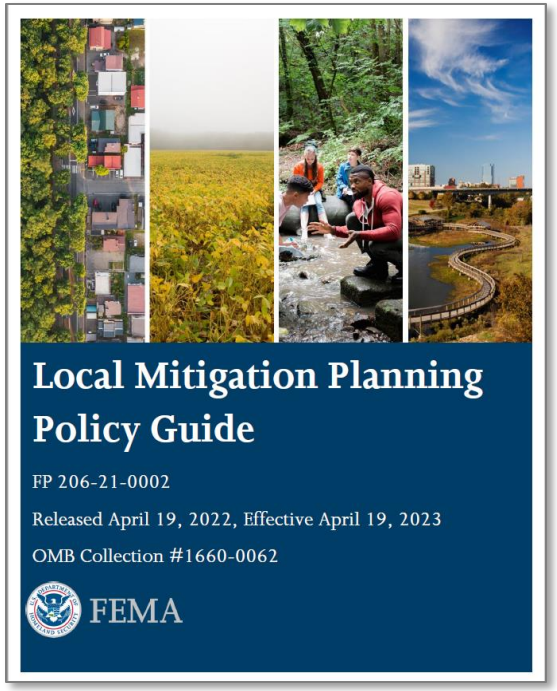
MITIGATION ACTIONS

FEMA Requirements



E2-b. The plan must describe the status of all hazard mitigation actions in the previous plan by identifying whether they have been completed or not, for each jurisdiction. For actions that are not complete, the plan must state whether the action is no longer relevant or will be included in the updated action plan.

MITIGATION ACTIONS

2015 Plan Goals

Cambridge HMP 2015 Mitigation Actions

Mitigation Action	Measure Type	Implementation Responsibility	Priority	Time Frame	Potential Funding Sources
Flood Hazard Mitigation Measures					
A) Complete hydraulic modeling for the city	Prevention	DPW	High	2014–2018	City of Cambridge
B) Complete sewer separation and stormwater management program for Kirkland Street, Myrtle Street, Magnolia Street and Cambridge Street (CAM #011, areas 18 and 19)	Structural Projects	DPW	High	2014-2016	City of Cambridge
C) Complete sewer separation and stormwater management program for areas east of Fresh Pond Pkwy (area #6) and between Concord Avenue rotaries and New Street (area #5)	Structural Projects	DPW	High	2014-2016	City of Cambridge
D) Complete sewer separation at Porter Square (CAM 002 CSO area)	Structural Projects	DPW	High	2014–2018	City of Cambridge
E) Improve collection and conveyance system at area east of 2nd Street and north of Charles Street (area #27)	Structural Projects	DPW	High	2014–2018	City of Cambridge
F) Implement additional stormwater management measures: School, Pine, Cherry and Windsor Streets (area #26)	Structural Projects	DPW	High	2014–2018	City of Cambridge
G) Complete Cambridgeport stormwater management program: Newton, Green, Franklin and Sidney Streets (CAM 017, area #28)	Structural Projects	DPW	High	2014–2018	City of Cambridge
H) Complete sewer separation and stormwater management program for Irving, Bryant, Crescent, Carver and Sacramento Streets (CAM011, areas #16 and 17)	Structural Projects	DPW	High	2014–2017	City of Cambridge
I) Complete sewer separation and stormwater management program for Ellery Street and Broadway (CAM011, area #24)	Structural Projects	DPW	High	2014–2017	City of Cambridge
J) Establish funding program for residential structural improvements and flood proofing	Prevention/ Property Protection	CDD, DPW	Medium	2016-2018	City of Cambridge, FEMA
K) Floodplain Management	Prevention	Conservation Commission	Low	2014-2018	City of Cambridge
L) Floodplain Mapping	Prevention	CDD, Conservation Commission	Low	2014-2018	City of Cambridge
Winter Storm Hazard Mitigation Measures					
M) Expand program to clear snow and maintain public ROWs (e.g., travel ways for non-vehicular mobility and access for vulnerable populations)	Prevention	DPW	Medium	2014-2018	City of Cambridge, DCR, MassDOT
Geologic Hazard Mitigation Measures					
N) Determine vulnerability of roadways and utilities to earthquakes in the high liquefaction areas	Prevention	EMD, DPW, Inspectional Services	Medium	2016-2018	City of Cambridge
Extreme Temperature Mitigation Measures					
O) Provide facility for additional vulnerable populations during extreme temperature event	Prevention/ Public Education & Awareness	DHSP, EMD	Medium	2014-2016	City of Cambridge
Wind Mitigation Measures					
P) Increase public education on the benefits and proper care of trees on private property	Public Education & Awareness	Inspectional Services, EMD	Low	2015-2017	City of Cambridge, MEMA
Climate Change Mitigation Measures					
Q) Complete Climate Change Vulnerability Assessment	Prevention	CDD	High	2014	City of Cambridge
R) Complete Climate Change Adaptation Plan	Prevention	CDD	High	2014-2015	City of Cambridge, EOEEA
S) Encourage installation of solar photovoltaic systems, cogeneration, and other energy supplies	Prevention	CDD	Low	2014-2017	City of Cambridge
T) Encourage energy efficiency in buildings through zoning requirements and community outreach	Prevention	CDD	Low	2014-2017	City of Cambridge
Other Hazard Mitigation Measures					
U) Evacuation Protocol Review	Emergency Services Protection	EMD	High	2015-2016	City of Cambridge
V) Develop program for enhanced staffing for disaster recovery	Prevention/ Emergency Services Protection	Inspectional Services, CPHD	Medium	2014-2016	City of Cambridge

MITIGATION ACTIONS

Who can provide updates?

24 Past Mitigation Actions:

12 Flood Hazard Mitigation Measures	**4** Climate Change Mitigation Measures	**4** Other Hazard Mitigation Measures

1 Geologic Hazard Mitigation Measure	**1** Extreme Temperature Mitigation Measure	**1** Wind Mitigation Measure	**1** Winter Storm Hazard Mitigation Measure

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PUBLIC MEETING #1

Public Stakeholders Outreach

Date	Week of May 22
Time	6PM – 8PM
Format	Hybrid

STC not required to attend

Any concerns with this plan?

HMPT WORKSHOP

HMPT
Workshop
Logistics Survey

Public

Stakeholders

Outreach

JUNE

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

JULY

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

AUGUST

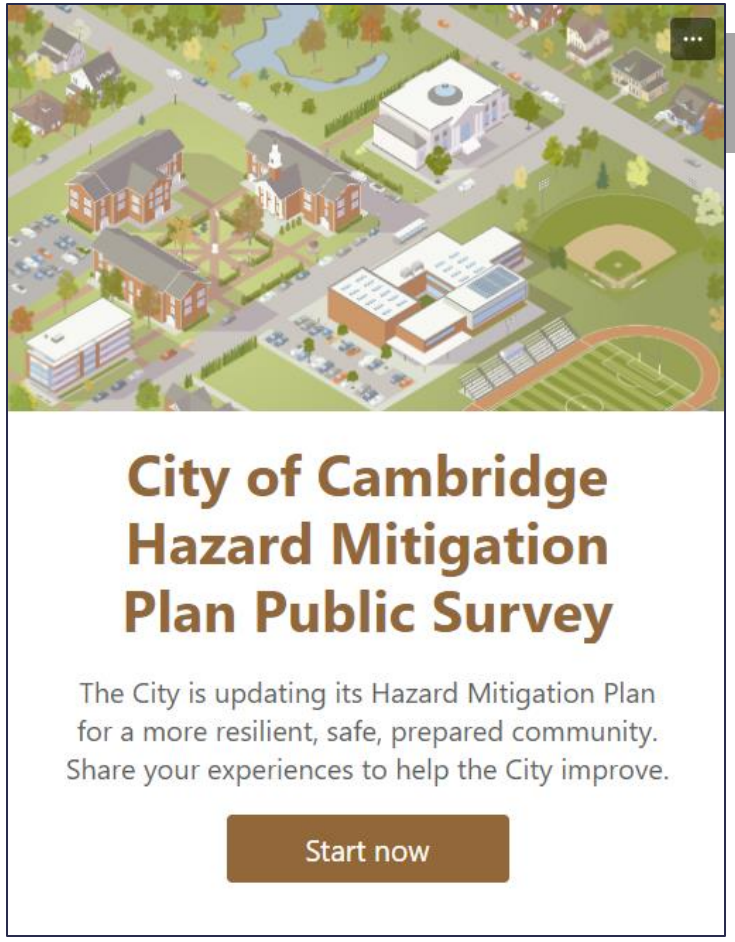
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

PUBLIC SURVEY

Public Stakeholders Outreach

Promotional Material

Survey Preview



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NEXT STEPS

Take Follow Up Survey
Mitigation Goals

Support Input on Past
Mitigation Actions

+ Review Chapter 3 Hazard Profiles

+ Initiate Capabilities Assessment

+ Next Meeting May 22 at 1PM

Hazard Mitigation Plan Update 2023

Questions?

CITY OF CAMBRIDGE

Weston & Sampson SM

HAZARD MITIGATION PLAN 2023 UPDATE STEERING COMMITTEE MEETING #2 (APRIL) NOTES

April 24, 2023

Attendees

City of Cambridge

- Leila Mekias, CDD
- Susanne Rasmussen, CDD
- Anthony Tuccinardi, CISD
- Catherine Woodbury, DPW
- Deputy Chief Colin Walsh, Fire Dept.
- Jeremiah Hart
- Marlees Owayda, CDD
- Brian McLane
- Jacob Lazzara, CISD
- Jim Wilcox, DPW
- Julie Torelli-Greenwood, CWD
- Crystal Rosa, Human Rights Commission
- Mark Gallagher, CWD
- Sam Lipson, CPHD
- Vedad Konjic, CPS Facilities

Weston & Sampson

- Robin Seidel, Project Manager
- Emily Judson, Resiliency Planner

Discussion items

Overview of Work in Progress

- Work on chapters 3, 4, and 6 has started.
    - Chapter 3: Hazard Profiles is under internal review and will be sent to the STC soon for comments and review.
    - Chapter 4: Facility/Asset Inventory has also been started. W&S to send RFI for critical asset inventory layers from Kleinfelder from Resilient Cambridge and CCVA. C
    - Chapter 5: Mitigation Goals & Capabilities started with the materials and information presented today at the meeting.
- Capabilities assessment needs to start as soon as possible.

Mitigation Goals Update

- Consolidate the 2015 eight (8) goals into five (5) goals

    - Add emphasis of equity
    - Shorter and communicable to public
    - Plain language easy to understand
    - Hit on five important terms for HMPs:
        - Protect
        - Communicate
        - Coordinate/collaborate
        - Invest/Plan
        - Monitor
    - Used prior objectives where reasonable, added objectives from other resources, and consolidated many objectives

- ***Follow up: Mitigation Goals Survey and provide feedback on new revised goals***

2015 HMP Mitigation Actions:

- Discussion of FEMA Requirements
    - Discussion of the definition of Critical Facilities. W&S will look into if FEMA's definition is flexible and can be expanded upon.
        - Suggestion to request input from residents on critical assets at public meeting.
    - Discussion of the distinction between actions related to extreme hazard categories and distinct Climate Change Mitigation Actions.
        - Outcome: climate change mitigation actions were broader and related to mitigation of emissions or citywide adaptation planning
    - The group discussed the status of the 2015 HMP actions for a table to be included in the final report and added comments for how to expand, clarify, or remove in next plan.
        - The spreadsheet will be shared around to fill out the last remaining action status

Outreach & HMPT Meetings

- Public Meeting #1: Week of May 22nd 6:00 PM to 8:00 PM
    - Public overview of the project and opportunity for input, questions, concerns.
    - This meeting will be hybrid
    - **Follow up:** *Who books this date on the City calendar and how will it be advertised?*

- HMPT Workshop Scheduling
    - **Follow up: HMPT Survey**

    - **Follow up Questions** (can answer in the survey):
        - *Are there dates/times that don't work?*
        - *Are there formats that work better for people (hybrid/online/in person)?*
        - *Are we missing any questions on the HMPT Survey for invitees?*
        - *Are you available to help facilitate in person?*

- Distribution of Public Survey
    - **Follow up ask:** *What are best practices for print distribution and promotion, especially for ongoing survey participation?*

Action Items

1. STC to Review Chapter 3
2. Send Mitigation Goals Survey to STC
3. Send **HMPT Survey** to STC
4. Send Follow Up Questions to STC
5. Leila to Initiate Capabilities Assessment

Next Steering Committee Meeting Agenda (tentative)

- Overview of Work in Progress
- Capabilities Assessment
- Asset Inventory
- Public Meeting Debrief
- HMPT Workshop Preparation
- Next Steps

City of Cambridge
2023 Hazard Mitigation Plan Update
Steering Committee Meeting
May 22, 2023
1:00 to 2:00 PM

STEERING COMMITTE MEETING #3: MAY

AGENDA

1:00 PM **Overview of Work in Progress**
- Project Timeline
- Tasks Underway

1:05 PM **Hazard Mitigation Goals**
- Final approval

1:15 PM **Capabilities Assessment**
- Review of Survey Questions
- Discussion

1:30 PM **Asset Inventory**
- Review of FEMA Requirements
- Review inventory to date
- Process for updates

1:50 PM **Outreach & HMPT Meetings**
- Public Meeting #1 booked June 13, 2023, 6:00 PM
- HMPT workshops - scheduling in progress

1:55 PM **Next Steps**
- Distribute Capabilities Assessment
- Provide input on Asset Inventory
- Next Meeting 6/26/2023 1 to 2 PM

2:00 PM **Conclude**

Hazard Mitigation Plan Update 2023

Steering Committee Meeting #3

May 22, 2023

CITY OF CAMBRIDGE

Weston & Sampson SM

AGENDA

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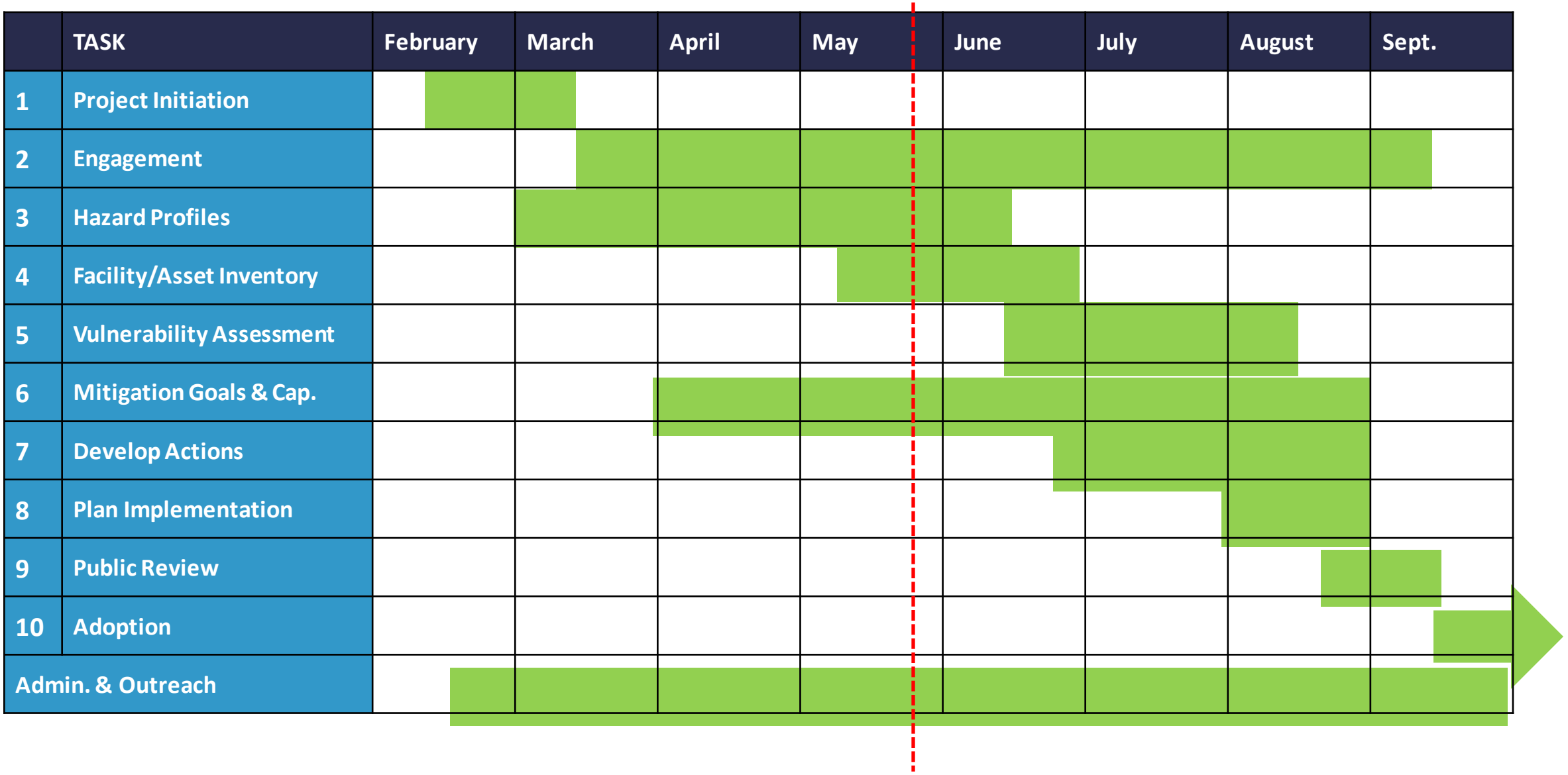
WORK IN PROGRESS

Project Timeline



WORK IN PROGRESS

Project Tasks align with the Final Document Chapters:

Task 1: Project Initiation

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Task 5: Vulnerability Assessment

Task 6: Mitigation Goals and Capabilities

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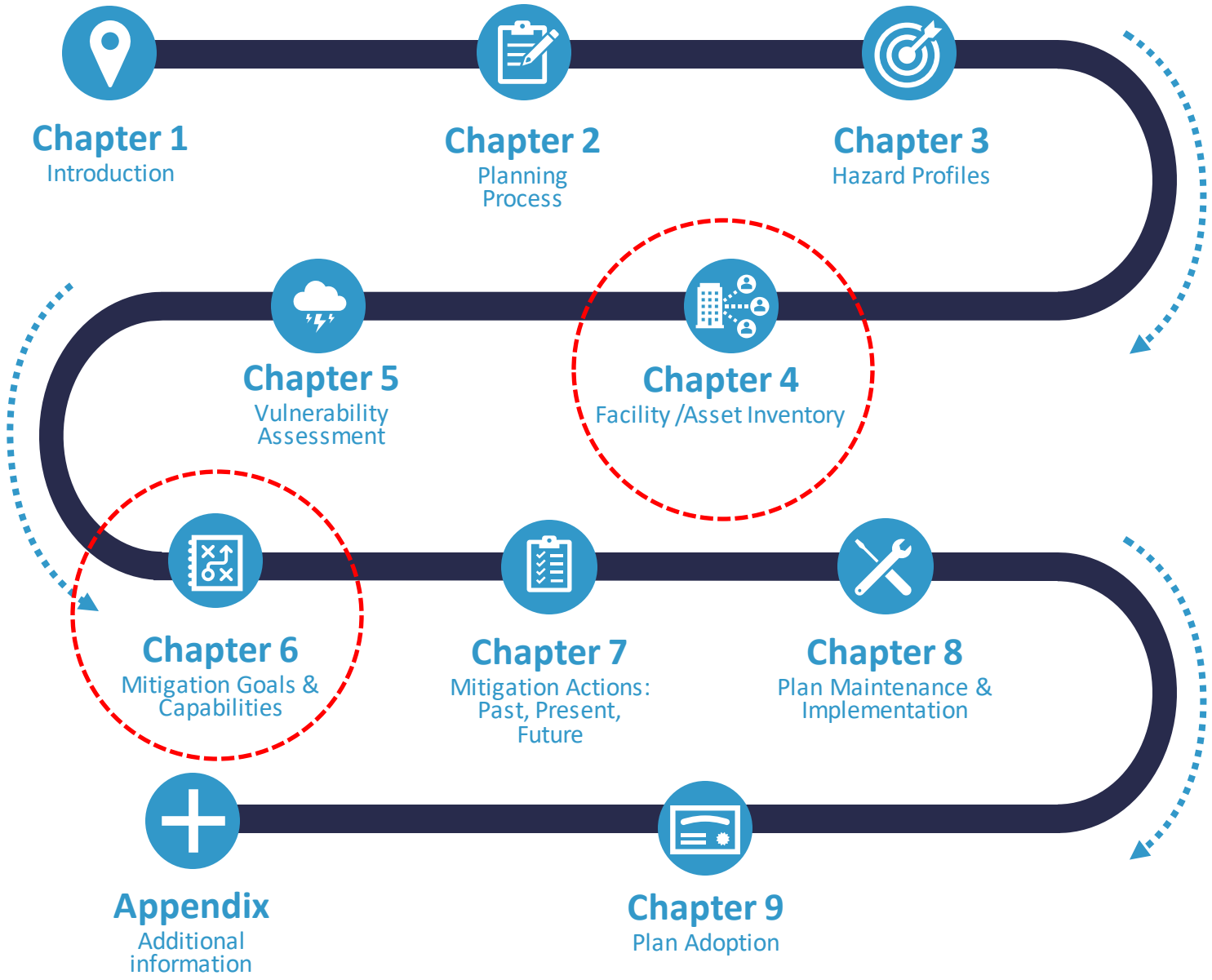
Ongoing Public Outreach

Ongoing Project Administration



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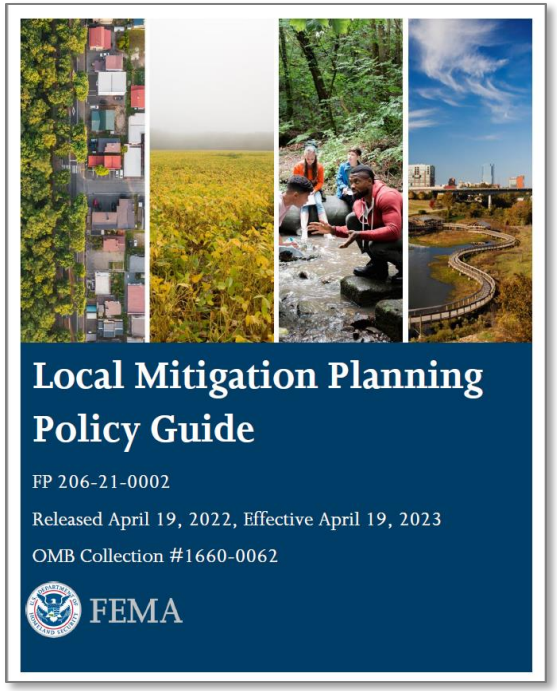
MITIGATION GOALS

FEMA Requirements



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Goals are broad, long-term policy and vision statements that explain what is to be achieved by implementing the mitigation strategy.

MITIGATION GOALS

Vote with Slido to endorse goals

Discussion welcome

Recommended 2023 Goals

1. Equitably ***Protect*** Health and Safety of the Community
2. Promote Public Awareness and Resilience through ***Communication***
3. ***Coordinate and Collaborate*** in Hazard Mitigation Planning and Climate Adaptation
4. ***Invest in and Plan for*** Priority Hazard Mitigation Implementation
5. Improve Capacity to ***Monitor*** Existing Changes

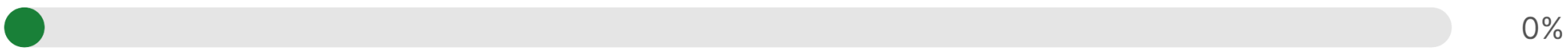
Do you endorse Mitigation Goal #1? Equitably Protect Health and Safety of the Community

Multiple Choice Poll | 8 votes | 8 participants

Yes - 8 votes

No - 0 votes

Propose an edit - 0 votes



slido

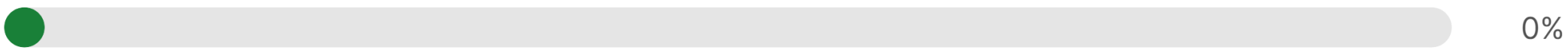
Do you endorse Mitigation Goal #2? Promote Public Awareness and Resilience through Communication

Multiple Choice Poll | 8 votes | 8 participants

Yes - 8 votes

No - 0 votes

Propose an edit - 0 votes



slido

Do you endorse Mitigation Goal #3? Coordinate and Collaborate in Hazard Mitigation Planning and Climate Adaptation

Multiple Choice Poll | 9 votes | 9 participants

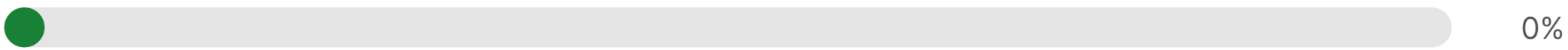
Yes - 8 votes

89%

No - 1 vote

11%

Propose an edit - 0 votes



0%

slido

Do you endorse Mitigation Goal #4? Invest in and Plan for Priority Hazard Mitigation Implementation

Multiple Choice Poll | 8 votes | 8 participants

Yes - 7 votes

88%

No - 0 votes

0%

Propose an edit - 1 vote

13%

slido

Do you endorse Mitigation Goal #5? Improve Capacity to Monitor Existing Changes

Multiple Choice Poll | 5 votes | 5 participants

Yes - 4 votes

No - 1 vote

Propose an edit - 0 votes

MITIGATION GOALS

2023 HMP goals endorsed by Steering Committee

1. Equitably ***Protect*** Health and Safety of the Community
2. Promote Public Preparedness and Resilience through ***Communication***
3. ***Coordinate and Collaborate*** among City Departments and with Community Partners on Hazard Mitigation Planning and Climate Adaptation
4. ***Plan for and Sustainably Invest in*** Priority Hazard Mitigation Implementation
5. Improve Capacity to ***Monitor*** Natural Hazards and ***Respond*** to Changes

AGENDA

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CAPABILITIES ASSESSMENT

FEMA Requirement

Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement 44 CFR § 201.6(c)(3))

EXISTING

Does the plan describe how the existing capabilities of each participant are available to support the mitigation strategy? Does this include a discussion of the existing building codes and land use and development ordinances or regulations?

FUTURE

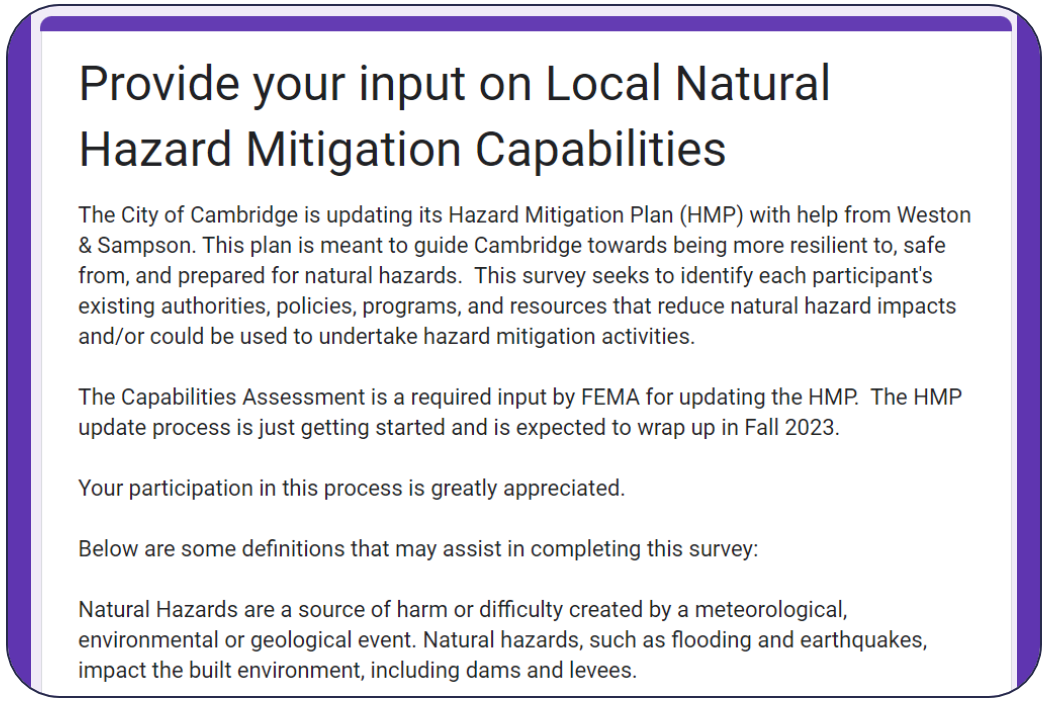
Does the plan describe each participant's ability to expand and improve the identified capabilities to achieve mitigation?

CAPABILITIES ASSESSMENT

Survey

Agencies, stakeholders, organizations, groups, and individuals can all have capabilities.

Survey Screenshot



Provide your input on Local Natural Hazard Mitigation Capabilities

The City of Cambridge is updating its Hazard Mitigation Plan (HMP) with help from Weston & Sampson. This plan is meant to guide Cambridge towards being more resilient to, safe from, and prepared for natural hazards. This survey seeks to identify each participant's existing authorities, policies, programs, and resources that reduce natural hazard impacts and/or could be used to undertake hazard mitigation activities.

The Capabilities Assessment is a required input by FEMA for updating the HMP. The HMP update process is just getting started and is expected to wrap up in Fall 2023.

Your participation in this process is greatly appreciated.

Below are some definitions that may assist in completing this survey:

Natural Hazards are a source of harm or difficulty created by a meteorological, environmental or geological event. Natural hazards, such as flooding and earthquakes, impact the built environment, including dams and levees.

[Screenshare of Capabilities Assessment]

Survey Being Distributed to the following

- Assessing
- Budget
- Fire
- Police
- City Clerk's Office
- City Manager's Office
- Commission on Persons with Disabilities
- Commission on Immigrant Rights and Citizenship
- Community Development (CDD)
- Community Safety
- Electrical
- Emergency Communications
- Equity and Inclusion
- Finance
- Historical Commission
- Human Rights Commission
- Human Service Programs
- Information Technology
- Inspectional Services
- LGBTQ+ Commission
- Peace Commission
- Public Health
- Public Schools
- Public Works
- Traffic, Parking, and Transportation (TPT)
- Veterans' Services
- Water Department
- Women's Commission

AGENDA

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Asset Inventory	**1:30 PM**
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Asset Inventory

FEMA Requirements

Provide a description of which assets, including structures, systems, populations and other assets as defined by the community, within locations identified to be hazard prone, are at risk from the effects of the identified hazard(s).

Assets are determined by the community and include, but are not limited to:

- People (including underserved communities and socially vulnerable populations).
- Structures (including facilities, lifelines and critical infrastructure).
- Systems (including networks and capabilities).
- Natural, historic, and cultural resources.
- Activities that have value to the community

ASSET INVENTORY

Previous Asset inventory obtained from:

- Climate Change Vulnerability Assessment (CCVA) Report - Part 1 (November 2015)
- Climate Change Vulnerability Assessment (CCVA) Report - Part 2 (February 2017)

Previous Asset Inventory:

Upcoming Asset Inventory:

Re-organize and update: add, delete, modify

Review who in the City can support this effort for each sub-category

AGENDA

Work in Progress	1:00 PM
Mitigation Goals	1:05 PM
Capabilities Assessment	1:15 PM
Asset Inventory	1:30 PM
Outreach & HMPT Meetings	**1:50 PM**
Next Steps	1:55 PM
Conclude	2:00 PM

PUBLIC MEETING #1

Public | Stakeholders | Outreach

Date	June 13
Time	6PM – 7PM
Format	Virtual

STC not required to attend

A recording with subtitles in all languages will be posted on the website afterwards

AGENDA

Work in Progress	1:00 PM
Mitigation Goals	1:05 PM
Capabilities Assessment	1:15 PM
Asset Inventory	1:30 PM
Outreach & HMPT Meetings	1:50 PM
Next Steps	**1:55 PM**
Conclude	2:00 PM

NEXT STEPS

Take Capabilities Assessment Survey

Support Input on Asset Inventory

+ Public Meeting on June 13th

+ HMPT Workshop Dates TBD

+ Next Meeting June 26 at 1PM

Hazard Mitigation Plan Update 2023

Questions?

CITY OF CAMBRIDGE

Weston & Sampson SM

HAZARD MITIGATION PLAN 2023 UPDATE STEERING COMMITTEE MEETING #3 (MAY) NOTES

May 22, 2023

Attendees

City of Cambridge

- Leila Mekias, CDD
- Susanne Rasmussen, CDD
- Catherine Woodbury, DPW
- Deputy Chief Colin Walsh, Fire Dept.
- Jeremiah Hart, Fire Dept.
- Brian McLane, DPW
- Jacob Lazzara, CISD
- Jim Wilcox, DPW
- Julie Torelli-Greenwood, CWD
- Crystal Rosa, Human Rights Commission
- Sam Lipson, CPHD
- Vedad Konjic, CPS Facilities
- Nancy Porter, CPHD

Weston & Sampson

- Robin Seidel, Project Manager
- Jennie Moonan, HMP Technical Lead
- Emily Judson, Resiliency Planner

Discussion items

Overview of Work in Progress

- Hazard Profiles (Chapter 3) wrapping up
- Facility / Asset Inventory just initiated (Chapter 4)
- Vulnerability Assessment (Chapter 5) next month
- Mitigation Goals to be completed today, Capabilities Assessment ongoing
- Mitigation Actions – initiate discussion at next month's meeting

Mitigation Goal Endorsement

- Voting via slido and discussion:
    - **Goal #1:**
        - Proposed Goal: Equitably Protect Health and Safety of the Community

        - Full endorsement (8 votes)
    - **Goal #2:**
        - Proposed Goal: Promote Public Awareness and Resilience through Communication
        - Edit: change “awareness” to “*preparedness*”
        - Final Goal: Promote Public Preparedness and Resilience through Communication
        - Full endorsement after edit (8 votes)
    - **Goal #3:**
        - Proposed Goal: Coordinate and Collaborate in Hazard Mitigation Planning and Climate Adaptation
        - Edit: coordinate and collaborate *among city departments and with community partners*
        - Final Goal: Coordinate and Collaborate among City Departments and with Community Partners on Hazard Mitigation Planning and Climate Adaptation
        - Full endorsement after edit (9 votes)
    - **Goal #4:**
        - Proposed Goal: Invest in and Plan for Priority Hazard Mitigation Implementation
        - Edit: *Sustainably* invest
        - Edit: Plan for and sustainably invest in (switch order from original)
        - Final Goal: Plan for and Sustainability Invest in Priority Hazard Mitigation Implementation
        - Full endorsement after edit (8 votes)
    - **Goal #5:**
        - Proposed Goal: Improve Capacity to Monitor Existing Changes
        - Edit: remove “existing”
        - Edit: monitor and *respond to* emerging changes
        - Edit: Improve capacity to monitor natural hazards and respond to changes
        - Final Goal: Improve Capacity to Monitor Natural Hazards and Respond to Changes
        - Full endorsement after edit (5 votes)

Capabilities Assessment:

- Explanation and presentation of Capabilities Assessment Survey
- Comment on the Plan Questions: clarify in survey that we want Department-specific plans and that the HMP will bring those plans together

- Discussion regarding mutual aid: there is a lot of mutual aid. Provide clarification on what need and create more space (or another question) for answer.
- Note: a new department was just created to manage building renovation (to be added to the list)
- Make departments multiple choice in survey
- Leila to send the survey to the group for comment
- Leila, WSE, and the STC to review the list of City departments listed and confirm who should receive survey

Asset Inventory:

- Discussion about activities:
    - Activities include community-building events (i.e., Porchfest), they create social resiliency, community cohesion, and practice in emergency logistical planning.
    - Put bikeshare and bike paths under Systems
    - Change activities to actual actions (i.e., swimming)
    - Best way to input on activities is to
        - Look at City Calendar as starting point
        - TPT has special events calendar, can get filtered list from Brooke McKenna
        - Get input on privately organized community events during HMPTs
- Leila to send spreadsheet to STC for comment

Outreach & HMPT Meetings

- Public Meeting #1: June 13, 2023 - 6:00 PM to 7:00 PM
    - Public overview of the project and opportunity for input on how natural hazards affect the community, questions, concerns.
    - This meeting will be virtual
    - Leila to coordinate outreach

- WSE to send workplan documenting schedule for duration of project
    - Note: September 11, 18, 25 are City Council meetings for vote
    - HMP will probably be on the meeting on the 18th
    - Last HMP public meetings are planned for September right after the holiday

- HMPT list need input from STC on contact information and organizations/categories that are missing. Leila sent to STC on 5/22/2023.

Action Items

1. Leila/WSE to send the Capabilities Assessment survey to STC for comment and/or completion
2. Leila/WSE to send Asset Inventory spreadsheet to STC for comment
3. STC to provide input on HMPT list Leila to STC for input
4. STC to send comments on the above action items
5. Weston & Sampson to send City Council meeting information including vote language

Next Steering Committee Meeting Agenda (tentative)

- Overview of Work in Progress
- Asset Inventory – last questions and outstanding items
- Preliminary Mitigation Actions
- Public Meeting Debrief
- HMPT Workshop Preparation

City of Cambridge
2023 Hazard Mitigation Plan Update
Steering Committee Meeting
June 26, 2023
1:00 to 2:00 PM

STEERING COMMITTE MEETING #4: JUNE AGENDA

1:00 PM **Overview of Work in Progress**

- Project Timeline
- Tasks Underway
- Questions on ongoing input & reviews requested?

1:10 PM **Outreach & HMPT Meetings**

- Public Meeting #1 June 13, 2023, 6:00 PM completed
- HMPT Workshop #1: June 29, 2023 10:00 AM to 11:30 AM
- HMPT Workshops 2 & 3

1:15 PM **Mitigation Actions**

1:40 PM **Plan Evaluation and Maintenance (if time allows)**

1:55 PM **Next Steps**

- Next Meeting 7/24/2023 1 to 2 PM
- Provide input on requested items

2:00 PM **Conclude**

Hazard Mitigation Plan Update 2023

Steering Committee Meeting #4

June 26, 2023

CITY OF CAMBRIDGE

Weston & Sampson SM

AGENDA

Work in Progress	1:00 PM
Outreach & HMPT Meetings	1:05 PM
Mitigation Actions	1:15 PM
Plan Maintenance (if time allows)	1:30 PM
Next Steps	1:55 PM
Conclude	2:00 PM

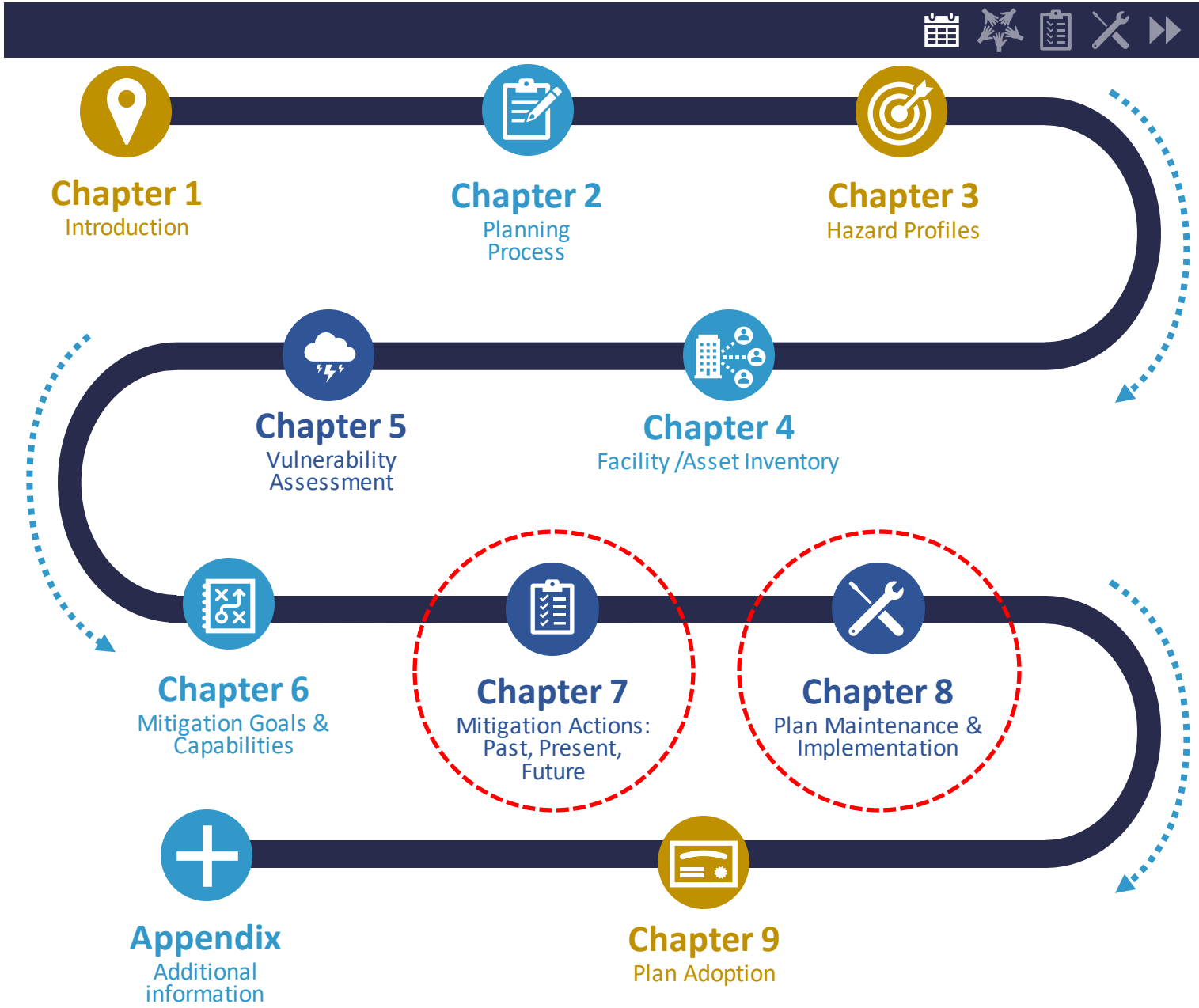
AGENDA

Work in Progress	1:00 PM
Outreach & HMPT Meetings	1:05 PM
Mitigation Actions	1:15 PM
Plan Maintenance (if time allows)	1:30 PM
Next Steps	1:55 PM
Conclude	2:00 PM

WORK IN PROGRESS

Project Tasks align with the Final Document Chapters:

- ~~**Task 1:** Project Initiation~~
- **Task 2:** Initiation of Engagement
- **Task 3:** Hazard Profiles
- **Task 4:** Facility/Asset Inventory
- **Task 5:** Vulnerability Assessment
- **Task 6:** Mitigation Goals and Capabilities
- **Task 7:** Mitigation Actions: Past, Present, and Future
- **Task 8:** Plan Maintenance and Implementation
- **Task 9:** Public Review
- **Task 10:** MEMA and FEMA Review, City Adoption
- **Ongoing** Public Outreach
- **Ongoing** Project Administration

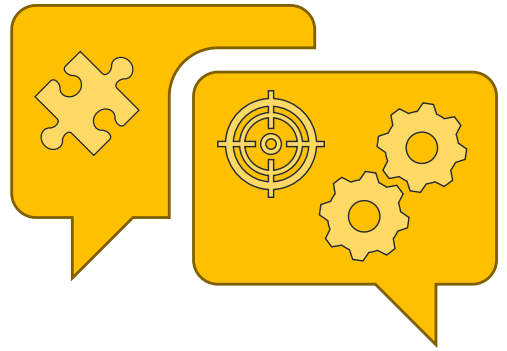


Draft Submitted to City **In-progress** **Not Started**

AGENDA

Work in Progress	1:00 PM
Outreach & HMPT Meetings	1:05 PM
Mitigation Actions	1:15 PM
Plan Maintenance (if time allows)	1:30 PM
Next Steps	1:55 PM
Conclude	2:00 PM

OUTREACH + HMPT MEETINGS



Public Meeting #1

June 13, 2023
Completed

HMPT Workshop #1

June 29, 2023
10 AM – 11:30 AM

Asset Inventory

HMPT Workshop #2

July 11, 2023
6 PM – 7:30 PM

Mitigation Actions

HMPT Workshop #3

July 25, 2023
4 PM – 5:30 PM

Final Feedback

AGENDA

Work in Progress	1:00 PM
Outreach & HMPT Meetings	1:05 PM
Mitigation Actions	**1:15 PM**
Plan Maintenance (if time allows)	1:30 PM
Next Steps	1:55 PM
Conclude	2:00 PM

MITIGATION ACTION CATEGORIES

PREVENTATIVE

1. **Preventive** activities keep flood problems from getting worse. The use and development of flood-prone areas is limited through planning, land acquisition, or regulation. They are usually administered by building, zoning, planning, and/or code enforcement offices.

- Floodplain mapping and data
- Open space preservation
- Floodplain regulations
- Erosion setbacks
- Planning and zoning
- Stormwater management
- Drainage system maintenance
- Building codes

PROPERTY PROTECTION

2. **Property protection** activities are usually undertaken by property owners on a building-by-building or parcel basis.

- Relocation
- Acquisition
- Building elevation
- Retrofitting
- Sewer backup protection
- Insurance

MITIGATION ACTION CATEGORIES

NATURAL RESOURCE PROTECTION

3. **Natural resource protection** activities preserve or restore natural areas or the natural functions of floodplain and watershed areas. They are implemented by a variety of agencies, primarily parks, recreation, or conservation agencies or organizations.

- Wetlands protection
- Erosion and sediment control
- Natural area preservation
- Natural area restoration
- Water quality improvement
- Coastal barrier protection
- Environmental corridors
- Natural functions protection

EMERGENCY SERVICES

4. **Emergency services** measures are taken during an emergency to minimize its impact. These measures are usually the responsibility of city or county emergency management staff and the owners or operators of major or critical facilities.

- Hazard threat recognition
- Hazard warning
- Hazard response operations
- Critical facilities protection
- Health and safety maintenance
- Post-disaster mitigation actions

MITIGATION ACTION CATEGORIES

STRUCTURAL PROJECTS

5. **Structural projects** keep flood waters away from an area with a levee, reservoir, or other flood control measure. They are usually designed by engineers and managed or maintained by public works staff.

- Reservoirs
- Levees/floodwalls
- Diversions
- Channel modifications
- Storm drain improvements

PUBLIC INFORMATION

6. **Public information** activities advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards, and the natural and beneficial functions of local floodplains. They are usually implemented by a public information office.

- Map information
- Outreach projects
- Real estate disclosure
- Library
- Technical assistance
- Environmental education

MITIGATION ACTIONS

Mitigation Action	Hazard Addressed	Implementation Responsibility / Department	Priority (low/med/high)

AGENDA

Work in Progress	1:00 PM
Outreach & HMPT Meetings	1:05 PM
Mitigation Actions	1:15 PM
Plan Maintenance (if time allows)	**1:30 PM**
Next Steps	1:55 PM
Conclude	2:00 PM

PLAN MAINTENANCE

Roles and Responsibilities

Who in the City is responsible for ***leading*** monitoring and maintenance of the HMP?

Responsibilities include:

- Tracking the progress of the plan
- Sharing this progress with the public
- Making monitoring information publicly available
- Notifying the public when new information has been posted or updated
- Providing the public with opportunities to give input on this information

PLAN MAINTENANCE

Roles and Responsibilities

Who in the City will ***participate*** in monitoring and maintenance of the HMP?

Responsibilities include:

- Supporting tracking the progress of the plan
- Supporting sharing this progress with the public
- Making monitoring information publicly available
- Notifying the public when new information has been posted or updated
- Providing the public with opportunities to give input on this information

PLAN MAINTENANCE

Roles and Responsibilities

With what ***frequency*** will this group meet and append the Plan?

Examples:

- Monthly
- Quarterly
- Yearly

Efficiency:

- Combine with another regularly scheduled meeting?

PLAN MAINTENANCE

Roles and Responsibilities

How will the City ***continue*** to seek public participation ***after*** the plan has been approved and ***during*** the plan's implementation?

The plan may contain a narrative description or an itemized list of steps, demonstrating the prescribed method that will be followed to obtain future public participation.

Special consideration should be given to identifying and using unique and meaningful ways to keep the public engaged in the process.

Examples include, but are not limited to: periodic presentations on the plan's progress to elected officials, schools or other community groups; annual questionnaires or surveys; public meetings; postings on social media; and interactive websites.

PLAN MAINTENANCE

Roles and Responsibilities

If time allows: How will each participant ***integrate information*** from the mitigation strategy into their identified ***planning mechanisms***?

Integrate means to include hazard mitigation principles, vulnerability information and mitigation actions into other existing community planning to leverage activities that have co-benefits, reduce risk and increase resilience. Planning mechanisms refers to the governance structures used to manage local land use development and community decision-making, such as budgets, comprehensive plans, capital improvement plans, economic development strategies, climate action plans or other long-range plans.

AGENDA

Work in Progress	1:00 PM
Outreach & HMPT Meetings	1:05 PM
Mitigation Actions	1:15 PM
Plan Maintenance (if time allows)	1:30 PM
Next Steps	**1:55 PM**
Conclude	2:00 PM

NEXT STEPS

Capabilities Assessment

Start Reviewing Chapters

+ Provide input on requested items

+ HMPT Workshop Thursday at 10 AM

+ Next Meeting July 24 at 1PM

Hazard Mitigation Plan Update 2023

Questions?

CITY OF CAMBRIDGE

Weston & Sampson SM

HAZARD MITIGATION PLAN 2023 UPDATE STEERING COMMITTEE MEETING #4 (JUNE) NOTES

June 26, 2023

Attendees

City of Cambridge

- Leila Mekias, CDD
- Susanne Rasmussen, CDD
- Catherine Woodbury, DPW
- Jeremiah Hart, Fire Dept.
- Jim Wilcox, DPW
- Nancy Porter, CPHD
- Mark Gallagher
- Rachel Tenanhaus

Weston & Sampson

- Robin Seidel, Project Manager
- Jennie Moonan, HMP Technical Lead
- Emily Judson, Resiliency Planner

Presentation

- Work in progress
  - Robin reviewed status of each chapter (see slide)

- Outreach & HMPT Meetings
  - HMPT Workshop #1: June 29, 2023 – 10 AM – 11:30 AM
  - HMPT Workshop #2: July 11, 2023 – 6 PM – 7:30 PM
  - HMPT Workshop #3: July 11, 2023 – 4 PM – 5:30 PM

- Mitigation Actions
  - Jennie reviewed “what are mitigation actions” (see slides)

- Plan Maintenance
  - Discussion notes below

Discussion items

Mitigation Actions

See Spreadsheet *2023.06.26 Draft STC Generated Mitigation Actions* (attached)

What is the HMP Action Commitment?

- The City is committing to working on it within the next 5 years, but there are also opportunities to amend that commitment and there is no penalty if the action is not completed

Will this help projects get funding?

- The HMP will make these actions eligible for FEMA funding
- May help support case to obtain other sources of funding, too

Should we include actions that are joint ventures with other communities?

- We should prioritize projects that the City has full control of

Plan Maintenance: Roles & Responsibilities

Who in the City is responsible for leading monitoring and maintenance of the HMP?

- New Hazard Mitigation (?) Manager who is currently be hired at City Manager's office (hiring in progress)

Who in the City will participate in monitoring and maintenance of the HMP?

- Same Departments as STC

With what frequency will this group meet and append the Plan?

Thoughts:

- Combine it with other regularly scheduled program meetings
- It could be part of STC for Resilient Cambridge Plan meetings
- Quarterly

Final Decision:

- Yearly

How will the City continue to seek public participation after the plan has been approved and during the plan's implementation?

- What is the process to modify the plan? That's when we'd want to have a public process

    - Committee will make updates at any time, updates don't need to be certified by City Council, and that group could decide if/how/when to have a public process around that modification
- Could be that we will update the StoryMap throughout the process and notify people? Yes
- Incorporate feedback opportunities that are more fun and concrete and/or integrate into an existing set City process

If time allows: How will each participant integrate information from the mitigation strategy into their identified planning mechanisms?

- Ran out of time – return to this next meeting

Action Items

- Follow up with Susanne about Capabilities Assessment (WSE)
- HMPT Workshops - attend
- City to Review Chapters provided

Next Steering Committee Meeting Agenda (tentative)

- Overview of Work in Progress
- Working session on asset inventory
- Review initial mitigation list
- Discuss final HMPT workshop
- Chapter Reviews

City of Cambridge
2023 Hazard Mitigation Plan Update
Steering Committee Meeting
July 24, 2023
1:00 to 2:00 PM

STEERING COMMITTE MEETING #5: JULY

AGENDA

1:00 PM **Overview of Work in Progress**

- Tasks Underway
- Remaining timeline & meetings

1:10 PM **Prioritization Criteria & Process for Prioritizing Mitigation Actions**

- Criteria
- Process
- HMPT Meeting #3

1:35 PM **Asset Inventory Discussion**

- Critical Assets
- Community Lifelines
- Overview Maps

1:50 PM **Draft Report Template**

1:55 PM **Next Steps**

- Last STC Meeting August 8, 2023: 1 to 2 PM (could some stay until 2:30 PM?)
- Review draft chapters provided
- Review mitigation actions following HMPT Meeting #3

2:00 PM **Conclude**

Hazard Mitigation Plan Update 2023

Steering Committee Meeting #5

July 24, 2023

CITY OF CAMBRIDGE

Weston & Sampson SM

AGENDA

Overview of Work in Progress	1:00 PM
Mitigation Actions: Prioritization Process	1:10 PM
Asset Inventory Discussion	1:35 PM
Draft Report Template	1:50 PM
Next Steps	1:55 PM
Conclude	2:00 PM

AGENDA

Overview of Work in Progress	1:00 PM
Mitigation Actions: Prioritization Process	1:10 PM
Asset Inventory Discussion	1:35 PM
Draft Report Template	1:50 PM
Next Steps	1:55 PM
Conclude	2:00 PM

WORK IN PROGRESS

Project Tasks align with the Final Document Chapters:

~~**Task 1:** Project Initiation~~

Task 2: Initiation of Engagement

Task 3: Hazard Profiles

Task 4: Facility/Asset Inventory

Task 5: Vulnerability Assessment

Task 6: Mitigation Goals and Capabilities

Task 7: Mitigation Actions: Past, Present, and Future

Task 8: Plan Maintenance and Implementation

Task 9: Public Review

Task 10: MEMA and FEMA Review, City Adoption

Ongoing Public Outreach

Ongoing Project Administration

CHAPTER PROGRESS

	Chapter	Status	Draft to City	Deadline for City Review	Responsible Reviewer	Final Draft Deliverable to City
1	Introduction & Goals	In Review by City	June 26	**July 7**	Susanne R.	August ~~11~~ 9
2	Planning Process	Internal Review	July 28	August 7	Susanne R.	August ~~11~~ 9
3	Hazard Profiles	In Review by City	June 23	**July 21**	Susanne R. , Catherine W., Sam L, Nancy R., Fire Dept.	August ~~11~~ 9
4	Facility/Asset Inventory	In Progress	July 28	**July 21**	STC July Meeting	August ~~11~~ 9
5	Vulnerability Assessment	In Progress	July 28	August 7	?	August ~~11~~ 9
6	Mitigation Capabilities	In Progress	July 28	August 7	?	August ~~11~~ 9
7	Mitigation Actions	In Progress	July 31	August 7	?	August ~~11~~ 9
8	Plan Implementation	Internal Review	July 24	August 7	Susanne R.	August ~~11~~ 9
9	Plan Adoption	In Review by City	June 9	**June 30**	Susanne R.	September 25

ENGAGEMENT PROGRESS

Steering Committee (STC) Meetings	Status	Meeting Date	Notes
STC #1 (March)	Complete	March 27, 2023	Hazard Profiles, Stakeholder Outreach & Engagement Plan, Capabilities Assessment, confirm STC meetings.
STC #2 (April)	Complete	April 24, 2023	Proposed Mitigation Goals & Objectives, Past (2015) Mitigation Actions, Outreach & HMPT meetings.
STC #3 (May)	Complete	May 22, 2023	Endorse Mitigation Goals, Launch Capabilities Assessment Survey, Asset Inventory Presentation & Discussion, Outreach & HMPT Meetings.
STC #4 (June)	Complete	June 26, 2023 July 12, 2023	Review questions/concerns re: Asset inventory, Review questions on Chapter 1, initiate discussion on Hazard Mitigation Actions, review past and projected development.
STC #5 (July)	Today!	July 24, 2023	Review results of capabilities assessment, review vulnerability assessment, initiate discussion on plan maintenance and implementation
STC #6 (August)		**August 8, 2023**	Review questions on draft plan.

ENGAGEMENT PROGRESS

Other Meetings, Workshops, and Surveys	Status	Final Meeting/ Deliverable Date
HMPT Workshop #1	Complete	June 29, 2023
HMPT Workshop #2	Complete	July 11, 2023
HMPT Workshop #3		July 25, 2023
Public Meeting #1	Complete	June 13, 2023
Public Meeting #2		Week of September 13, 2023 (Day Virtual)
Public Meeting #3		Week of September 13, 2023 (Evening In-Person)
Public Survey	Complete	Posted in English (June 15, 2023); Posted in other languages (July 12, 2023); Final Deliverable (August 4, 2023)
ESRI StoryMap	Starting July 26	September 5, 2023
Presentation to City Council for Adoption		September 18, 2023
Street Team		Upcoming

AGENDA

Overview of Work in Progress	1:00 PM
Mitigation Actions: Prioritization Process	**1:10 PM**
Asset Inventory Discussion	1:35 PM
Draft Report Template	1:50 PM
Next Steps	1:55 PM
Conclude	2:00 PM

MITIGATION ACTION: PRIORITIZATION PROCESS OVERVIEW

1. Consider the **Prioritization Criteria** for **each Mitigation Action**

2. **Rate** each Action under **each Criteria**

3. **Add up** all the ratings for each Action

4. Finalize Prioritization **Categories**: **Low, Medium, High**

PRIORITIZATION CRITERIA

STAPLEE (by FEMA)

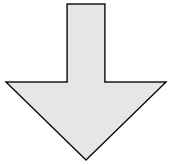
SOCIAL	TECHNICAL	ADMINISTRATIVE	POLITICAL	LEGAL	ECONOMIC	ENVIRONMENTAL

STAPLEE Criteria	S (Social)		T (Technical)			A (Administrative)			P (Political)			L (Legal)			E (Economic)				E (Environmental)				
Considerations → for Alternative Actions ↓	Community Acceptance	Effect on Segment of Population	Technical Feasibility	Long-term Solution	Secondary Impacts	Staffing	Funding Allocated	Maintenance/ Operations	Political Support	Local Champion	Public Support	State Authority	Existing Local Authority	Potential Legal Challenge	Benefit of Action	Cost of Action	Contributes to Economic Goals	Outside Funding Required	Effect on Land/ Water	Effect on Endangered Species	Effect on HAZMAT/ Waste Sites	Consistent with Community Environmental Goals	Consistent with Federal Laws

PRIORITIZATION CRITERIA

STAPLEE (by FEMA)

SOCIAL	TECHNICAL	ADMINISTRATIVE	POLITICAL	LEGAL	ECONOMIC	ENVIRONMENTAL



Criteria for Cambridge

LIFE SAFETY	SOCIAL	TECHNICAL	ADMINISTRATIVE	POLITICAL	LOCAL CHAMPION	LEGAL	PROPERTY PROTECTION	ENVIRONMENTAL

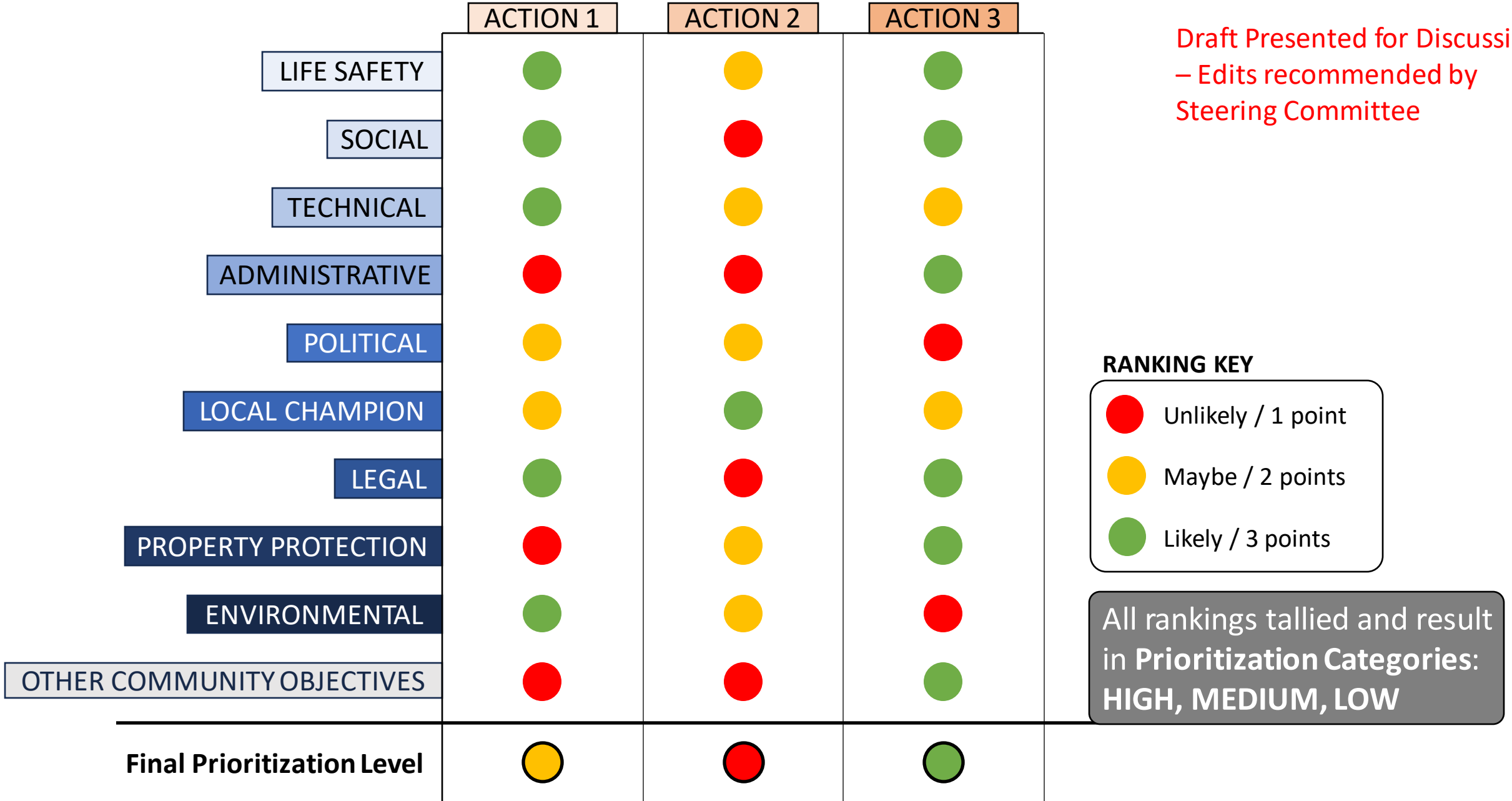
OTHER COMMUNITY OBJECTIVES

PRIORITIZATION CRITERIA

LIFE SAFETY	*Will this actions **protect lives** and **prevent injury?***
SOCIAL	*Will the action have a **positive impact** on the community and **vulnerable populations?***
TECHNICAL	*Is the mitigation action **technically feasible?***
ADMINISTRATIVE	*Does the City have the **capabilities to implement and maintain** the action?*
POLITICAL	*Does **the public support** the mitigation action?*
LOCAL CHAMPION	*Is there a **strong advocate** for the project within the City?*
LEGAL	*Does the City have the **authority** to implement the action?*
PROPERTY PROTECTION	*Will this action **eliminate or reduce damage** to structures and infrastructure?*
ENVIRONMENTAL	*Will the action **protect and preserve** the City's natural resources?*
OTHER COMMUNITY OBJECTIVES	*Does the action advance other community objectives such as economic development, environmental quality, or open space preservation?*

Draft Presented for Discussion – Edits recommended by Steering Committee

PRIORITIZATION CRITERIA



Draft Presented for Discussion – Edits recommended by Steering Committee

RANKING KEY

- Unlikely / 1 point
- Maybe / 2 points
- Likely / 3 points

All rankings tallied and result in **Prioritization Categories: HIGH, MEDIUM, LOW**

AGENDA

Overview of Work in Progress	1:00 PM
Mitigation Actions: Prioritization Process	1:10 PM
Asset Inventory Discussion	**1:35 PM**
Draft Report Template	1:50 PM
Next Steps	1:55 PM
Conclude	2:00 PM

ASSET INVENTORY

Three Tiers of Critical Assets:

1. Critical Facilities tracked by Eversource to maintain power
2. Community Lifelines
3. Assets deemed important by the community

PEOPLE
Assets that serve populations that are more vulnerable to disaster (e.g., elderly, children, visiting populations) and/or serve densely populated areas.

STRUCTURES
Built facilities that provide community lifeline services. A community lifeline enables the continuation of critical government and business functions and is essential to human health and safety or economic security.

SYSTEMS
A collection of components that perform a critical service for the community. Systems are linear type assets. Systems may include horizontal assets associated with linear type assets.

Natural, Historical, & Cultural Resources (NHCR)
Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Assets that posses historical, cultural, archaeological or paleontological significance

Activities that have Value to the Community

Data Sources

City's GIS
CCVA(2015)
Resilient Cambridge

Cambridge Special Events Calendar from TPT

TOTAL "CRITICAL" ASSET INVENTORY

People		Structures		Systems		Natural, Historical, & Cultural Resources	
Asset Type	Number of Assets	Asset Type	Number of Assets	Asset Type	Number of Assets	Asset Type	Number of Assets
Arts and Culture	7	Emergency Operations Center	1	Antenna Tower-Publically Sourced	3	Community Assets	51
Child and Youth Services	6	Emergency Shelters	17	Backup Electric Generator	50	Community Gardens	14
Community Resources	7	Fire Stations	8	Cell Towers	3	Historic Markers	0
Daycare Facilities	76	Food-Related Service	22	Data Hub, Colocation Center	2	Landmarks and Easements	113
Elderly Facilities	18	Gas Station	12	Emergency Communications Center	1	MHC Areas	57
Health Centers	13	Grocery Stores	89	Energy Steam Line	1	MHC Points	1372
Health-Related Service	20	Hazardous Materials Storage	38	Energy System Power Plant	6	National Reg of Historic Places	226
Hospitals	3	MBTA Bridges	1	Gas Distribution System	16	NRHP	193
Housing	13	MBTA Underpass	1	Major Roads	47	Open Space	221
Housing-Related Service	2	Municipal Buildings	21	Natural Gas Station	2	Places of Worship	80
Inclusionary	57	Municipal Parking Lots	10	NSTAR Electric Substation	20	Public Art	206
Nonprofit, Scattered Site HO	254	Other Bridges	1	Sewer & Stormwater Pump Stations	70	Reservoir	5
Playgrounds	60	Pharmacy	15	Steam Generating Facilities	1	Water Bodies	2
Private Housing	23	Police Stations	5	Stormwater Pump Station	8		
Private Schools	34	Post Offices	7	Subway Station	10		
Public Housing	46	Professional Ambulance Service	1	Telephone Office, Switch	1		
Public Schools	18	Public Libraries	7	Trackless Trolley	1		
Shelter	6	Snow Emergency Lots	5	Train	3		
Waterplay	30	Tunnels	1	Transmission Line	1		
Youth Centers	4	University Police	2	Utility Facilities	5		
Public Pools	3			Water System	5		

1800+ Assets

- Maps by category showing where assets are distributed

TOTAL "CRITICAL" ASSET INVENTORY

Question:

- Do you have community data on % of residents who don't own a car?

People		Structures		Systems		Natural, Historical, & Cultural Resources	
Asset Type	Number of Assets	Asset Type	Number of Assets	Asset Type	Number of Assets	Asset Type	Number of Assets
Arts a				Antenna Tower-Publically Sourced	3	Community Assets	51
Child				Backup Electric Generator	50	Community Gardens	14
Comr				Cell Towers	3	Historic Markers	0
Dayca				Data Hub, Colocation Center	2	Landmarks and Easements	113
Elder				Emergency Communications Center	1	MHC Areas	57
Healt				Energy Steam Line	1	MHC Points	1372
Healt				Energy System Power Plant	6	National Reg of Historic Places	226
Hospi				Gas Distribution System	16	NRHP	193
Housing		MBTA Underpass	1	Major Roads	47	Open Space	221
Housing-Related Service	2	Municipal Buildings	21	Natural Gas Station	2	Places of Worship	80
Inclusionary	57	Municipal Parking Lots	10	NSTAR Electric Substation	20	Public Art	206
Nonprofit, Scattered Site HO	254	Other Bridges	1	Sewer & Stormwater Pump Stations	70	Reservoir	5
Playgrounds	60	Pharmacy	15	Steam Generating Facilities	1	Water Bodies	2
Private Housing	23	Police Stations	5	Stormwater Pump Station	8		
Private Schools	34	Post Offices	7	Subway Station	10		
Public Housing	46	Professional Ambulance Service	1	Telephone Office, Switch	1		
Public Schools	18	Public Libraries	7	Trackless Trolley	1		
Shelter	6	Snow Emergency Lots	5	Train	3		
Waterplay	30	Tunnels	1	Transmission Line	1		
Youth Centers	4	University Police	2	Utility Facilities	5		
Public Pools	3			Water System	5		

1800+ Assets

- Maps by category showing where assets are distributed

COMMUNITY LIFELINES

A lifeline enables the continuous operation of critical government and business functions and is essential to human health and safety or economic security. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function.

Safety and Security - Law Enforcement/Security, Fire Service, Search and Rescue, Government Service, Community Safety

Communications - Infrastructure, Responder Communications, Alerts Warnings and Messages, Finance, 911 and Dispatch

Food, Water, Shelter - Food, Water, Shelter, Agriculture

Transportation - Highway/Roadway/Motor Vehicle, Mass Transit, Railway, Aviation, Maritime

Health and Medical - Medical Care, Public Health, Patient Movement, Medical Supply Chain, Fatality Management

Hazardous Material - Facilities, HAZMAT, Pollutants, Contaminants

Energy - Power Grid, Fuel

COMMUNITY LIFELINE IDENTIFICATION

People		Structures		Systems		Natural, Historical, & Cultural Resources	
Asset Type	Number of Assets	Asset Type	Number of Assets	Asset Type	Number of Assets	Asset Type	Number of Assets
Arts and Culture	7	Emergency Operations Center	1	Antenna Tower-Publically Sourced	3	Community Assets	51
Child and Youth Services	6	Emergency Shelters	17	Backup Electric Generator	50	Community Gardens	14
Community Resources	7	Fire Stations	8	Cell Towers	3	Historic Markers	0
Daycare Facilities	76	Food-Related Service	22	Data Hub, Colocation Center	2	Landmarks and Easements	113
Elderly Facilities	18	Gas Station	12	Emergency Communications Center	1	MHC Areas	57
Health Centers	13	Grocery Stores	89	Energy Steam Line	1	MHC Points	1372
Health-Related Service	20	Hazardous Materials Storage	38	Energy System Power Plant	6	National Reg of Historic Places	226
Hospitals	3	MBTA Bridges	1	Gas Distribution System	16	NRHP	193
Housing	13	MBTA Underpass	1	Major Roads	47	Open Space	221
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Nonprofit, Scattered Site HO	254	Other Bridges	1	Sewer & Stormwater Pump Stations	70	Reservoir	5
Playgrounds	60	Pharmacy	15	Steam Generating Facilities	1	Water Bodies	2
Private Housing	23	Police Stations	5	Stormwater Pump Station	8		
Private Schools	34	Post Offices	7	Subway Station	10		
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Shelter	6	Snow Emergency Lots	5	Train	3		
Waterplay	30	Tunnels	1	Transmission Line	1		
Youth Centers	4	University Police	2	Utility Facilities	5		
Public Pools	3			Water System	5		

808 Assets

- Maps by lifeline category

COMMUNITY LIFELINE IDENTIFIC

Question:

- Should we add a category called " Community Support" which would include daycares, religious institutions etc?

People		Structures					
Asset Type	Number of Assets	Asset Type	Number of Assets	Asset Type	Number of Assets	Asset Type	Number of Assets
Arts and Culture	7	Emergency Operations Center	1	Antenna Tower-Publically Sourced	3	Community Assets	51
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Waterplay	30	Tunnels	1	Transmission Line	1		
Youth Centers	4	University Police	2	Utility Facilities	5		
Public Pools	3			Water System	5		

- Safety and security
- Food water Shelter
- Health and Medical
- Energy
- Communications
- Transportation
- Hazardous material

AGENDA

Overview of Work in Progress	1:00 PM
Mitigation Actions: Prioritization Process	1:10 PM
Asset Inventory Discussion	1:35 PM
Draft Report Template	**1:50 PM**
Next Steps	1:55 PM
Conclude	2:00 PM

DRAFT REPORT TEMPLATE

1. Introduction

1.1. What is a Hazard Mitigation Plan?

Hazard mitigation planning is an iterative process that seeks to reduce the impact of natural hazards on people and property. Cambridge has assessed a variety of natural hazards that pose a risk to the health and welfare of residents, identified specific vulnerabilities associated with those hazards and climate change, and identified location capabilities and specific mitigation actions to protect homes, businesses, and the critical infrastructure that keeps the City running. This process is tailored to address the issues affecting Cambridge residents now and into the future and is crucial to building community resilience.

What are Natural Hazards?
Natural hazards are a source of harm or difficulty created by a meteorological, environmental or geological event (such as extreme wind events, tornadoes, winter weather as well as earthquakes flooding, and fires).

Vulnerability is a description of which community "assets" (e.g., people, structures, systems, natural resources, cultural resources, historic resources, etc.) are at risk from the effects of a natural hazard.

Hazard Mitigation is the effort to reduce impacts from natural hazards through community planning, policy changes, educational programs, infrastructure projects, and other activities.

Climate change refers to long-term fluctuations in regional temperatures and weather patterns. These fluctuations can be natural, due to events such as solar activity or volcanic eruptions. These fluctuations are also driven by human activities, primarily the burning of fossil fuels like coal, oil, and gas, which have been prominent since the 1800s. Increasing global temperatures have resulted in a multitude of impacts, including but not limited to rising sea levels, shrinking of the polar ice caps, receding glaciers, changes in seasonality, and shifting animal and plant populations (Climate Change Vulnerability Assessment (CCVA), 2015). Climate change has increased the frequency and intensity of many natural hazards creating a greater need for proactive planning. Chapter 3 includes additional information on natural hazard severity and risk.

Resilience is the ability to withstand and swiftly recover from an extreme event. Ideally, resilient systems "bounce forward" to create healthier, greener, and more equitable systems and spaces.

1.2. Benefits of Natural Hazard Mitigation Planning

Completing natural hazard mitigation planning provides benefits to Cambridge:

1. Increasing public awareness of natural hazards that may affect the community reduces overall risk. By providing education and outreach, individuals are able to understand how natural hazards may affect their lives and what the region, the City, and they as individuals can do and are doing to minimize impacts of those hazards.
2. Proactive planning creates efficiency beyond City limits. Developing a HMP allows state and local governments to work together and combine hazard risk reduction with other community goals and plans.
3. The community's greatest vulnerabilities can be prioritized to receive resources. Developing a plan of hazard mitigation measures considers a prioritization process that reflects the cost and benefit of safety, property protection, technical, political, legal, environmental, economic, social, administrative, and other community objectives, quantitatively and/or qualitatively.
4. The implementation of an HMP saves taxpayer money. According to FEMA, one dollar spent on federal hazard mitigation grants saves an average of six dollars on disaster response (NIBS, 2019).
5. Maintaining a FEMA compliant HMP also makes the municipality eligible for federal grant funding (FEMA, 2020). Hazard mitigation funding is available through the Federal Emergency Management Agency (FEMA). To be eligible for FEMA Grants, local governments must prepare an HMP that meets the requirements established in the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by the Disaster Mitigation Act of 2000. The HMP also ensures that federally funded projects reflect a community's priorities and offer solutions to specific threats. Please refer to Chapter 7 for more information on FEMA grants and other potential funding sources.

1.3. Review and Analysis

Weston & Sampson, in coordination with City staff, collected and reviewed federal, statewide, and local reports and documents. These documents were reviewed for relevance to hazards and inclusion of actions that could relate to this plan. The City of Cambridge has been at the forefront of climate resilience planning for many years. This HMP reflects prior work completed in Cambridge, as noted below in the figure. Citations provided throughout the body of this report (summarized in the resultant bibliography) indicating the extent and details of the existing plans, studies, reports, and technical information used to complete this update.

3. *Coordinate and Collaborate* among City Departments and with Community Partners on Hazard Mitigation Planning and Climate Adaptation

- Develop internal strategies to review and update current emergency preparedness, outreach, and response activities to anticipate future changes in vulnerabilities.
- Encourage private property-owners, institutions, and local businesses to implement measures to protect their own property.
- Work regionally with state, regional and federal agencies as well as surrounding communities to mitigate impacts from natural hazards and to respond and recover from hazard events.

4. *Plan for and Sustainably Invest in* Priority Hazard Mitigation Implementation

- Continue to program mitigation projects in the Cambridge capital improvement planning.
- Identify and seek funding for priority measures to mitigate or eliminate significant hazards and impacts.

5. Improve Capacity to *Monitor* Natural Hazards and *Respond* to Changes

- Continue to identify and understand how climate change may alter where and how the City is vulnerable to natural hazards.
- Ensure City departments, committees, and boards have adequate data, guidance, staff, training, and equipment to respond to natural hazard events, maintain preparedness, and anticipate future changes in vulnerabilities.

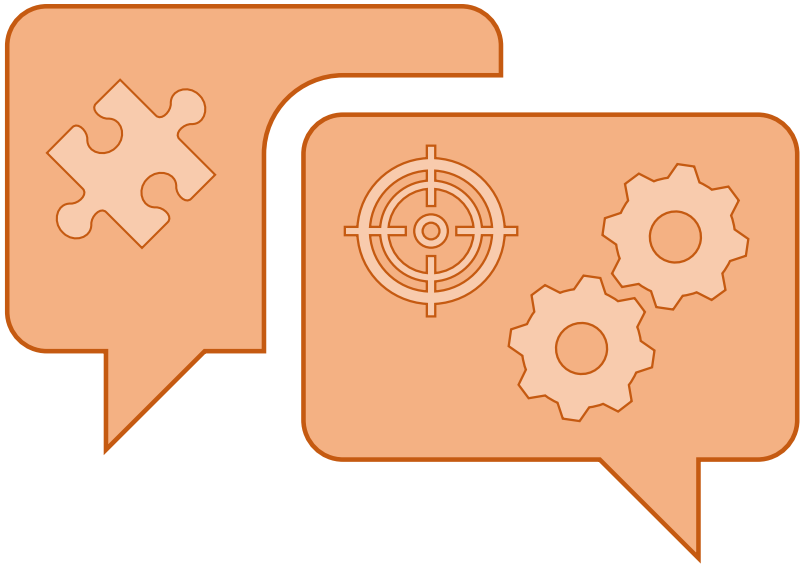
AGENDA

Overview of Work in Progress	1:00 PM
Mitigation Actions: Prioritization Process	1:10 PM
Asset Inventory Discussion	1:35 PM
Draft Report Template	**1:50 PM**
Next Steps	1:55 PM
Conclude	2:00 PM

NEXT STEPS

Virtual: Sept. 13 at 12PM-1PM

In-Person: Sept. 13 at 6PM-7PM



NEXT STEPS

Review Mitigation Actions post-HMPT Workshop & Preliminary Ranking

Continue Reviewing Chapters

- **Provide input on requested items**
- **HMPT Workshop Tuesday 4 – 5:30 PM**
- **Next Meeting August 8, 2023 at 1PM**

Hazard Mitigation Plan Update 2023

Questions?

CITY OF CAMBRIDGE

Weston & Sampson SM

HAZARD MITIGATION PLAN 2023 UPDATE STEERING COMMITTEE MEETING #5 (JULY) NOTES

July 24, 2023

Attendees

City of Cambridge

- Leila Mekias, CDD
- Susanne Rasmussen, CDD
- Catherine Woodbury, DPW
- Jeremiah Hart, Fire Dept.
- Nancy Porter, CPHD
- Mark Gallagher
- Rachel Tenanhaus
- Marlees Owayda
- Colin S. Walsh
- Julie Greenwood-Torelli

Weston & Sampson

- Robin Seidel, Project Manager
- Jennie Moonan, HMP Technical Lead
- Emily Judson, Resiliency Planner
- Jocelyn Tsai, Resiliency Planner

Presentation

- Work in progress
    - Robin reviewed status of each chapter (see slide)

- Prioritization Criteria & Process for Prioritizing Mitigation Actions
    - Jennie reviewed how to assess actions and introduces the process of prioritizing (see slides)

- Asset Inventory Discussion
    - Robin reviewed current asset inventory and community lifelines (see slides)

- Draft Report Template
    - Robin presented an example of how the final report will look and feel (see slides)

- Outreach & HMPT Meetings
    - HMPT Workshop #3: July 25, 2023 – 4 PM – 5:30 PM
    - Public Meeting #1: September 13, 2023 – 12 PM – 1 PM (Virtual)
    - Public Meeting #2: September 13, 2023 – 6 PM – 7 PM (In-Person)

Discussion items

Chapter Review + Schedule

Chapter Review

- *Chapters 1+2:* to be reviewed by Susanne and Leila
- *Chapter 3:* Nancy is reviewing it, she will be done hopefully by this afternoon
- *Chapter 4:* We will send draft to STC by end of this week, then reviewer will be decided at end of this meeting
- *Chapter 5-7:* STC to review
- *There is also review period after August 9*

Public Meeting

- Add more visual cues, i.e. flooding maps for people who are less familiar with the material
- In-person: printed maps on tables?
- Need to make the in-person one hybrid

Public Survey

- We'll incorporate comments from public survey into the submission for August 9, not initial City review

September 18 City Council meeting

- STC should be there

Leila is recruiting for Street Team now so they may help promote public meeting

Prioritization Criteria & Process for Prioritizing Mitigation Actions

Local Champion Criteria

- The committee determined that we should remove Local Champion because if an action is important, we will assign it a local champion.

Life Safety Criteria

- Concern over how we are assessing life safety, vulnerable populations, and whose lives are considered most valuable in an emergency.

Political Criteria

- The committee determined that we should change is to Public Support or similar title, instead of Political.

Legal Criteria

- Discussion about why this is on the list if the City cannot carry out actions that it does not have legal authority to do. We are keeping this one to support regional or other partnership actions that the City could support but not complete alone.

Equity Criteria

- The committee discussed adding an Equity Criteria section to replace Local Champion, which would help weight actions that help vulnerable communities.

Overall Takeaways

- Reframe / restructure prioritization criteria to be more directly connected with Goals.

Asset Inventory

Do you have community data on % of residents who don't own a car?

- Susanne will send the data – looks like about 63.2% of residents with cars

Should we add a category called "Community Support" which would include daycares, religious institutions etc.?

- Ran out of time to discuss

Action Items

- HMPT Workshops - attend
- Review Mitigation Actions Post-HMPT Workshop & Preliminary Ranking
- City to Review Chapters provided
- Public Meetings (September 13) – attend
- Susanne to send car ownership data
- WSE to directly connect prioritization criteria to goals

Next Steering Committee Meeting Agenda (tentative)

- Overview of Work in Progress
- Discuss Public Meetings
- Chapter Reviews

City of Cambridge
2023 Hazard Mitigation Plan Update
Steering Committee Meeting
August 8, 2023
1:00 to 2:00 PM

STEERING COMMITTE MEETING #6: AUGUST AGENDA

1:00 PM **Overview of Work in Progress**

- Tasks Underway
- Draft chapters
- Remaining timeline & meetings

1:05 PM **Questions for the Committee**

1:20 PM **Review Mitigation Actions & Updated Prioritization**

1:55 PM **Next Steps**

- Review of Complete Draft of HMP
  - Targeted chapters (Ch. 4 Asset Inventory, Ch. 5 Vulnerability Assessment, Ch 6. Capabilities Assessment, Ch. 7 Mitigation Actions)
  - Comments due by Friday August 25th
- Offer HTMP Opportunity to review concurrently?

2:00 PM **Conclude**

Hazard Mitigation Plan Update 2023

Steering Committee Meeting #6

August 8, 2023

CITY OF CAMBRIDGE

Weston & Sampson SM

AGENDA

Overview of Work in Progress	1:00 PM
Questions for the Committee	1:05 PM
Review Mitigation Actions & Updated Prioritization	1:20 PM
Next Steps	1:55 PM
Conclude	2:00 PM

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Overview of Work in Progress	1:00 PM
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WORK IN PROGRESS

Project Tasks align with the Final Document Chapters:

~~**Task 1:** Project Initiation~~

Task 2: Initiation of Engagement

Task 3: Hazard Profiles

Task 4: Facility/Asset Inventory

Task 5: Vulnerability Assessment

Task 6: Mitigation Goals and Capabilities

Task 7: Mitigation Actions: Past, Present, and Future

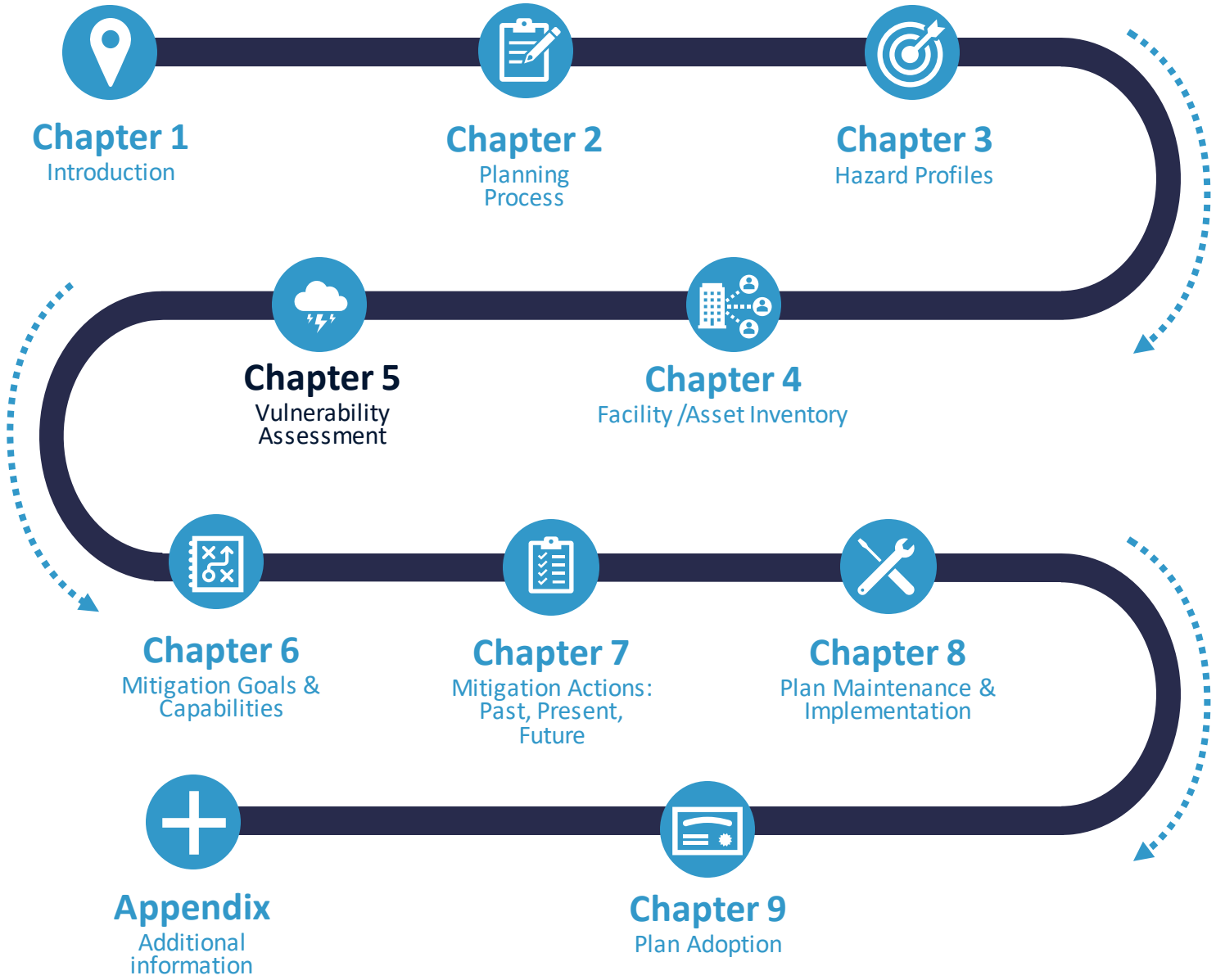
Task 8: Plan Maintenance and Implementation

Task 9: Public Review

Task 10: MEMA and FEMA Review, City Adoption

Ongoing Public Outreach

Ongoing Project Administration



CHAPTER PROGRESS

	Chapter	Status	Draft to City	Deadline for City Review	Final Draft Deliverable to City
1	Introduction & Goals	Complete	June 26	**July 7**	August ~~11~~ 9
2	Planning Process	In Review by City	July 28	August 7	August ~~11~~ 9
3	Hazard Profiles	Complete	June 23	**July 21**	August ~~11~~ 9
4	Facility/Asset Inventory	Internal Review	July 28	**July 21**	August ~~11~~ 9
5	Vulnerability Assessment	In Progress	July 28	August 7	August ~~11~~ 9
6	Mitigation Capabilities	Internal Review	July 28	August 7	August ~~11~~ 9
7	Mitigation Actions	In Review by City	July 31	August 7	August ~~11~~ 9
8	Plan Implementation	In Review by City	July 24	August 7	August ~~11~~ 9
9	Plan Adoption	Complete	June 9	**June 30**	September 25

ENGAGEMENT PROGRESS

Steering Committee (STC) Meetings	Status	Meeting Date	Notes
STC #1 (March)	Complete	March 27, 2023	Hazard Profiles, Stakeholder Outreach & Engagement Plan, Capabilities Assessment, confirm STC meetings.
STC #2 (April)	Complete	April 24, 2023	Proposed Mitigation Goals & Objectives, Past (2015) Mitigation Actions, Outreach & HMPT meetings.
STC #3 (May)	Complete	May 22, 2023	Endorse Mitigation Goals, Launch Capabilities Assessment Survey, Asset Inventory Presentation & Discussion, Outreach & HMPT Meetings.
STC #4 (June)	Complete	June 26, 2023 July 12, 2023	Review questions/concerns re: Asset inventory, Review questions on Chapter 1, initiate discussion on Hazard Mitigation Actions, review past and projected development.
STC #5 (July)	Complete	July 24, 2023	Review results of capabilities assessment, review vulnerability assessment, initiate discussion on plan maintenance and implementation
STC #6 (August)	Today!	August 8, 2023	Review questions on draft plan.

ENGAGEMENT PROGRESS

Other Meetings, Workshops, and Surveys	Status	Final Meeting/ Deliverable Date
HMPT Workshop #1	Complete	June 29, 2023
HMPT Workshop #2	Complete	July 11, 2023
HMPT Workshop #3	Complete	July 25, 2023
Public Meeting #1	Complete	June 13, 2023
Public Meeting #2		September 13, 2023 (Day Virtual)
Public Meeting #3		September 13, 2023 (Evening In-Person)
Public Survey	Complete	Posted in English (June 15, 2023); Posted in other languages (July 12, 2023); Final Deliverable (August 4, 2023)
ESRI StoryMap	In progress	September 5, 2023
Presentation to City Council for Adoption		September 18, 2023

AGENDA

Overview of Work in Progress	1:00 PM
Questions for the Committee	**1:05 PM**
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MITIGATION ACTION

[New Actions List.xlsx (sharepoint.com)]

#	Action	Cost	Geographic Coverage	Funding Source	Timeframe to Start	Associated Goal(s)	Hazards	Consistency with Other Plans	Enhances Inclusion and Equity / Co-Benefits	Priority	Source (internal)
		Greater than $2 mil = high $500k- $2 mil = medium Less than $500k = low	regional city-wide neighborhood specific site specific	Capital Budget Municipal Bond Grant Staff Time	In Progress Less than 1 year 1-2 years 2-5 years	1. Equitably Protect health and safety 2. Communication 3. Coordinate and Collaborate 4. Sustainably invest 5. Monitor and Respond			Positive Impact on Students Positive Impact on Diverse Groups Enhances Community Education Positive Impact on Renters Equitable Implementation		
1	Update and improve the City's HeatViewer with best available information	Low	City-Wide		Less than 1 year	#2 Communication	Extreme Heat		Enhances Community Education, Equitable Implementation	Medium	Weston & Sampson
2	Update and Improve Floodplain Mapping (Cambridge Flood Viewer)	Low	City-Wide		Less than 1 year	#2 Communication	Precipitation Flooding, Coastal Flooding	Resilient Cambridge Handbook - Strategy A7: Enhance Emergency Response Plans	Enhances Community Education, Equitable Implementation	Medium	2015 HMP
3	Undertake interventions as a regional collaboration at Charles River and Amelia Earhart Dam to reduce overtopping/flanking	High	Regional		Less than 1 year	#3 Coordinate & Collaborate, #4 Sustainably Invest	Coastal Flooding	Resilient Cambridge Handbook - Strategy A7: Enhance Emergency Response Plans	Positive Impact on Diverse Groups	High	STC
4	Perform a study to identify how to best protect Fresh Pond reservoir from saltwater intrusion	Low	Site Specific		2-5 years	#1 Protect, #3 Coordinate & Collaborate, #4 Sustainably Invest	Coastal Flooding	Resilient Cambridge Handbook -Strategy C1: Protect Fresh Pond Reservoir		High	STC
5	Design and construct stormwater holding tanks for Baldwin and Cambridgeport neighborhoods	High	Neighborhood specific		In Progress	#1 Protect, #4 Sustainably Invest	Precipitation Flooding	DPW 10-year Sewer Plan - Goal 4: Manage stormwater quality and quantity. Resilient Cambridge Handbook - Strategy C5: Upgrade Stormwater Storage.		High	STC
6	Initiate a City led program to install valves to mitigate basement backups of stormwater/sewage due to wet weather events	Low	City-Wide		Less than 1 year	#1 Protect	Precipitation Flooding	DPW 10-year Sewer Plan - Goal 5: Reduce flooding and protect neighborhoods		Medium	STC
7	Improve collection and conveyance system at area east of 2nd Street and north of Charles Street (area #27)	High	Neighborhood specific		Less than 1 year	#1 Protect, #4 Sustainably Invest	Precipitation Flooding	DPW 10-year Sewer Plan - Goal 4: Manage stormwater quality and quantity		High	2015 HMP
8	Complete in-progress stormwater management program: Newton, Green, Franklin and Sidney Streets (CAM 017, area #28), School, Pine, Cherry and Windsor Streets (area #26)	High	Neighborhood specific		Less than 1 year	#1 Protect, #4 Sustainably Invest	Precipitation Flooding	DPW 10-year Sewer Plan - Goal 4: Manage stormwater quality and quantity		High	2015 HMP
9	Design and construct updates to metering stations for Combined Sewers	Medium	City-Wide		Less than 1 year	#5 Monitor & Respond	Precipitation Flooding	DPW 10-year Sewer Plan - Goal 4: Manage stormwater quality and quantity. Resilient Cambridge Handbook - Strategy C5: Upgrade Stormwater Storage		Medium	HMPT Room 3

PRIORITIZATION CRITERIA

CRITERIA 1	Does the action contribute to regional resilience?
CRITERIA 2	Is the action part of other plans?
CRITERIA 3	Does the action positively impact residents of LMI or EJ Census Block Groups?
CRITERIA 4	Is the action a nature-based solution?
CRITERIA 5	Would the action mitigate economic loss/damage?
CRITERIA 6	Will the action reduce life/safety risk?
CRITERIA 7	Does the action address future climate change projections?
CRITERIA 8	Does the action leverage innovation /technology?

SCORING:

YES = 1 POINT

NO = 0 POINT

PRIORITIZATION CRITERIA

	ACTION 1	ACTION 2	ACTION 3
CRITERIA 1	1	0	1
CRITERIA 2	0	0	1
CRITERIA 3	0	0	0
CRITERIA 4	1	1	1
CRITERIA 5	1	0	1
CRITERIA 6	0	0	0
CRITERIA 7	1	1	1
CRITERIA 8	0	0	1
Final Prioritization Level	4	2	6

SCORING:

YES = 1 POINT

NO = 0 POINT

RANKING KEY

- Low : 1-2 point
- Medium : 3-4 points
- High : > 4 points

All rankings tallied and result in **Prioritization Categories: HIGH, MEDIUM, LOW**

AGENDA

Overview of Work in Progress	1:00 PM
Questions for the Committee	1:05 PM
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Next Steps	**1:55 PM**
Conclude	2:00 PM

NEXT STEPS

Review Complete Draft of HMP

Comments due by Friday, August 25th

+ **Targeted chapters for review:**
  - **Ch 4: Asset Inventory**
  - **Ch 5: Vulnerability Assessment**
  - **Ch 6: Capabilities Assessment**
  - **Ch 7: Mitigation Actions**

+ **Offer HMPT opportunity to review concurrently?**

AGENDA

Overview of Work in Progress	1:00 PM
Questions for the Committee	1:05 PM
Review Mitigation Actions & Updated Prioritization	1:20 PM
Next Steps	1:55 PM
Conclude	2:00 PM

Hazard Mitigation Plan Update 2023

Questions?

CITY OF CAMBRIDGE

Weston & Sampson SM

City of Cambridge
2023 Hazard Mitigation Plan Update
Steering Committee Meeting
August 8, 2023
1:00 to 2:00 PM

STEERING COMMITTE MEETING #6

1:00 PM Overview of Work in Progress

- Tasks Underway
- Draft chapters
- Remaining timeline & meetings

1:05 PM Questions for the Committee

Questions for the Committee:

1. Inspect and maintain targeted infrastructure pre-storm events (e.g., remove sediment and obstructions to allow stormwater to flow unimpeded) should we remove this? Doesn't the city already do this?

   City has ongoing operation and maintenance plan, they don't need more funding for that.

   Remove this action.

2. Chapter 3: The following indicated events represent significant historic flood events in Cambridge, with widespread flooding.
   a. MWH/Stantec had drafted a memo to the City for the July 10, 2010 flooding.
   b. We can ask Leila for this memo from Jim W

   Jim can provide memo. Stantec has storms that they use for modeling that are significant, basically dates and rainfall.

   WSE to send Jim the HMP section so he can see what he can provide.

3. Chapter 3: In 2018, the fire dept. reported 103 acres of wildfire. This number is a significant outlier compared to the others in the table provided. Please confirm.

Year	# of Incidents	# of Acres Burned (Fire Module)	# of Wildland Acres Burned	Total Acres Burned
2017	26	1	0	1
2018	18	0	103	103
2019	8	0	1	1
2020	31	0	4	4
2021	9	1	0	1
2022	17	1	0	1
Total	83	1	108	109

Colin Walsh: yes, this is correct, there was a large incident that year.

4. Chapter 4: Need the rest of the community events list from Leila for first ½ of year

Rachel might have it or will check. WSE needs Dec-May.

5. Chapter 4: When the climate change vulnerability assessment was completed in 2015, new data was developed for that project. It identifies a lot of what is already now included in your GIS database. However, for that project, more sensitive information such as gas distribution was included. I'm assuming this information, along with the Eversource list may not be something we want to create maps for that would then be publicly available. But we also need to decide if this should be included in the analysis. Not including it is okay. We just need a decision.

Susanne has internal crosswalk so WSE can make source clear about where information is coming from.

Do not share the maps with the public, represent them in the narrative only.

6. Chapter 8: Catherine asked in comments if someone was reviewing the chapter with the City Manager office to ensure the tasks are consistent with the new position's responsibilities and staffing? Will this be done once the final full draft plan is completed this week?

Susanne: We are working to organize an update meeting on Friday, so the team will let Owen know that we want him to check this chapter for the responsibilities of the new hire position.

7. Are there any regulations supporting Zoning Article 20.70 Flood Plain Overlay District?

   Reach out to Jennifer LeTeranea
   jletourneau@cambridgema.gov

8. Floodplain management
   a. Is the Planning Board formally the community floodplain administers? Is there a specific person that is designated and is that person a Certified Floodplain Manager?
   b. Who can we talk to ask more questions about the flood plain ordinance?
   c. Is the Flood Plain Overlay District the only active flood ordinance for Cambridge? Is there a more general Flood Protection/Prevention Ordinance?
      i. Minimum requirements for new and redevelopment in flood plain – enclosures can only be for parking, lowest flood has to be at 1 foot over base flood elevation
   d. Do you have a scoresheet for the most recent CRS Community Assistance Visit?
   e. When was your last CRS Community Assistance Visit?
   f. What are your substantial damage/improvement procedures? Is the threshold 50%? Do you track this cumulatively?

   Reach out to Jennifer LeTeranea
   jletourneau@cambridgema.gov

1:20 PM Review Mitigation Actions & Updated Prioritization

Four Dollar Sign Buckets:
$ = Under 100k
$$ = 100k - 500k
$$$ = 500k - 2mil
$$$$ = Over 2mil

Prioritization:
Leila asked if this process is okay with everyone? Yes, move forward.

1:55 PM Next Steps

- Review of Complete Draft of HMP

  - Targeted chapters (Ch. 4 Asset Inventory, Ch. 5 Vulnerability Assessment, Ch 6. Capabilities Assessment, Ch. 7 Mitigation Actions)
  - Comments due by Friday August 25th
- Offer HTMP Opportunity to review concurrently?

2:00 PM **Conclude**

Natural Hazard Mitigation Plan Update 2023

City Official's Meeting

August 11, 2023

CITY OF CAMBRIDGE

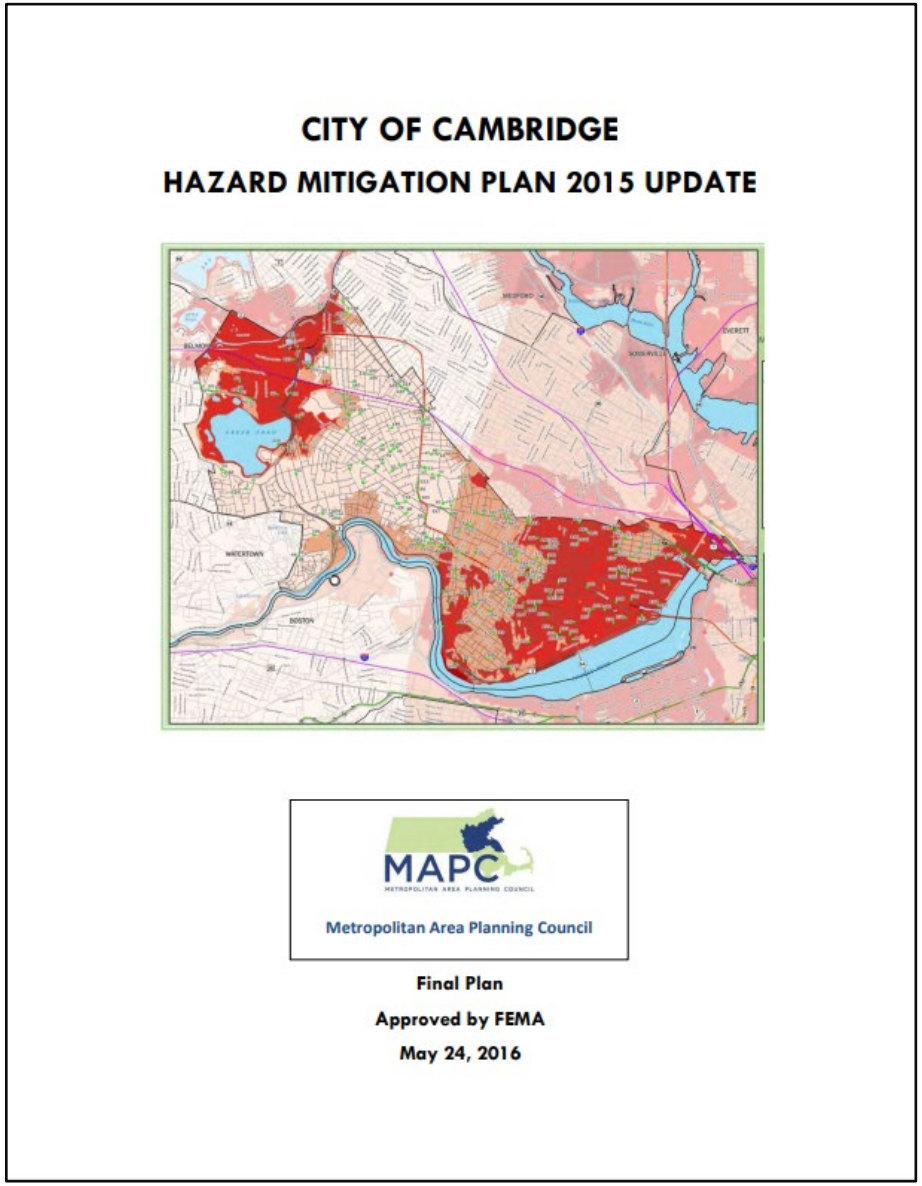
Weston & Sampson SM

2015 HMP PLAN UPDATE

CITY OF CAMBRIDGE
HAZARD MITIGATION PLAN 2015 UPDATE
Prepared by MAPC

Adopted: 3/21/2016
Approved: 5/24/2016
Expired: 5/24/2021

24 Mitigation Actions for 2016-2021



https://www.cambridgema.gov/-/media/Files/firedepartment/emergencymanagement/cambridgehazardmitigationplan2015updatefemaapproved052415forweb.pdf

FEMA & MEMA REQUIREMENTS

"The Disaster Mitigation Act of 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (44 CFR Part 201), creating the framework for state, local, tribal and territorial governments to engage in hazard mitigation planning to receive certain types of non-emergency disaster assistance."

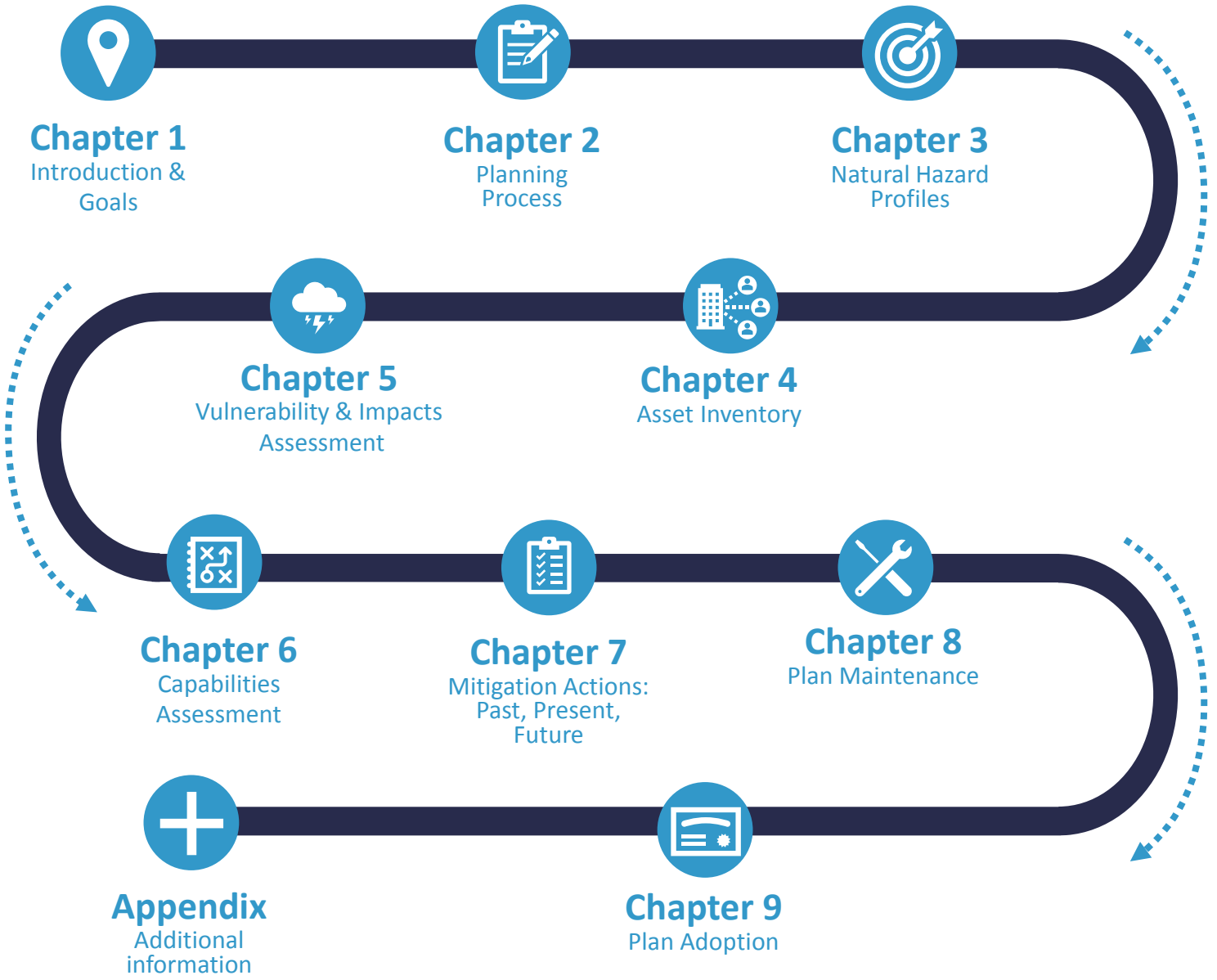
FEMA updated *Local Mitigation Planning Policies and Guidance* (released April 2022, effective April 2023)

FEMA updated *Location Mitigation Planning Handbook* (May 2023)

2022 Updates Include:

- ✓ Expanded list of participants required in planning process.
- ✓ Requires consideration of climate change.
- ✓ Recognizes the important role of adopting and enforcing building, land use, and development code.
- ✓ Facilitates stronger alignment with other FEMA mitigation programs.

NHMP SCOPE OF WORK



CH 1: INTRODUCTION & GOALS

MITIGATION GOALS:

Protect	Equitably ***Protect*** Health and Safety of the Community
Communication	Promote Public Preparedness and Resilience through ***Communication***
Coordinate & Collaborate	***Coordinate and Collaborate*** among City Departments and with Community Partners on Hazard Mitigation Planning & Climate Adaptation
Sustainably Invest	Plan for & ***Sustainably Invest*** in Priority Hazard Mitigation Implementation
Monitor & Respond	Improve Capacity to ***Monitor*** Natural Hazards and ***Respond*** to Changes

CH 2: PLANNING PROCESS

City Staff

Steering Committee

Group of **19 key City staff** responsible for making final planning decisions. Steering Committee Meetings will guide the planning process, endorse draft Goals, and members will participate in Hazard Mitigation Planning Workshops.

6 Monthly Meetings & 3 Workshops

Stakeholders

Hazard Mitigation Planning Team (HMPT)

Group of **90 stakeholders** bringing a wide range of local expertise and perspectives. The group will include advocates, residents, business-owners, state and local agency representatives, and people from various other organizations.

3 Workshops

Public

Public Engagement

Public Meetings will be an opportunity to educate about the HMP, share progress, and gather feedback and ideas. Results from these meetings and other feedback will be integrated into the final report. The group will include advocates, residents, business-owners, state and local agency representatives, and people from various other organizations.

3 Public Meetings
150+ Survey Responses

CH 3: NATURAL HAZARD PROFILES

HURRICANES / TROPICAL STORMS

INLAND FLOODING

EXTREME TEMPERATURES

SEVERE WINTER WEATHER / NOR'EASTERS

COASTAL FLOODING

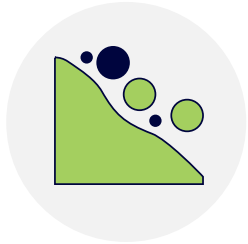
TSUNAMI

DROUGHT

WILDFIRE

EARTHQUAKES

TORNADOES



LANDSLIDES

INVASIVE SPECIES

CH 3: NATURAL HAZARD PROFILES

Chapter 3 Identifies the hazards that can affect the city and associated risk:

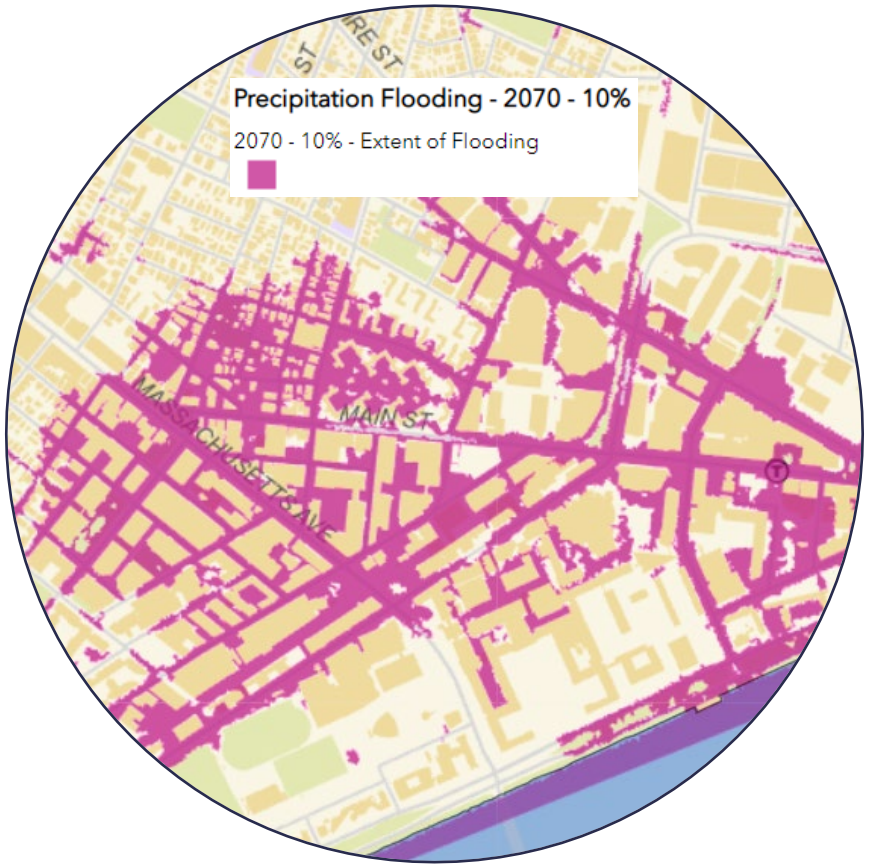
Location: Where each hazard might affect the planning area

Extent: Potential intensities

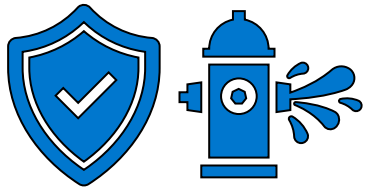
Previous Occurrence: How often events have happened in the past?

Future Probability: How likely they are to occur in the future?

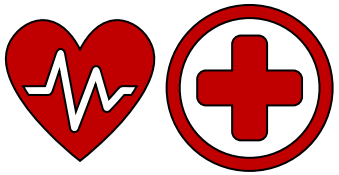
WSE drafted chapter 3 using the best public available data for Cambridge, and the Steering Committee provided thorough review



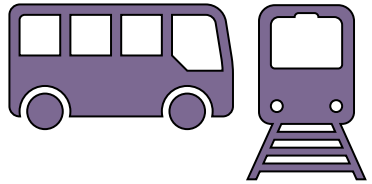
CH 4: ASSET INVENTORY



Safety & Security



Health & Medical

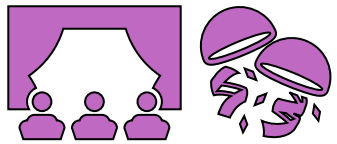


Transportation

Food, Water, Shelter

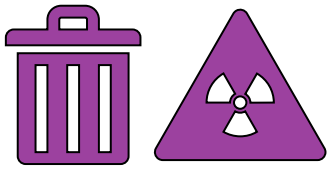
Parks & Greenspace

Communications



Cultural, Historic, & Events

Energy



Hazardous Material Management

CH 4: ASSET INVENTORY

People

Assets that serve populations that are more vulnerable

- Child and Youth Services
- Hospitals
- Housing
- Schools
- Shelter

Structures

Built facilities that provide community lifeline services

- Emergency Shelters
- Grocery Stores
- Fire Stations
- Food-related Services
- Gas Stations
- Tunnels

Systems

Collection of components that perform a critical service for the community

- Power Grid
- Cell Towers
- Energy System Power Plant
- Major Roads
- Train
- Water System

Resources

Natural, cultural, and historic resources

- Open Space
- Places of Worship
- Public Art
- Water Bodies
- Historic Markers
- Landmarks and Easements

Economy & Activities

Economy

- Top Employers
- Targeted areas

Activities that increase community morale and well-being

- Farmer's Markets
- Street Fairs and Festivals
- Public Health Fair
- Community Bike Rides

CH 5: VULNERABILITY & IMPACTS ASSESSMENT

Risks and Vulnerabilities

Probability of Occurrence

Consequence of Occurrence

Higher Probability /Lower Consequence

- Wildfire/Brushfire
- Invasive Species
- Drought

Higher Probability /Higher Consequence

- Severe Winter Weather/Nor'easters
- Extreme Temperatures
- Inland Flooding
- Hurricanes/Tropical Storms

Lower Probability / Lower Consequence

- Landslides

Lower Probability /Higher Consequence

- Coastal Flooding
- Tsunami
- Tornado
- Earthquakes

CH 6: CAPABILITIES ASSESSMENT

The City of Cambridge has a unique set of capabilities, in the form of laws, policies, programs, staff, funding and other resources, to carry out the NHMP and increase resilience.

There are 4 types of mitigation capabilities:

- Planning and Regulatory Capabilities
- Administrative and Technical Capabilities
- Financial Capabilities
- Education and Outreach Capabilities

CH 6: CAPABILITIES ASSESSMENT

The following opportunities were identified through discussions with the STC, input from the NHMPT, and the public:

- Improved coordination between Departments
- Centralized hazard mitigation efforts including leadership role & develop overarching plan
- Coordinate with adjacent communities for hazard preparation and response
- Develop an operations plan for DPW and Police on how to respond to flooding

CH 7: MITIGATION ACTIONS

A mitigation action is a measure, project, plan, or activity proposed to reduce current and future vulnerabilities.

Before an event

Local code and regulations
Maintenance
Proactive Structural Projects

During an event

Warnings
Protection of critical facilities
Emergency response

Following an event

Clean up
Restoration
Enhancement

COMMUNICATIONS

This actions will create resilience for the City of Cambridge (ability to withstand and swiftly recover from an extreme event). These actions will support adaptation to climate change.

CH 7: MITIGATION ACTIONS

Action	Natural Hazard Mitigated	Cost	Geographic Coverage
Lead Department	Consistency with Other Plans	Greater than $2 mil = $$$$ Over $500k up to $2M = $$$ Over $100k up to $500k = $$ Up to $100k = $	regional city-wide neighborhood specific site specific
Funding Source	Timeframe to Start	**Enhances Inclusion and Equity / Co-Benefits**	Associated Goals
Capital Budget Operating Budget Municipal Bond Grant Staff Time	In Progress Less than 1 year 1-2 years 2-5 years	Positive Impact on Students Positive Impact on Diverse Groups Enhances Community Education Positive Impact on Renters Equitable Implementation	1. Equitably Protect health and safety 2. Communication 3. Coordinate and Collaborate 4. Sustainably invest 5. Monitor and Respond

CH 7: MITIGATION ACTIONS

[Copy of New Actions List.xlsx (sharepoint.com)]

#	Action	Lead Dept	Cost	Geographic Coverage	Funding Source	Timeframe to Start	Associated Goal(s)	Hazards	Consistency with Other Plans	Enhances Inclusion and Equity / Co-Benefits	Priority
			Greater than $2 mil = $$$$ Over $500k up to $2M = $$$ Over $100k up to $500k = $$ Up to $100k = $	regional city-wide neighborhood specific site specific	Capital Budget Operating Budget Municipal Bond Grant Staff Time	In Progress Less than 1 year 1-2 years 2-5 years	1. Equitably Protect health and safety 2. Communication 3. Coordinate and Collaborate 4. Sustainably invest 5. Monitor and Respond			Positive Impact on Students Positive Impact on Diverse Groups Enhances Community Education Positive Impact on Renters Equitable Implementation	
1	Update and improve the City's HeatViewer with best available information	Department of Public Works, Community Development Department	Low	City-Wide	Operating Budget	Less than 1 year	#2 Communication	Extreme Heat		Enhances Community Education, Equitable Implementation	Medium
2	Update and Improve Floodplain Mapping (Cambridge Flood Viewer)	Department of Public Works	Low	City-Wide	Operating Budget	Less than 1 year	#2 Communication	Precipitation Flooding, Coastal Flooding	Resilient Cambridge Handbook - Strategy A7: Enhance Emergency Response Plans	Enhances Community Education, Equitable Implementation	Medium
3	Undertake interventions as a regional collaboration at Charles River and Amelia Earhart Dam to reduce overtopping/flanking	Department of Public Works, City of Arlington	High	Regional	Grant	Less than 1 year	#3 Coordinate & Collaborate, #4 Sustainably Invest	Coastal Flooding	Resilient Cambridge Handbook - Strategy A7: Enhance Emergency Response Plans	Positive Impact on Diverse Groups	High
4	Perform a study to identify how to best protect Fresh Pond reservoir from saltwater intrusion	Department of Public Works	Low	Site Specific	Capital Budget	2-5 years	#1 Protect, #3 Coordinate & Collaborate, #4 Sustainably Invest	Coastal Flooding	Resilient Cambridge Handbook -Strategy C1: Protect Fresh Pond Reservoir		High
5	Design and construct stormwater holding tanks for Baldwin and Cambridgeport neighborhoods	Department of Public Works	High	Neighborhood specific	Municipal Bond	In Progress	#1 Protect, #4 Sustainably Invest	Precipitation Flooding	DPW 10-year Sewer Plan - Goal 4: Manage stormwater quality and quantity. Resilient Cambridge Handbook - Strategy C5: Upgrade Stormwater Storage.		High
6	Initiate a City led program to install valves to mitigate basement backups of stormwater/sewage due to wet weather events	Department of Public Works	Low	City-Wide	Operating Budget	Less than 1 year	#1 Protect	Precipitation Flooding	DPW 10-year Sewer Plan - Goal 5: Reduce flooding and protect neighborhoods		Medium
7	Improve collection and conveyance system at area east of 2nd Street and north of Charles Street (area #27)	Department of Public Works	High	Neighborhood specific	Municipal Bond	Less than 1 year	#1 Protect, #4 Sustainably Invest	Precipitation Flooding	DPW 10-year Sewer Plan - Goal 4: Manage stormwater quality and quantity		High
8	Complete in-progress stormwater management program: Newton, Green, Franklin and Sidney Streets (CAM 017, area #28), School, Pine, Cherry and Windsor Streets (area #26)	Department of Public Works	High	Neighborhood specific	Municipal Bond	Less than 1 year	#1 Protect, #4 Sustainably Invest	Precipitation Flooding	DPW 10-year Sewer Plan - Goal 4: Manage stormwater quality and quantity		High
9	Design and construct updates to metering stations for Combined Sewers	Department of Public Works	Medium	City-Wide	Capital Budget	Less than 1 year	#5 Monitor & Respond	Precipitation Flooding	DPW 10-year Sewer Plan - Goal 4: Manage stormwater quality and quantity. Resilient Cambridge Handbook - Strategy C5: Upgrade Stormwater Storage		Medium

CH 7: MITIGATION ACTIONS

Grant Funding Criteria

CRITERIA 1	Does the action contribute to regional resilience?
CRITERIA 2	Is the action part of other plans?
CRITERIA 3	Does the action positively impact residents of LMI or EJ Census Block Groups?
CRITERIA 4	Is the action a nature-based solution?
CRITERIA 5	Would the action mitigate economic loss/damage?
CRITERIA 6	Will the action reduce life/safety risk?
CRITERIA 7	Does the action address future climate change projections?
CRITERIA 8	Does the action leverage innovation /technology?

SCORING:

YES = 1 POINT

NO = 0 POINT

CH 8: PLAN MAINTENANCE

MONITORING THE PLAN

The Hazard Mitigation Manager will monitor the status of mitigation actions on an ongoing basis with annual meetings to update the status of mitigation actions.

EVALUATING THE PLAN

The Steering Committee will meet annually to evaluate the effectiveness of the plan. The STC may also be called to meet after a major event or storm to evaluate the effectiveness of the plan.

UPDATING THE PLAN

The Hazard Mitigation Manager will initiate the process to complete a comprehensive update to the HMP at least every five years to maintain FEMA funding eligibility, or complete plan updates after a major disaster event.

INTEGRATING THE PLAN

Cambridge can integrate ideas, information, and strategy into Building and Zoning Regulations, Community Plans, Emergency Management Plans, and develop strong partnerships between planners and emergency managers.

PUBLC PARTICIPATION THROUGHOUT PLAN MAINTENANCE

The city is committed to developing equitable and impactful public participation. Public engagement activities will align with the annual evaluation, monitoring, and plan update meetings as well as with large storms or events.

CH 8: PLAN MAINTENANCE

- Track the progress of the NHMP Mitigation Actions - Who?
- Reconvene the Steering Committee annually to monitor, evaluate, update, and integrate the plan. How often?
- Share NHMP progress with the public, at least once a year. Who, how, how often?
- Make all monitoring information publicly available. Where?
- Notify the public when new information has been posted or updated. How and how?
- Provide the public opportunities to give input on this information. How?

CH 9: PLAN ADOPTION

City of Cambridge

IN CITY COUNCIL
_____, 2023

CITY OF CAMBRIDGE, MASSACHUSETTS
RESOLUTION NO. _____

A RESOLUTION OF THE CITY OF CAMBRIDGE ADOPTING THE 2023 HAZARD MITIGATION PLAN UPDATE

MAYOR SIDDIQUI

WHEREAS the City Council recognizes the threat that natural hazards pose to people and property within the City of Cambridge; and

WHEREAS the City of Cambridge has prepared a multi-hazard mitigation plan, hereby known as the City of Cambridge 2023 Hazard Mitigation Plan Update, in accordance with federal laws, including the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended; the National Flood Insurance Act of 1968, as amended; and the National Dam Safety Program Act, as amended; and

WHEREAS the City of Cambridge 2023 Hazard Mitigation Plan Update identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the City of Cambridge from the impacts of future hazards and disasters; and

WHEREAS duly-noticed public meetings on the 2023 Hazard Mitigation Plan Update were held by the City on June 13, 2023 and two on September 13, 2023; and

WHEREAS the City Council authorizes Departments to executive their responsibilities demonstrated in the 2023 Hazard Mitigation Plan Update; and

WHEREAS adoption by the City Council demonstrates its commitment to hazard mitigation and achieving the goals outlined in the City of Cambridge 2023 Hazard Mitigation Plan Update; now therefore be it

Resolved: That in accordance with M.G.L. 40 §4 or the charter and ordinances of the City of Cambridge, the City Council adopts the City of Cambridge 2023 Hazard Mitigation Plan Update. While content related to the City of Cambridge may require revisions to meet the plan approval requirements, changes occurring after adoption will not require the City of Cambridge to re-adopt any further iterations of the plan. Subsequent plan updates following the approval period for this plan will require separate adoption resolutions.

Option 1: Approve Plan, allowing for potential updates due to MEMA/FEMA Review. Resolution language leaves room for any required NHMP revisions that occur after adoption is approved

Option 2: Submit plan to MEMA and FEMA, wait for responses, and then City Council can formally adopt and respond to FEMA.

Due to City's desired schedule, we recommend Option 1

Natural Hazard Mitigation Plan Update 2023

Thank you!

CITY OF CAMBRIDGE

Weston & Sampson SM

Appendix B

Hazard Mitigation Planning Team Materials

YOU'RE INVITED!

You're invited to be on the City of Cambridge's Hazard Mitigation Planning Team!

The City has identified you as someone with a unique and valuable perspective on impacts of natural hazards, vulnerabilities, and risks facing the community in Cambridge. **Therefore, the City is inviting you to be a part of the Hazard Mitigation Planning Team (HMPT).** The HMPT is a team of local experts and community representatives who will be instrumental in developing an effective, meaningful, and ambitious plan for the resiliency and safety of the Cambridge community.

The City of Cambridge is updating its Hazard Mitigation Plan, which will study risks from natural hazards (such as flooding, winter storms, periods of extreme temperatures, etc.) and introduce approaches to address these hazards now and in the future. Your contributions in the workshops will be reviewed and incorporated into the plan, and you will also have the opportunity to give feedback on the final draft of the plan. Your participation will inform strategies for the resilience, security, and wellbeing of Cambridge.

If you are interested in participating in the HMPT, please fill out this **brief survey to indicate dates and times** that work best for you for these workshops: https://forms.office.com/r/MS6kdNBQCm

Survey Here!

Will you help?

***Expected Commitment*:**

- HMPT members should attend three (3) 1.5-hour Summer Workshops over the next four months. Dates and times of workshops will be chosen to best accommodate everyone on the Team, so please share your needs and scheduling preferences in the brief survey below.
- (optional) Join the Street Team (details will be shared at the first Workshop)

Your experiences and ideas are invaluable to the City and we look forward to your participation. **Thank you in advance for your contributions to the resilience and wellbeing of Cambridge!**

Cambridge HMPT Workshop Attendance List				
Contact	**Organization**	**Workshop #1 - June 29, 2023**	**Workshop #2 - July 11, 2023**	**Workshop #3 - July 25, 2023**
		Attended	Attended	Attended
David Morgan	Town of Arlington Department of Planning and Community Development		X	
Brooke Amendola	City of Boston Office of Emergency Management (OEM)	X		
Mikayla Criger	City of Boston OEM	X		X
Nikhil Nadkarni	City of Cambridge Community Development Department (CDD)		X	
Rachel Tanenhaus	City of Cambridge Commission for Persons with Disabilities	X	X	X
Nahid Chowdhury	CDD	X	X	X
Susanne Rasmussen	CDD	X		X
Michele Scott	City of Cambridge Community Safety Dept.	X		X
Catherine Woodbury	City of Cambridge Department of Public Works (DPW)	X	X	X
Tina Alu	Cambridge Economic Opportunity Committee, Inc.			X
Peter Vellucci	City of Cambridge Police Department	X		X
Julie Greenwood-Torelli	City of Cambridge Water Department			X
Ali Sorrels	Cambridge Women's Center	X		X
Sherry Bernard	Christian Life Center (Elnora Yard Food Pantry)	X		X
Cliff Cook	CDD	X		
Jeff Amero	City of Cambridge Information Technology Department (ITD)	X		
Jennifer Letourneau	City of Cambridge Conservation Commission	X	X	X
Leila Mekias	CDD	X	X	X
Lindsay Diaz	City of Cambridge Department of Human Service Programs (DHSP)		X	X
Melissa Castillo	DHSP	X		X
Phoebe West	City of Cambridge Office of the Housing Liaison + Multiservice Center	X		
Vernon Walker	Communities Responding to Extreme Weather (CREW)	X		
Susan Pacheco	City of Cambridge Council on Aging, Senior Center	X	X	
Nancy Porter	Cambridge Public Health Department (CPHD)			X
Sam Lipson	CPHD	X		
Julie Wood	Charles River Watershed Association	X		X
Celeste DePalma	MA Department of Conservation and Recreation (DCR)	X		X
Mike Galvin	DCR	X		
Mike J Nelson	DCR	X		
Robert Lowell	DCR	X		
Sarah J White	DCR	X		
William Gode	DCR	X		
Jason W Wright	Eversource		X	X
Pasang Lhamo	Friend of Jerry's Pond			X
Eric Grunebaum	Friends of Jerry's Pond, Friends of Alewife Reservation			X
Steven Nutter	Green Cambridge			X
Bill VanSchalkwyk	Harvard University	X		
Joanne Kossuth	Lesley University	X	X	
Barry Keppard	Metropolitan Area Planning Council	X		
Hannah Lyons-Galante	Massachusetts Bay Transportation Authority	X		
Suzanne Blake	Massachusetts Institute of Technology	X		X
Hillary Monahan	Massachusetts Water Resources Authority	X		
Emily Sullivan	City of Somerville	X	X	
Sarah Gyorog	Transition House	X		
Laurel Schwab	Town of Watertown	X	X	
Crystal Rosa	Cambridge Human Rights Commission	X	X	
Jim Wilcox	DPW	X	X	
Darrin Korte	Cambridge Community Center	X		
Mhamed Jounaidi	CDD		X	
Mike Johnston	Cambridge Housing Authority		X	
Rebecca Bowie	Cambridgeport Neighborhood Association	X		
Sean Sweeney	ITD	X		

Abebe Kelemework	CDD	X		
Ruth Ryals	Buena Vista Social Club	X		
Total Attendees		**42**	**17**	**23**

City of Cambridge
2023 Hazard Mitigation Plan Update
Hazard Mitigation Planning Team
June 29, 2023
10:00 to 11:30 AM

AGENDA HMPT WORKSHOP 1

10:00 AM Welcome & Introductions

- Introductions/Slido
- HMP Team Overview
- Ground Rules

10:05 AM Presentation

- Overview of Hazard Mitigation Plan
- Project Goals and Asset Inventory

10:20 AM Asset Inventory Activity

- Google Sheets Activity: participants will give input on hazards and vulnerabilities for specific assets
- 30+ minutes on the first category on the sheet
- Remaining time on other asset category/ies

11:15 AM Reconvene + Closing Thoughts

- Closing reflections from small group – quick highlights
- Final Slido question: Actions and Strategies

11:25 AM Next Steps

- Share additional ideas through the HMPT Inventory Survey by Jul. 6
- Next HMPT Workshop dates
  - Tue., Jul. 11: 6pm-7:30pm
  - Tue., Jul. 25: 4pm-5:30pm
- Public Survey

11:30 AM Conclude

Hazard Mitigation Plan Update 2023

HMPT Workshop 1
June 29, 2023

CITY OF CAMBRIDGE

Weston & Sampson SM

WELCOME

Introduce yourself in the ***chat***

HMPT ***Facilitators*** *will help lead the workshop*

City Officials *leading this project are here today*

Leila Mekias
Climate Resilience Project Planner

Robin Seidel
Project Manager, Weston & Sampson

Janet Moonan
Project Technical Lead, Weston & Sampson

Susanne Rasmussen
Director of Environmental and Transportation Planning

Joanna Nadeau
Senior Project Planner, Weston & Sampson

Emily Judson
Resiliency Planner, Weston & Sampson

GROUND RULES

- One mic, one person speaks at a time
- Step up, step back – share the air
- Be as present as you can
- Take away stories, not names
- Be respectful, be kind
- Speak from the heart, listen from the heart
- Trust you will know what to say

AGENDA

- Welcome & Introductions
- Overview of the Hazard Mitigation Plan
- Project Goals and Community Assets
- Asset Inventory Activity
- Reconvene + Discussion
- Next Steps + Conclude

AGENDA

- Welcome & Introductions
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HMP TEAM

City Staff

Steering Committee

Group of key City staff responsible for making final planning decisions. Steering Committee Meetings will guide the planning process, endorse draft Goals, and members will participate in Hazard Mitigation Planning Workshops.

Stakeholders

Hazard Mitigation Planning Team (HMPT)

Group of stakeholders bringing a wide range of local expertise and perspectives. The group will include advocates, residents, business-owners, state and local agency representatives, and people from various other organizations.

Outreach

Outreach Team

City team who can help with in-person and virtual outreach and engagement events. This could include activity at local community organizations, schools, events, door-to-door outreach, and others engagement.

Public

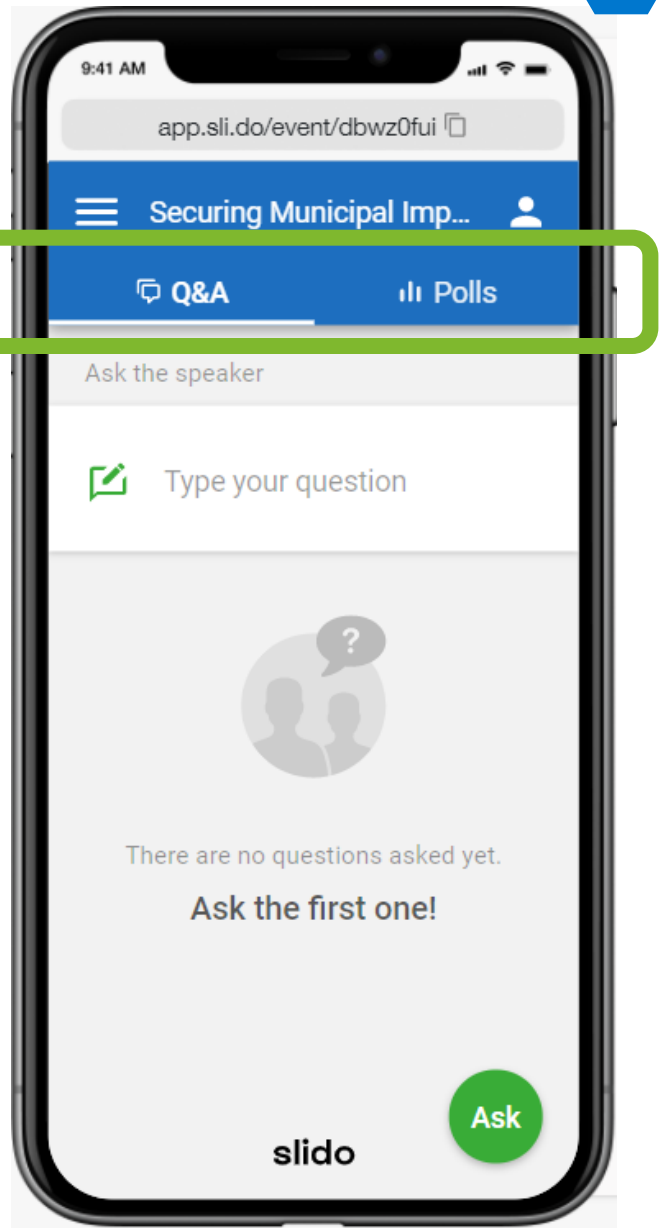
Public Engagement

Public Meetings will be an opportunity to educate about the HMP, share progress, and gather feedback and ideas. Results from these meetings and other feedback will be integrated into the final report. The group will include advocates, residents, business-owners, state and local agency representatives, and people from various other organizations.

The HMPT Members are key players in the overall engagement strategy

JOIN US ON SLIDO!

1. Get your phone ready
2. Follow instructions or use the QR code:

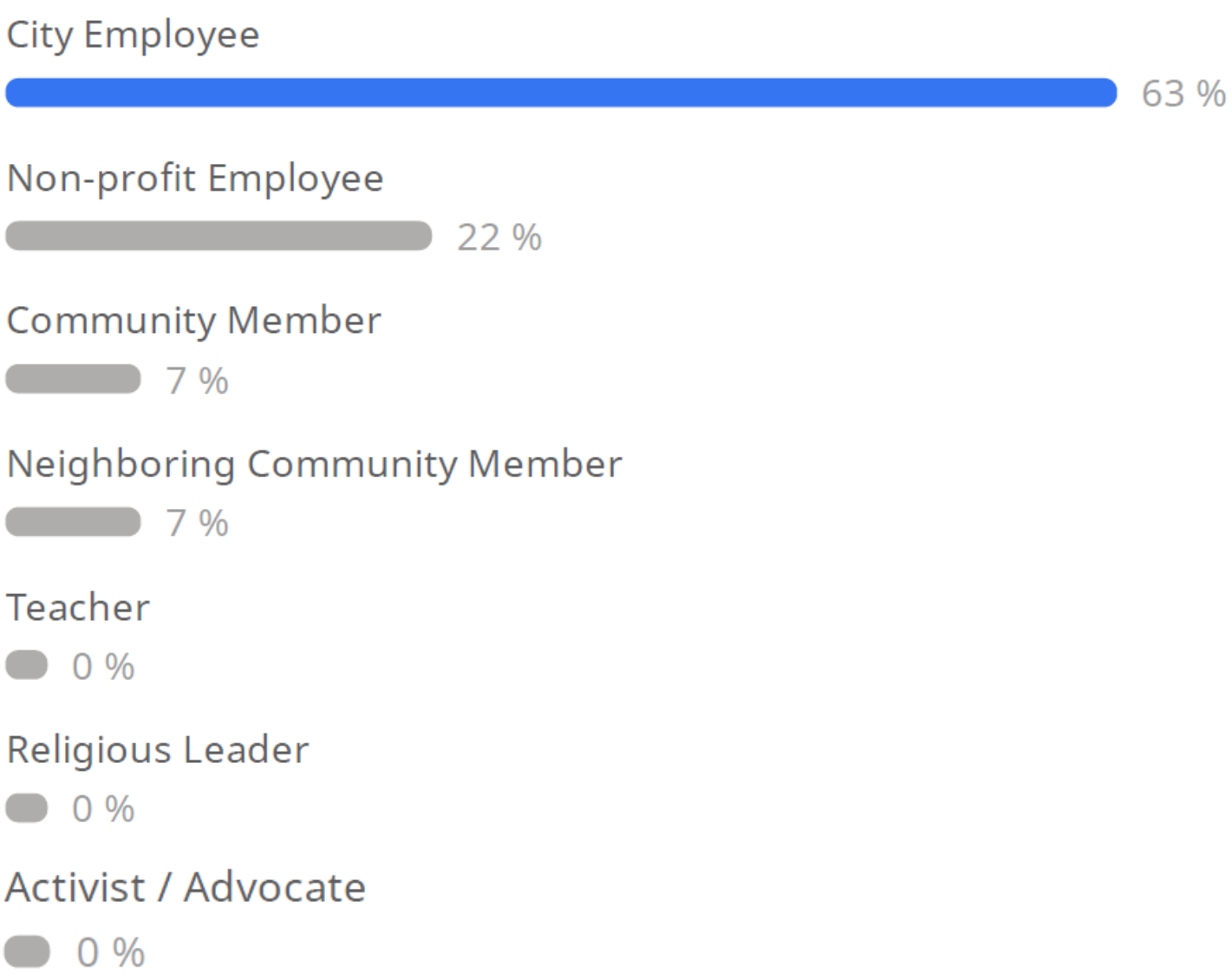


You can move between the Q&A tab and the polls tab!

INTRODUCTIONS

Who is here with us today?

RESULTS


City Employee
63 %
Non-profit Employee
22 %
Community Member
7 %
Neighboring Community Member
7 %
Teacher
0 %
Religious Leader
0 %
Activist / Advocate
0 %

AGENDA

- Welcome & Introductions
- Overview of the Hazard Mitigation Plan
- Project Goals and Asset Inventory
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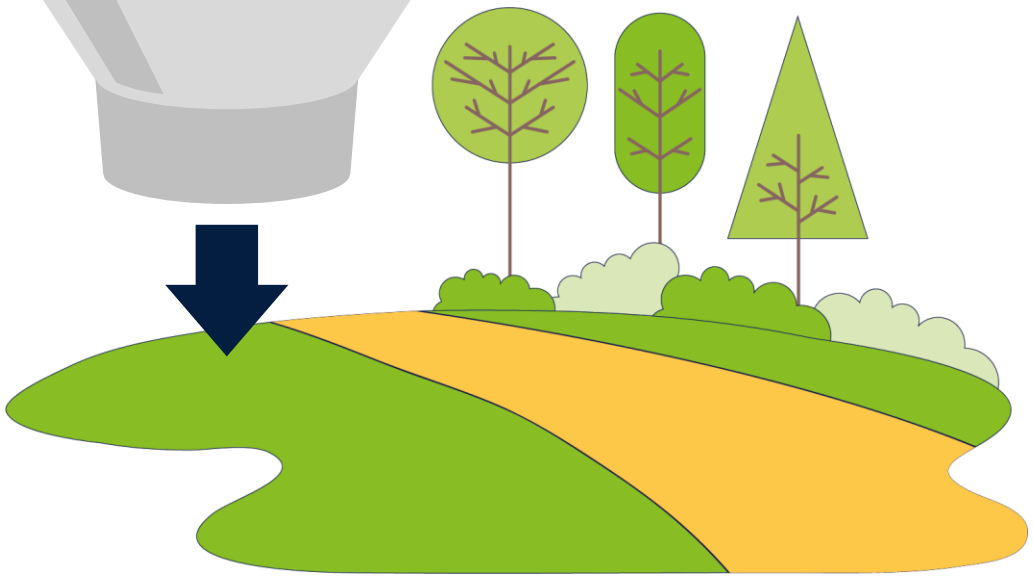
- Reconvene + Closing Thoughts
- Next Steps + Conclude

WHAT IS HAZARD MITIGATION?

Reduce impacts from natural hazards…

…through plans, projects, and services.



NATURAL HAZARDS

HURRICANES / TROPICAL STORMS

INLAND FLOODING

EXTREME TEMPERATURES

SEVERE WINTER WEATHER / NOR'EASTERS

COASTAL FLOODING

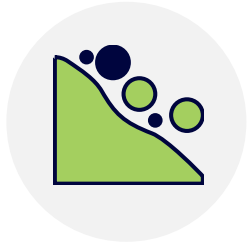
TSUNAMI

DROUGHT

WILDFIRE

EARTHQUAKES

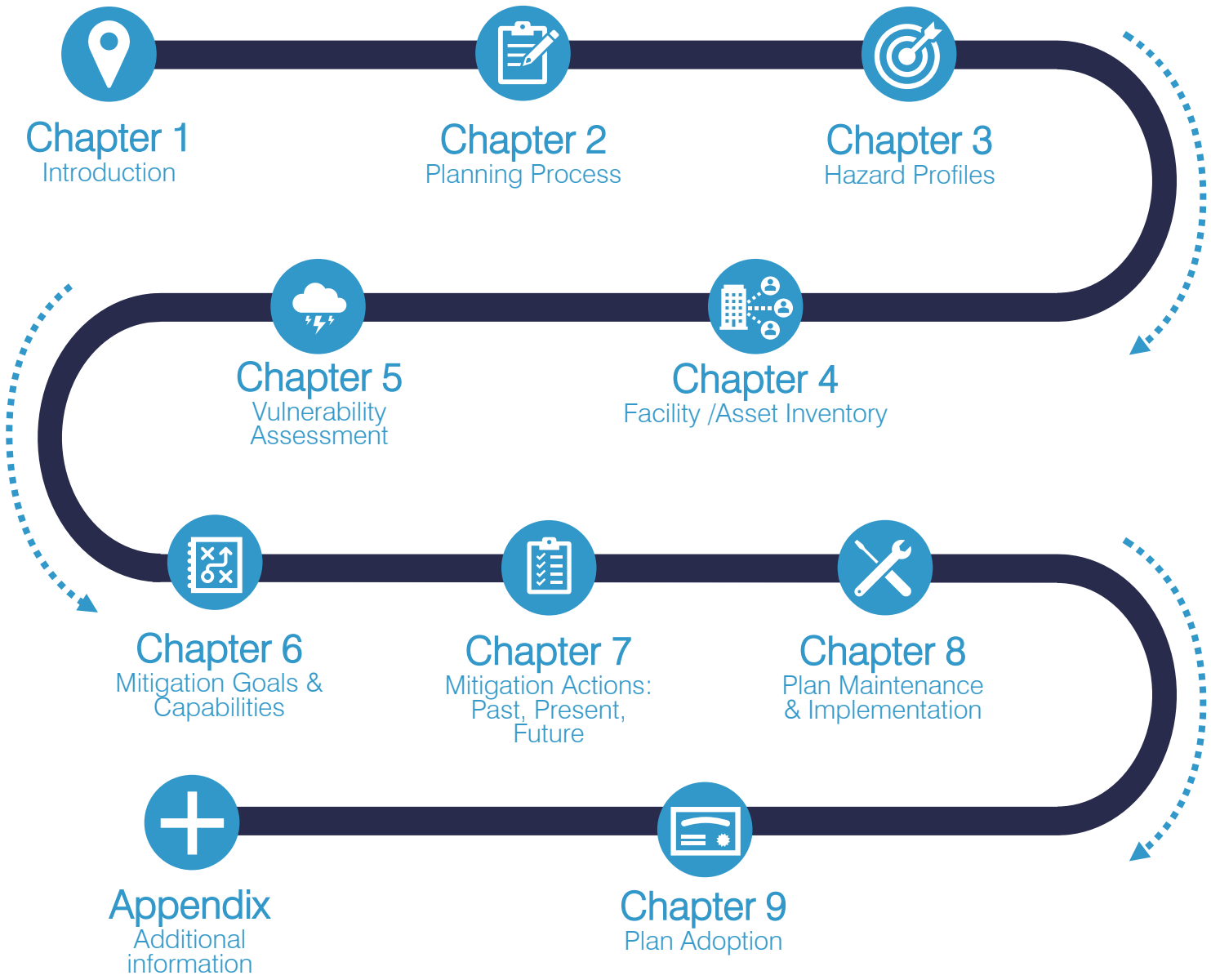
TORNADOES



LANDSLIDES

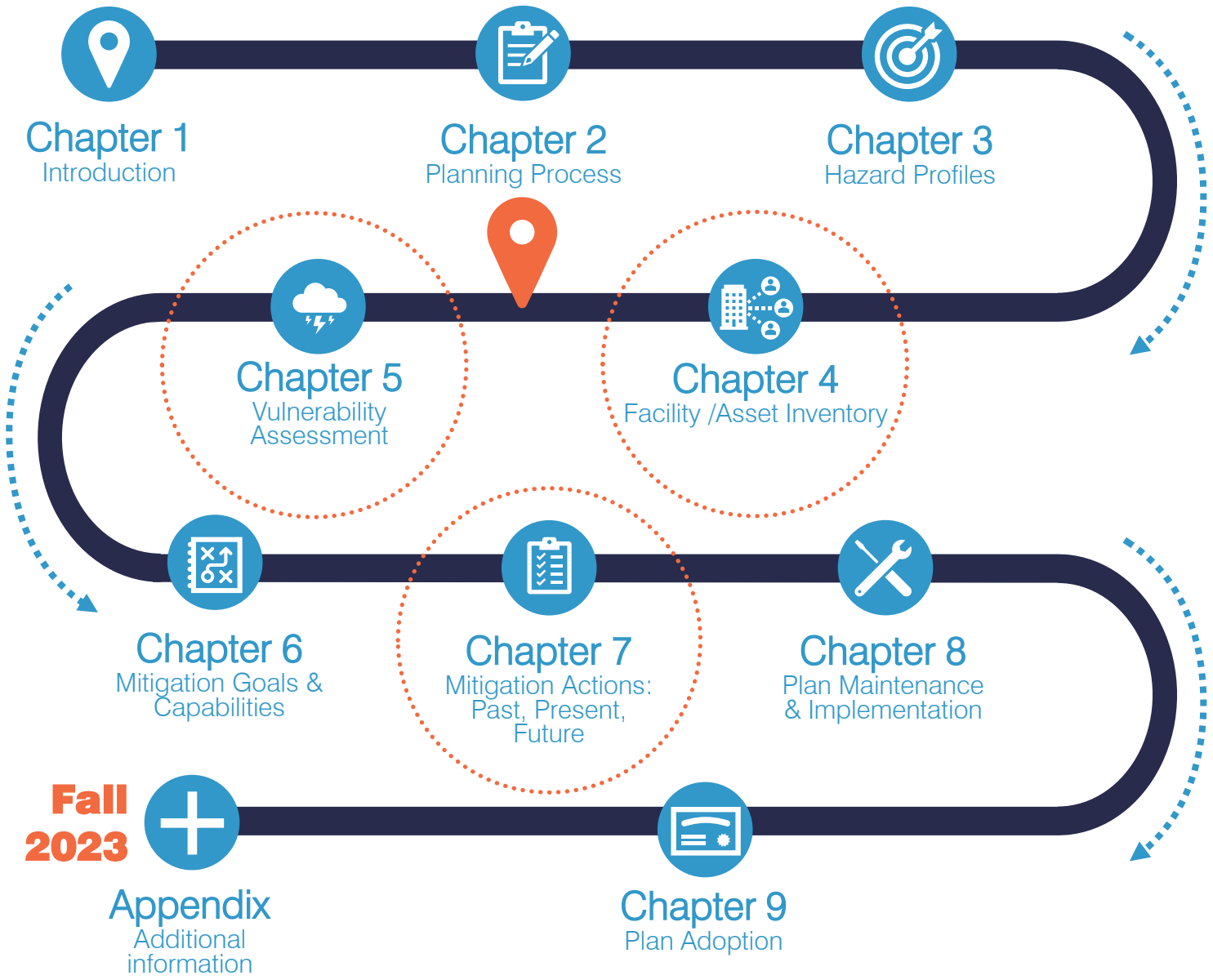
INVASIVE SPECIES

HMP OVERVIEW



HMP OVERVIEW

WHY ARE WE HERE TODAY?



Your input today will directly impact the **Facility/Asset Inventory Chapter,** as well as the **Vulnerability Assessment** and **Mitigation Actions**

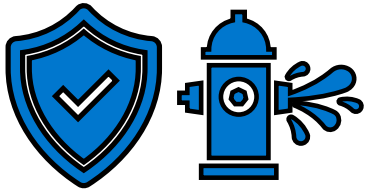
AGENDA

- Welcome & Introductions
- Overview of the Hazard Mitigation Plan
- **Project Goals and Asset Inventory**
- Asset Inventory Activity
- Reconvene + Closing Thoughts
- Next Steps + Conclude

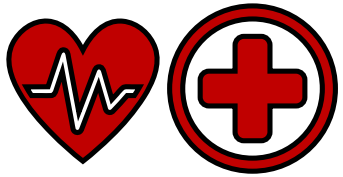
MITIGATION GOALS

Protect	Equitably ***Protect*** Health and Safety of the Community
Communication	Promote Public Preparedness and Resilience through ***Communication***
Coordinate & Collaborate	***Coordinate and Collaborate*** among City Departments and with Community Partners on Hazard Mitigation Planning & Climate Adaptation
Sustainably Invest	Plan for & ***Sustainably Invest*** in Priority Hazard Mitigation Implementation
Monitor & Respond	Improve Capacity to ***Monitor*** Natural Hazards and ***Respond*** to Changes

ASSET INVENTORY



Safety & Security



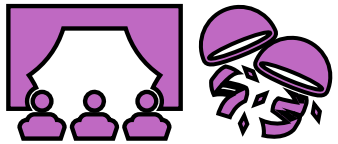
Health & Medical

Transportation

Food, Water, Shelter

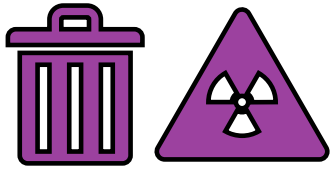
Parks & Greenspace

Communications



Cultural, Historic, & Events

Energy



Hazardous Material Management

ASSET INVENTORY EXAMPLES

People	Structures	Systems	Resources	Activities
Assets that serve populations that are more vulnerable to disaster (e.g., elderly, children, visiting populations) and/or serve densely populated areas.	**Built facilities that provide community lifeline services.** A community lifeline enables the continuation of critical government and business functions and is essential to human health and safety or economic security.	A **collection of components that perform a critical service for the community**. Examples include public transportation, railways, communications, powerlines, streets, water infrastructure.	**Natural, cultural, and historic resources** provide resiliency benefits, socio-economic benefits, or community benefits. They may also be sensitive habitats or assets historical significance that are vulnerable to hazard events.	**Activities** that benefit the community by **increasing community morale and well-being.** Activities may include education and knowledge transfer.

ASSET INVENTORY CATEGORIES

People

- Child and Youth Services
- Hospitals
- Housing
- Schools
- Shelter

Structures

- Emergency Shelters
- Grocery Stores
- Fire Stations
- Food-related Services
- Gas Stations
- Tunnels

Systems

- Power Grid
- Cell Towers
- Energy System Power Plant
- Major Roads
- Train
- Water System

Resources

- Open Space
- Places of Worship
- Public Art
- Water Bodies
- Historic Markers
- Landmarks and Easements

Activities

- Farmer's Markets
- Street Fairs and Festivals
- Public Health Fair
- Community Bike Rides

AGENDA

- Welcome & Introductions
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- **Asset Inventory Activity**
- Reconvene + Closing Thoughts
- Next Steps + Conclude

AGENDA

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CLOSING THOUGHTS

What are some valuable Activities in Cambridge?

RESULTS

- MSYEP parties and events
- Community iftar
- Head of the Charles
- Greek festivals etc at houses of worship
- Cambridge Science Fest
- Head of the Charles
- Talk to Daniel Wolf at CDD about play street and block parties. Talk to Nancy Rihan-Porter at Public Health about events she sponsors. Cambridge Community Corp out of Public Health for outreach. CET outreach teams at CDD and DHSP
- Radio in Spanish
- Head of the Charles
- Church activities
- Central sq starlight lounge
- Cambridge Dragon Boat Festival
- Danehy Family Day Fresh Pond Day Hoops-N-Health
- Riverfest, Port Pride Day, Pride Breakfast, block parties, Science Week
- Information sharing - April's Fair Housing Event
- Community building activities
- Farmers markets, community festivals
- Farmers markets, honk fest, road races
- Farmers markets; block parties;
- Jazz Fest, Annual Dance Party, Danehy Park Family Day
- Port pride day
- Events in the MIT Open Space (collaborative space between MIT and Cambridge in Kendall Sq.)

AGENDA

- Welcome & Introductions
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SAVE THE DATE

Workshop 2

When: July 11th

Time: 6 PM-7:30 PM

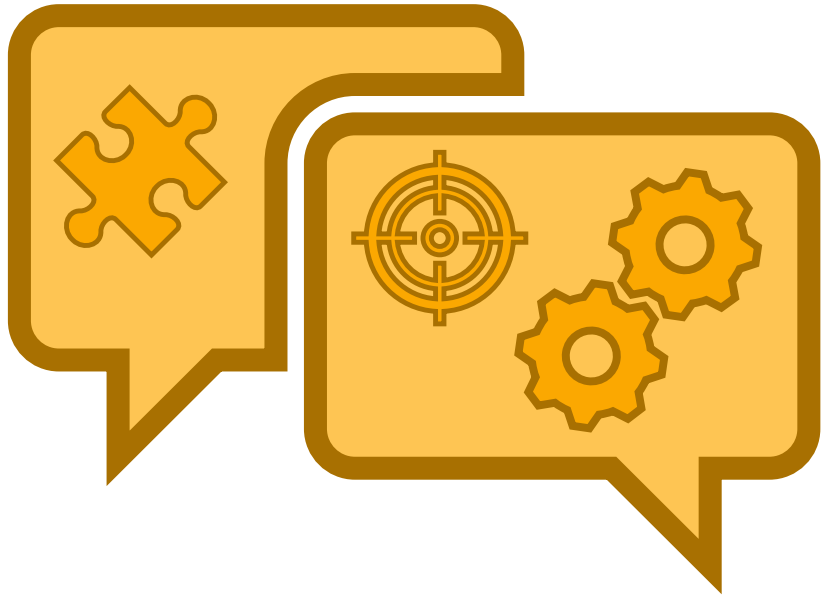
What: Discuss actions and strategies

Workshop 3

When: July 25th

Time: 4 PM-5:30 PM

What: Final Discussion



TAKE THE SURVEY!

This input will help shape the **strategies, projects, policies,** and **decisions** the City makes regarding natural hazards.

Please share with your networks!

Hazard Mitigation Plan Update 2023

Thank You!

CITY OF CAMBRIDGE

Weston & Sampson SM

HMPT Workshop #1: Asset Inventory

ASSET CATEGORY	ASSET TYPE	ASSETS: When you think of the people who use this asset type, which are the most important facilities or services for them in Cambridge?	Which natural hazards could most affect this asset?	How exactly might natural hazards impact the asset?	Who in the community will be most affected if this asset is impacted or unavailable?	Priority
PEOPLE Assets that serve populations that are more vulnerable to disaster (e.g., elderly, children, visiting populations) and/or serve densely populated areas.	**Child and Youth Services**	Out of School time Programs/ Non-profit and City Programs		The natural hazards listed can impact the asset by not allowing access to this resource.	Low income families, Black families	
	Housing	Populations: people living in affordable housing, voucher holders, people living in vulnerable housing situations, people who are doubled up, low income people	Extreme heat or cold, weather that causes outages	Both short term and long term impacts.		
		Resources: Cambridge Housing Authority, Multi-Service Center, Fuel Assistance, Cambridge Economic Opportunity Committee				
	Schools	MIT, Harvard, other schools				
		Schools (and Universities) have seasonal ebb and flow to their capacity and utilization Gyms and Athletic facilities are important as temporary				
		University population emergency response plans / housing				
	Shelter	Shelters for Homeless Individuals: Salvation Army, CASPAR, Harvard Square Homeless Shelter, St. Patrick's Women's Shelter, Y2Y, First Church, Heading Home. Warming Centers (seasonal), People in the family shelter system	Flooding	Many shelters are located in the basements of other structures	Our shelters are currently running at capacity, While we have put up temporary shelters for extreme weather events (such as the warming center) they do not have the ability to serve people for a longer term or with the same amenities as a longer term shelter system.	
	Transportation Infrastructure	Roadways	flooding, heat			
	Dams	Charles River Dam	flooding			
		AAD	flooding			
	People with Disabilities	Making sure people are at the table, assessing everyone's needs, bringing the lens of addressing all needs and many populations intersect		canary in the coalmine		
	Accommodating all needs, especially in emergencies					
	Unhoused people not in shelters	Outside sleepers- both generally around the City and populations in Alewife Brook and on the river	Forms of extreme weather	Outside sleepers are acutely affected by forms of extreme weather and many outside sleepers are not interested in going into shelters.		
	Emergency Resources / Redundancy Planning	Emergency housing				
		Hospital emergency spaces				
	Trusted Institutions / community centers	Cambridge Community Center - building trust over time so people know where to go in time of crisis https://www.cambridgecc.org/resiliencehub.html	Flooding, heat, storms			
	Community Organizations (local and regional)	Boston Center of Independent Living				
	Warming and cooling centers	for unhoused populations - get more info on improvements (Rachel/Pheobe)				
	Food distribution	Grocery stores, food pantry - affects all. Meals on wheels is a critical service for targeted group. When deliveries can't happen, could be several days and someone could not have anything to eat.	Flooding and severe winter storm - couldn't et deliveries. Power can also be an issue in that some food can't be stored but other food would be available.			

	Elderly Facilities (silver ribbon report has a list)		Extreme heat - used to worry about seniors but Cambridge housing has made a lot of improvements to adding AC, but have to be able to keep generators going and how much are we taxing the grid			
	Medication delivery	Those who receive delivery. Skinderian on Cambridge Street, Inman Sq Pharmacy. These two are locally owned and provide deliveries.	Storms, winds can down power lines and impact access			
	Public Pools	Allow people a place to go when it's hot out	Extreme heat			
	Shelters	Unhoused Individuals	Extreme heat would be a great risk			
	Hospitals/Health Centers	Mt Auburn Hospital/Cambridge Hospital				
	Youth Centers & Services	Day care facilities				
STRUCTURES Built facilities that provide community lifeline services. A community lifeline enables the continuation of critical government and business functions and is essential to human health and safety or economic security.	**Emergency Shelters, current shelters**	Get the list from the fire chief	All	power outages, too many people needing services	ALL	
	Police/Fire Stations	Main police station	All	power outages, resources constraints, communication	ALL	
	Ambulance Service/Emergency Response	Shelter on Albany St				
	Food-Related Service/Grocery	super markets/groceries; farmers markets; convenience stores; food pantries	Hurricane, tropics storms, flooding, snow, maybe earth quakes	power outages, resource constraints	All	
	Gas Station/EV chargers*(for now)	ev charging in municipal lots, Galleria parking garage	tropical storms, flooding, snow,	resource constraints	All	
	Bridges & Tunnels	All, including subway tunnels. MBTA Stations	hurricanes and flooding, snow storms, earthquakes,	impassable	All	
	Dams		flooding, hurricanes, winter storms	overtopping and flanking, failure	people in flood prone areas	
	transfer stations	outside the city		resources constraints, overfilling,	All	
	Hardware stores		snow, flooding,	Shortage of materials		
	Schools	preschools, primary schools	flooding, extreme temps, snow, * check if schools have AC,	power outages, family burden	EJ	
	Pharmacies	All	snow, flooding,	power outages	EJ	
	Libraries	Main Library and branches	flooding, hurricanes	power outages	EJ	
	Elderly Care Services	Elder care facilities, senior center	hurricane, snow, heat, flooding	any event which takes out the electricity . power outages	EJ	
	Municipal Facilities	DPW, City hall, City hall annex, water treatment plant	All	power outages	All	
	Community gathering places	Democracy center, Cambridge Women's Center, On the Rise, Material Aid and Advocacy Program, Salvation Army, Youth on Fire, Friday Cafe, Rindge Towers, Cambridge Community Center	hurricane, snow, heat, flooding	power outages, too many people needing services	EJ	
	Faith Community Buildings	Islamic Center of Boston, First Church (maybe include survey on which offer community services)	All	power outages, too many people needing services	EJ	
	Medical Facilities	Cambridge Health Alliance, Mount Auburn Hospital, Urgent Care Facilities. Maria Center(out patient care offering dialysis)	All	power outages, too many people needing services	EJ	
	Cambridge WTP		Flooding. Could have salt water intrusion into fresh pond if "stars were aligned" int erms of tides/storm surge.			
	Foundry					
	Fresh Pond Water Treatment plant		flooding; wind or extreme storms could cause disruption to the plant operation	flooding can undermine water mains- distribution; water quality issue if treatment plant is affect; saltwater intrusion	Do have an alternative supply within 2-3 hours; everyone; hospitals (water pressure); anyone without mobility/resources to get water; businesses and industry/bio tech	

	MWRA cottage farm WWTP facility					
	Payson Park (post treatment)					
SYSTEMS A collection of components that perform a critical service for the community. Systems are linear type assets. Systems may include horizontal assets associated with linear type assets.	**Cell Towers/Telephone Office**	Internet access via cell phone is the way that may lower income individuals. Internet network is more impact than perhaps telephone.	Flooding (inland/coastal)	Winter storm and hurricanes both have wind issue - can affect many systems and assets		
	Power Grid (ensuring power for Hospitals, police/fire communications, and backup generators)	Without functioning power, systems may fail	Severe winter weather	shut down portions of the grid		
	Citywide Wi-Fi					
	Energy System Power Plant					
	Backup Generators (Hospitals, nursing homes, assisted living, senior centers - community buildings - youth centers).	elderly, youth, vulnerable	eg protect fuel from flooding.			
	Hazardous materials and fuels	risk to flooding to cause environmental damage but also need to provide this service to all to evacuate and respond	e.g. protect gas stations from flooding			
	Major Roads (not evert street needs to be power, but there are critical streets that need to be maintained for emergency response - key routes and collectors (cambrike bike plan and collectors). Memorial Drive - DCR. Route 2/ Fresh Pond Parkway.		Severe winter weather	close all or some major roads		
	Train & Subway system	Could affect those that work at hospitals and nursing homes, provide critical response	Flooding is a big issue for red line. Flooding could be a big issue for Green line - esp. east Cambridge / north point sector. union square Somerville green line, too			
	Bus network	Keep Harvard square bus station open - critical. There is the electric bus facility on Mass Ave - may have particular need for power supply.				
	Water/Sewer/Stormwater	Water sewer are critical to maintain access for all health and safety				
	Police and Fire Communications and Vehicles					
	MWRA - Cottage Farm and Prison Point CSO facilities			Extreme winter storms impacts ability to get people to locations. Flooding risk is a top concern for MWRA.		
RESOURCES Natural Resources: Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Areas of sensitive habitat that are vulnerable to hazard events, protection of areas that are important to community objectives, such as the protection of sensitive habitat, provide socio-economic benefits, etc. Historical and Cultural Resources: Assets that posses historical, cultural, archaeological or paleontological significance,	**Open Space**	Charles River Reservation	Hurricane Flooding Drought Invasive Sp Fire Heat Flooding	Inundation of water, inaccessibility; downed trees/damage to natural habitat; erosion and riverbank impacts; water levels interacting with brownfields sites	Families with children losing open space access, esp. low income; ecosystem/other species; EJ Communities in denser neighborhoods, flood vulnerable locations (see clim vul plan) like the Port	
		Alewife River Reservation, incl stormwater wetland		Utility infrastructure disruption	power disruptions affect people with medical vulnerabilities and older adults; hospitals - incl water pressure loss; EJ communities	
		Fresh Pond Res., and Hobbs Brook distribution system		Water quality; harmful algal blooms	whole community affected by disrupted water supply	
		Jerry's Pond, Russell Field		Evacuation		
		Parks with water features, e.g. North Point Park		Disease from standing water, CSO backup/septic	health vulnerable populations/older adults	
		Quadrangle		water inundation to urban fill and 21E sites/haz mat release sites		
	Places of Worship	Harvard Square church buildings	Extreme storms, flooding, wind; earthquakes less likely	Power loss, wind damage, flood damage, loss of access; unofficial cooling centers and food distribution	People who rely on faith communities outreach/assistance; low income	
		CEOC				
		Margaret Fuller House				
		Cambridge Community Center				

including sites, contextual information, structures, districts, and objects significantly associated with or representative of earlier people, cultures, maritime heritage, and human activities and events.	**Community Gardens**	Longfellow House/Gardens			Visitors	
		Harvard Univ, MIT, incl art museums	Extreme storms, flooding, wind; earthquakes less likely	Power loss, wind damage, flood damage, loss of access	University community/students/staff; summer - international students/young adults (16-17)	
		Cemeteries: Mt Auburn, Cambridge	Flooding, wind damage	Damage to the site;historic resources and personal connections/families	All who value the cemetery history and those who are buried	
	Historic Sites and Districts	City Art Center (E Camb)			Families with kids losing access to this resource, affects community life	
		Austin Cooper				
		Danehy Park				
		Matignon HS				
	Arts and Cultural Facilities	Museum of Science				
	Restaurants, pharmacies, food markets, gas stations				When cooking at home is disrupted, need access to these	

City of Cambridge
2023 Hazard Mitigation Plan Update
Hazard Mitigation Planning Team
June 29, 2023
10:00 to 11:30 AM

NOTES HMPT WORKSHOP 1

Summary

Thirty-seven participants joined the workshop virtually and brainstormed key local assets in Cambridge, how those assets might be impacted by hazards, and who would be the most vulnerable to those impacts. The workshop format started with a presentation of natural hazards, an overview of the Hazard Mitigation Plan, and an overview of Assets. The assets were categorized by: People, Structures, Systems, Resources, and Activities. The participants were then broken into four groups to focus on one of the first four categories. After this exercise, the participants came back together to consider Activities as a group.

Key Findings

- The most concerning natural hazards were *flooding, winter storms,* and *extreme temperatures.*
- Assets in the *People* category that would be most impacted by natural hazards, especially for vulnerable groups, were shelters, housing, schools, and food distribution.
- Assets in the *Structures* category that would be most impacted by natural hazards, especially for vulnerable groups, were faith community buildings, medical facilities, transportation infrastructure, and Fresh Pond Water Treatment Plant.
- Assets in the *Systems* category that would be most impacted by natural hazards were the power grid, cell towers, MWRA facilities, and water/sewer system.
- Assets in the *Resources* category that would be most impacted by natural hazards, especially for vulnerable groups, were parks, open spaces, community gardens, and arts and cultural facilities.
- *Activities* included several Cambridge festivals and events like Head of the Charles, Cambridge Science Fest, farmers markets, Honk Fest, and other community-building activities that strengthen social resilience.
- The vulnerable groups that many participants were most concerned about were people with disabilities, currently unhoused people, low-income families, and households with language isolation.

City of Cambridge
2023 Hazard Mitigation Plan Update
Hazard Mitigation Planning Team
July 11, 2023
6:00 to 7:30 PM

AGENDA HMPT WORKSHOP 2

6pm **Introductions & Overview**
- Introductions + Ground Rules
- HMP Overview
- HMPT Workshop #1 Recap – hazards and assets
- What are hazard mitigation actions?
- Example mitigation actions completed in Cambridge

6:20 **Presentation: Actions for Structures**
- Overview of mitigation actions for Structures Asset Category

6:25 **Mitigation Activity: Structures**
- Google Sheets Activity: participants will give input on actions for assets in the Structures Asset Category

6:35 **Presentation: Actions for People**
- Overview of mitigation actions for People Asset Category

6:40 **Mitigation Activity: People**
- Google Sheets Activity: participants will give input on actions for assets in the People Asset Category

6:50 **Presentation: Actions for Systems**
- Overview of mitigation actions for Systems Asset Category

6:55 **Mitigation Activity: Systems**
- Google Sheets Activity: participants will give input on actions for assets in the Systems Asset Category

7:05 **Presentation: Actions for Resources**
- Overview of mitigation actions for Resources Asset Category

7:10 **Mitigation Activity: Resources**
- Google Sheets Activity: participants will give input on actions for assets in the Resources Asset Category

7:20 **Reconvene + Next Steps**
- *Final HMPT Workshop:* Tue., Jul. 25: 4pm-5:30pm
- Public Survey

7:30 **Conclude**

Hazard Mitigation Plan Update 2023

HMPT Workshop 2
July 11, 2023

CITY OF CAMBRIDGE

Weston & Sampson SM

WELCOME

Introduce yourself in the ***chat***

HMPT ***Facilitators*** *will help lead the workshop*

City Officials *leading this project are here today*

Leila Mekias
Climate Resilience Project Planner

Robin Seidel
Project Manager, Weston & Sampson

Janet Moonan
Project Technical Lead, Weston & Sampson

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GROUND RULES

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- Step up, step back – share the air
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AGENDA

- Introductions & Overview
- Mitigation Actions: **Structures**
- Mitigation Actions: **People**
- Mitigation Actions: **Systems**
- Mitigation Actions: **Resources**
- Next Steps + Conclude

AGENDA

- Introductions & Overview
- Mitigation Actions: **Structures**
- Mitigation Actions: **People**
- Mitigation Actions: **Systems**
- Mitigation Actions: **Resources**
- Next Steps + Conclude

HMP TEAM

City Staff

Steering Committee

Group of key City staff responsible for making final planning decisions. Steering Committee Meetings will guide the planning process, endorse draft Goals, and members will participate in Hazard Mitigation Planning Workshops.

Stakeholders

Hazard Mitigation Planning Team (HMPT)

Group of stakeholders bringing a wide range of local expertise and perspectives. The group will include advocates, residents, business-owners, state and local agency representatives, and people from various other organizations.

Outreach

Outreach Team

City team who can help with in-person and virtual outreach and engagement events. This could include activity at local community organizations, schools, events, door-to-door outreach, and others engagement.

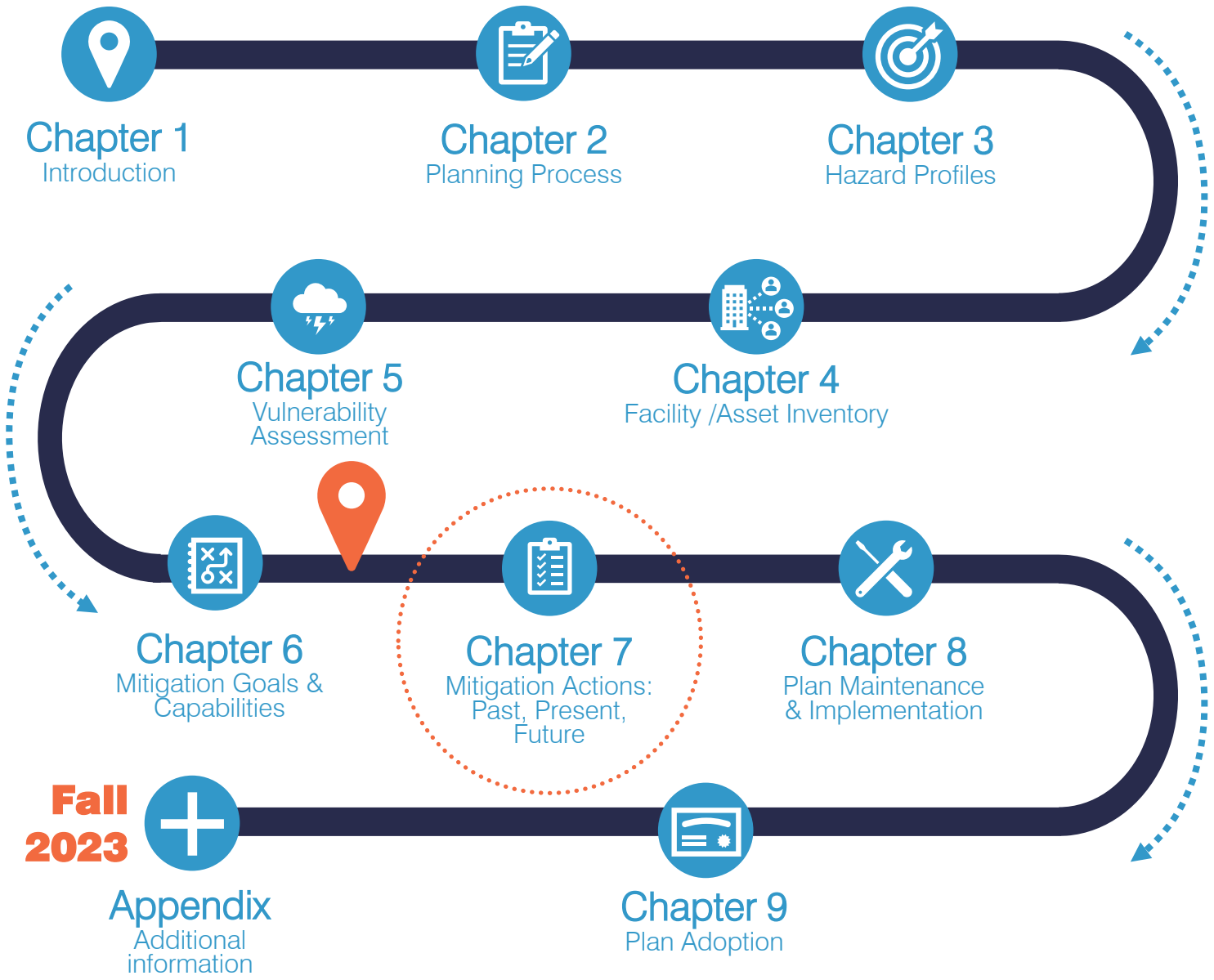
Public

Public Engagement

Public Meetings will be an opportunity to educate about the HMP, share progress, and gather feedback and ideas. Results from these meetings and other feedback will be integrated into the final report. The group will include advocates, residents, business-owners, state and local agency representatives, and people from various other organizations.

The HMPT Members are key players in the overall engagement strategy

WHY ARE WE HERE TODAY?

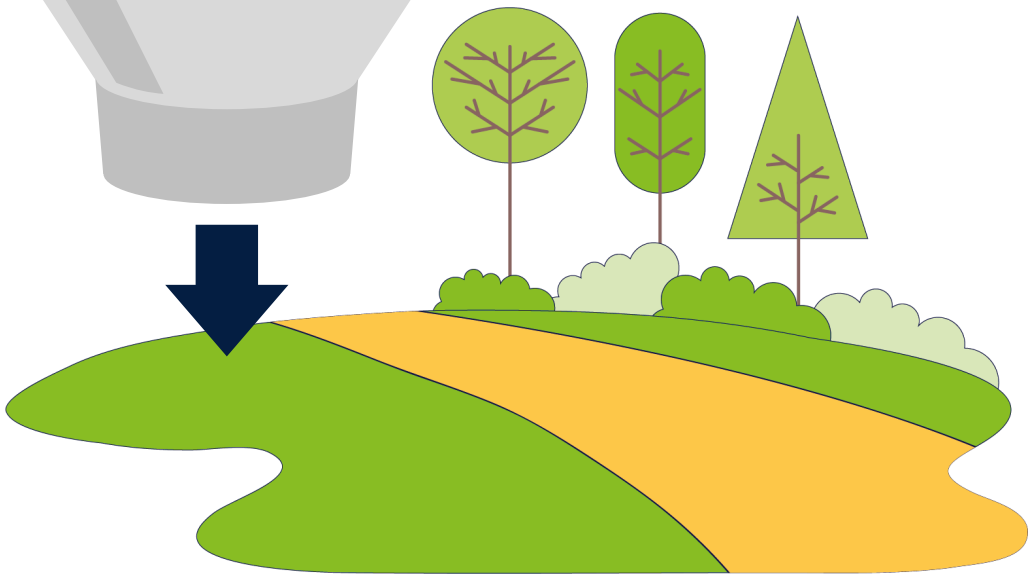


Your input today will directly impact the **Mitigation Actions** and how these actions can be **implemented** effectively and equitably.

WHAT IS HAZARD MITIGATION?

Reduce impacts from natural hazards…

…through plans, projects, and services.



NATURAL HAZARDS

HURRICANES / TROPICAL STORMS

INLAND FLOODING

EXTREME TEMPERATURES

SEVERE WINTER WEATHER / NOR'EASTERS

COASTAL FLOODING

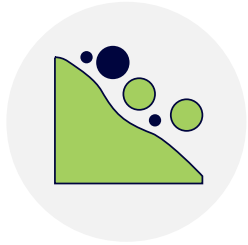
TSUNAMI

DROUGHT

WILDFIRE

EARTHQUAKES

TORNADOES



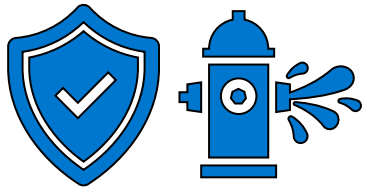
LANDSLIDES

INVASIVE SPECIES

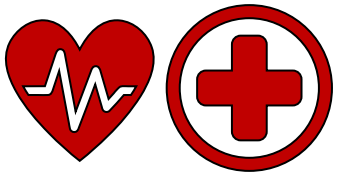
CAMBRIDGE MITIGATION GOALS

Protect	Equitably ***Protect*** Health and Safety of the Community
Communication	Promote Public Preparedness and Resilience through ***Communication***
Coordinate & Collaborate	***Coordinate and Collaborate*** among City Departments and with Community Partners on Hazard Mitigation Planning & Climate Adaptation
Sustainably Invest	Plan for & ***Sustainably Invest*** in Priority Hazard Mitigation Implementation
Monitor & Respond	Improve Capacity to ***Monitor*** Natural Hazards and ***Respond*** to Changes

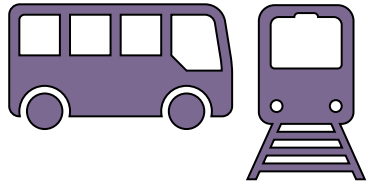
ASSET INVENTORY



Safety & Security



Health & Medical

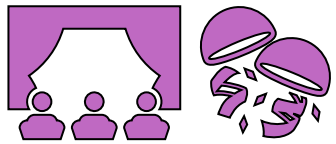


Transportation

Food, Water, Shelter

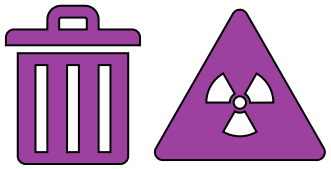
Parks & Greenspace

Communications



Cultural, Historic, & Events

Energy



Hazardous Material Management

HAZARD MITIGATION ACTIONS

A mitigation action is a measure, project, plan, or activity proposed to reduce current and future vulnerabilities.

Before an event

Local code and regulations
Maintenance
Proactive Structural Projects

During an event

Warnings
Protection of critical facilities
Emergency response

Following an event

Clean up
Restoration
Enhancement

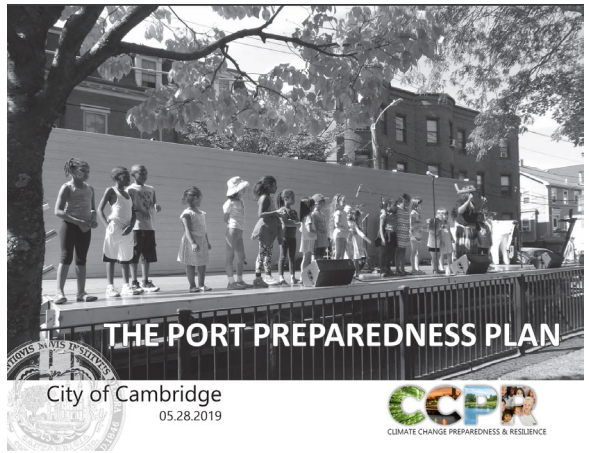
COMMUNICATIONS

This actions will create resilience for the City of Cambridge (ability to withstand and swiftly recover from an extreme event). These actions will support adaptation to climate change.

EXAMPLE MITIGATION ACTIONS COMPLETED IN CAMBRIDGE

Since 2015, the City has:

- ✓ Completed Climate Change Vulnerability Assessment
- ✓ Prepared Climate Change Preparedness & Resilience Plans
- ✓ Developed the Envision Cambridge Comprehensive Plan
- ✓ Reviewed Evacuation Protocol
- ✓ Completed hydraulic modeling for city
- ✓ Undertaken sewer separation projects
- ✓ Undertaken stormwater management projects
- ✓ Developed the Resilient Cambridge Plan
- ✓ Shared Cambridge Heat Viewer and Cambridge Flood Viewer
- ✓ Adopted climate resilience zoning amendment



The CCVA Report

Summary Report

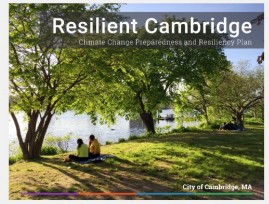
Resilient City Resilient People is an easy to read summary of the Resilient Cambridge Plan.

Download Resilient City Resilient People

Resilient Cambridge Plan

The Plan lays out the risks from climate change, the strategies, and the implementation schedule.

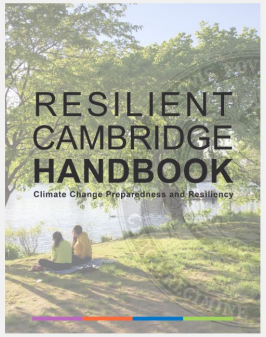
Download the Resilient Cambridge Plan



Resilient Cambridge Handbook

The handbook describes in detail the four categories of strategies in the Plan.

Download the Resilient Cambridge Handbook



AGENDA

- Introductions & Overview
- Mitigation Actions: **Structures**
- Mitigation Actions: **People**
- Mitigation Actions: **Systems**
- Mitigation Actions: **Resources**
- Next Steps + Conclude

STRATEGIES: STRUCTURES

Built facilities that provide community lifeline services. A community lifeline enables the continuation of critical government and business functions and is essential to human health and safety or economic security.

EXAMPLE IMPACTS TO STRUCTURES

MOST LIKELY HAZARDS

HURRICANES / TROPICAL STORMS

INLAND FLOODING

EXTREME TEMPERATURES

SEVERE WINTER WEATHER / NOR'EASTERS

EARTHQUAKES

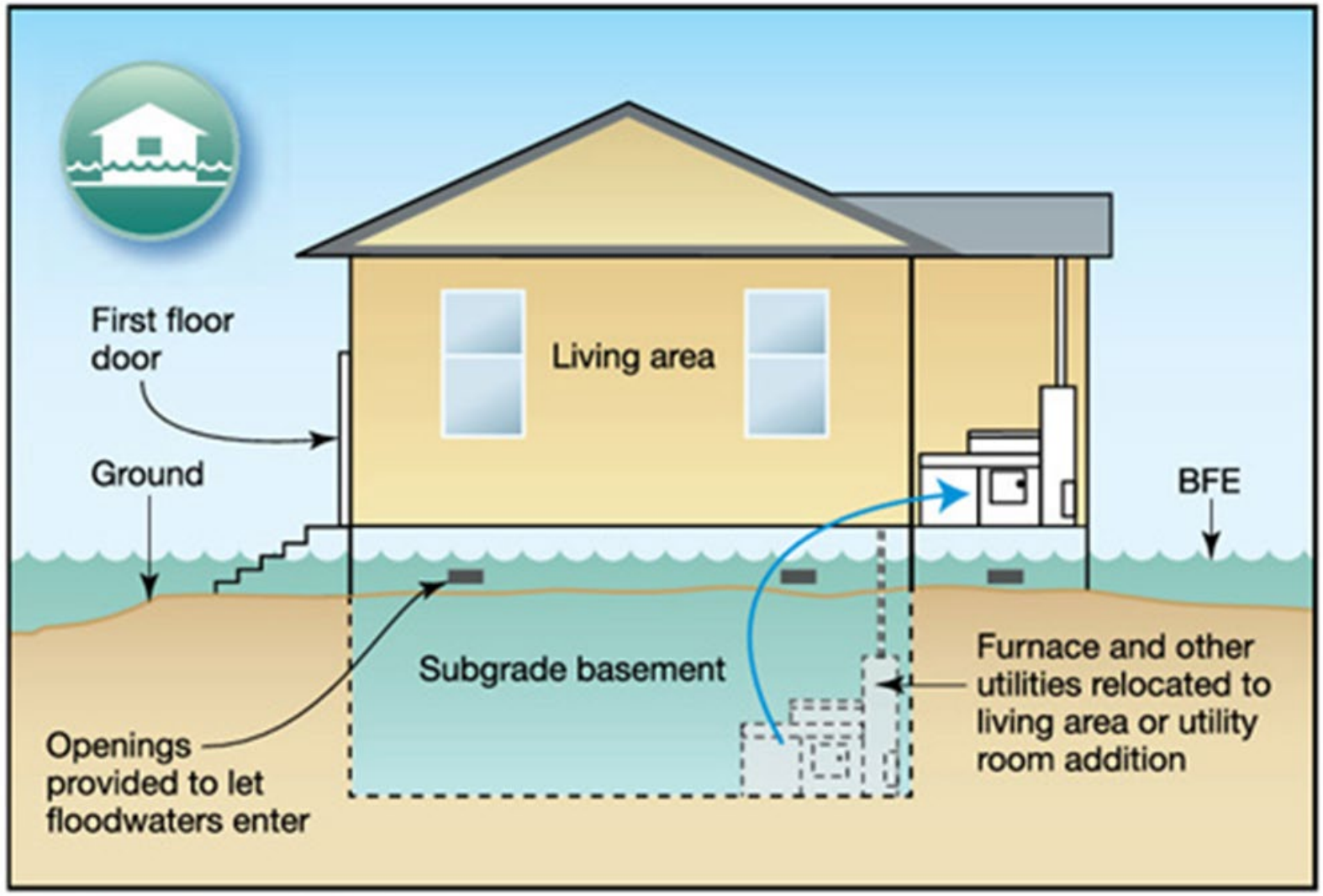
<u>Damage</u>
- Structural Failure
- Roof collapse

<u>Occupant Health & Comfort</u>
- Air quality
- Mold
- Public safety

<u>Loss of Use</u>
- Business downtime
- Relocation
- Lack of access to goods and services

FLOODING STRATEGIES

- Require new structures to build/protect to the 2070 10-year flood and recover from the 2070 100-year flood elevation
- Elevate or protect vulnerable utilities, such as fuel storage, furnaces, and electrical panels above 2070 100-year flood elevation
- Avoid using finished basements as living space if at risk of flooding
- Retreat
- Flood insurance



HEAT STRATEGIES

- Design buildings with passive strategies including building orientation, high-performance insulation and windows, shading, and natural ventilation, and cool or green roofs
- Design buildings with a high-performance building envelope
- Install cool, high solar reflectivity roofs
- Maximize opportunities for natural ventilation, upgrade building mechanical systems, and install ceiling fans (where applicable) for improved passive survivability

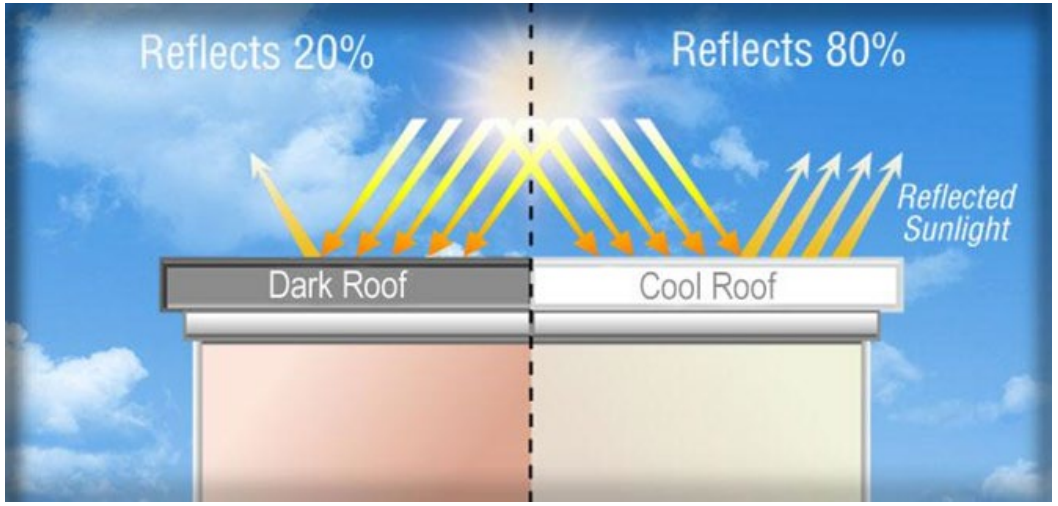


Figure 1: Dark vs. Cool Roof Surface Temperatures

A dark roof (left) becomes much hotter than a cool white roof (right) on a sunny afternoon.

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STRATEGIES: PEOPLE

Assets that serve populations that are more vulnerable to disaster (e.g., elderly, children, visiting populations) and/or serve densely populated areas.

EXAMPLE IMPACTS TO PEOPLE

MOST LIKELY HAZARDS

HURRICANES / TROPICAL STORMS

INLAND FLOODING

EXTREME TEMPERATURES

SEVERE WINTER WEATHER / NOR'EASTERS

WILDFIRE

<u>Public Safety</u>

- Building damage
- Windborne debris
- Medical transport

<u>Health & Comfort</u>

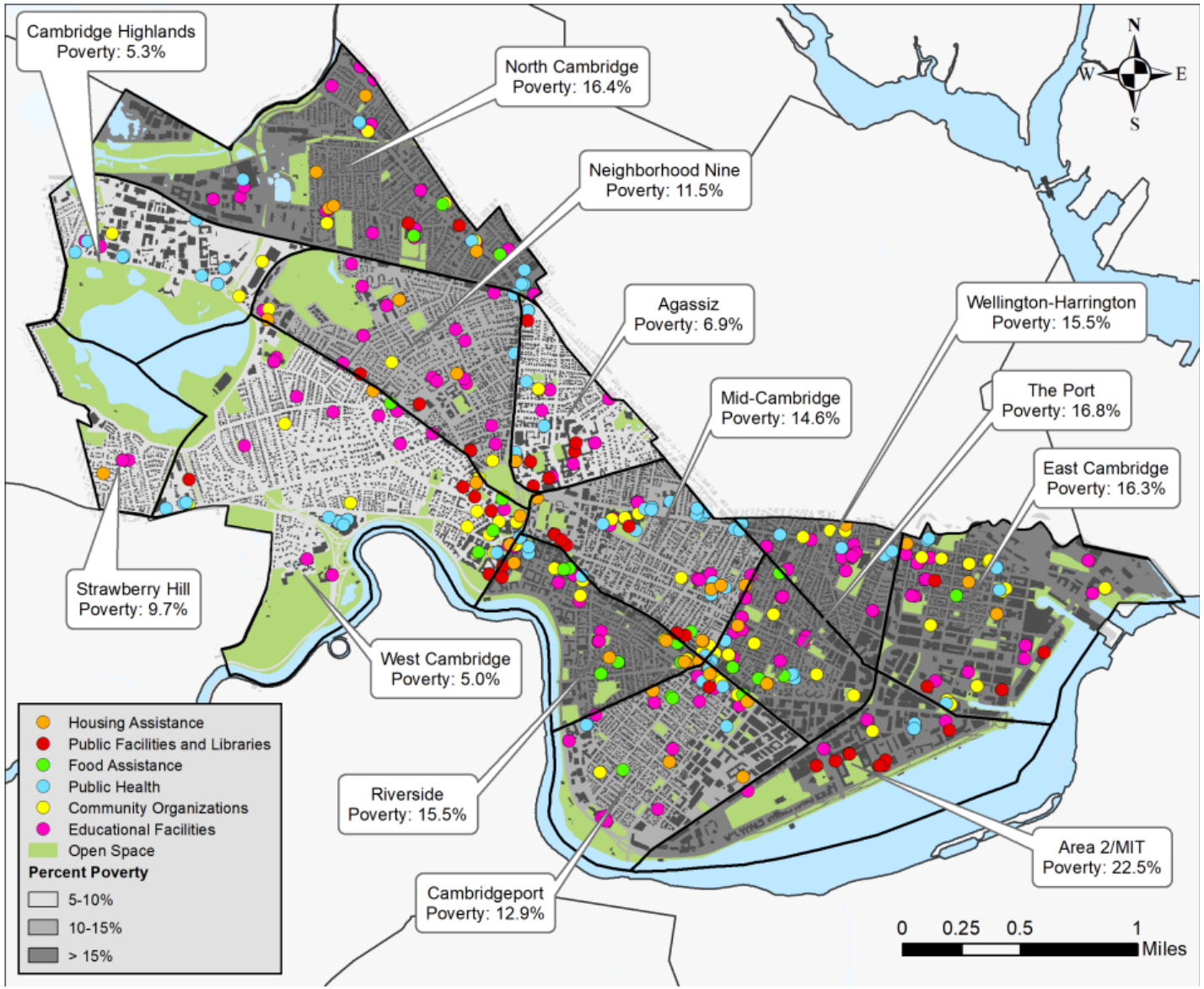
- Air quality
- Hypothermia
- Heat Exhaustion
- Long-term health affects

<u>Loss of Use</u>

- School closures
- Places to sleep (shelters, outdoors)
- Deliveries (meals, medication)
- Closed grocery/pharmacy

LOSS OF USE STRATEGIES

- Enhance Resilient Public Amenities
- Support Business and Organizational Preparedness
- Protect Community Resource Buildings
- Enhance Emergency Response Plans
- Provide For Healthcare Continuity and Access



HEALTH & COMFORT STRATEGIES

- Provide Neighborhood Resilience Hubs
- Create Support Systems For Populations At Risk
- Strengthen Emergency Communication Systems
- Encourage Stronger Social Network
- Continue Climate Education
- Support Renter Preparedness

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STRATEGIES: SYSTEMS

A collection of components that perform a critical service for the community. Systems are linear type assets. Systems may include horizontal assets associated with linear type assets.

EXAMPLE IMPACTS TO SYSTEMS

MOST LIKELY HAZARDS

HURRICANES / TROPICAL STORMS

INLAND FLOODING

EXTREME TEMPERATURES

SEVERE WINTER WEATHER / NOR'EASTERS

DROUGHT

<u>Public Safety</u>

- Drinking water supply
- Emergency communications

<u>Health & Comfort</u>

- Release of hazardous materials
- Combined Sewer Overflows, Sanitary Sewer Overflows/Basement Backups

<u>Loss of Use</u>

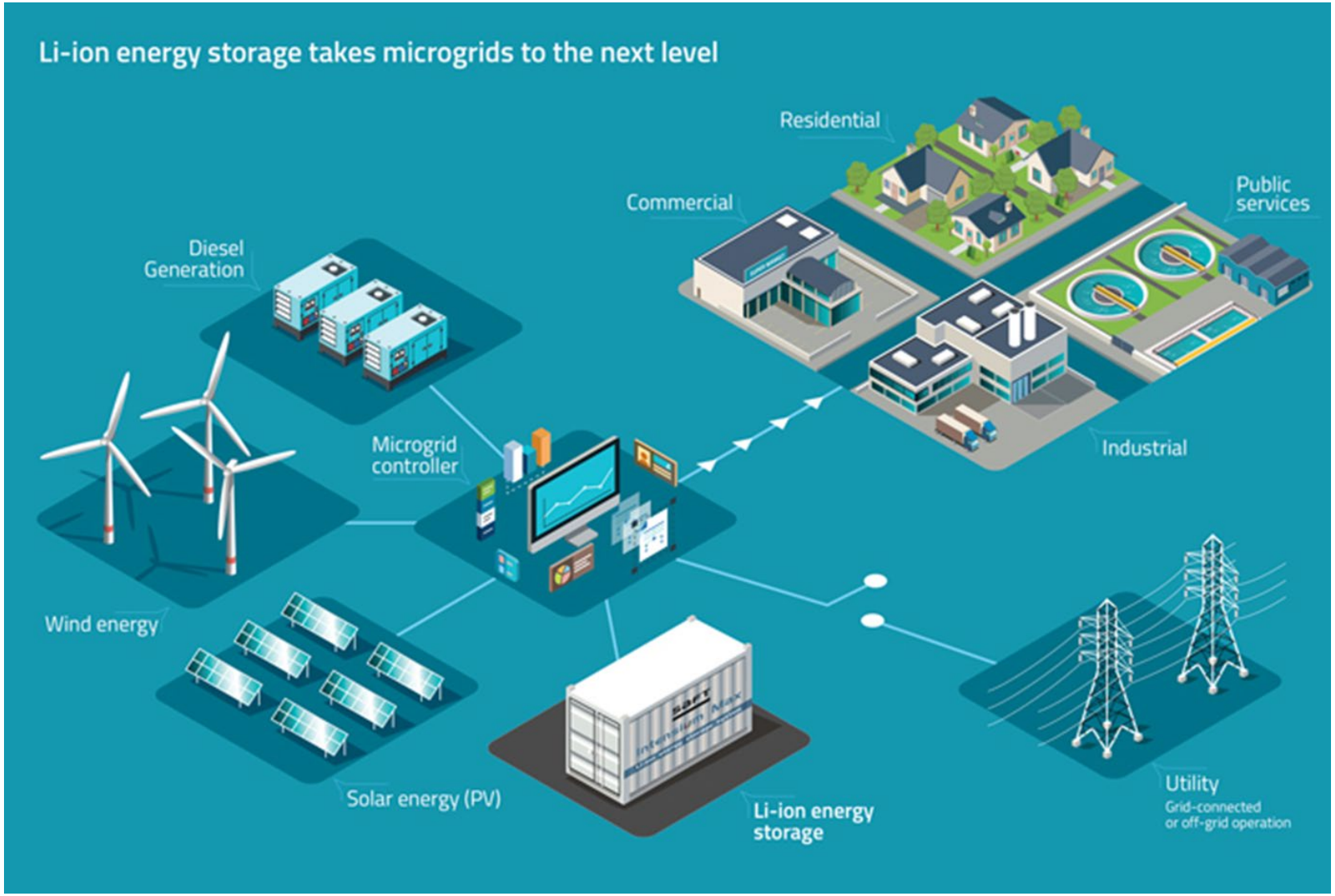
- Internet/Cellular connection
- Power grid
- Subway and buses

WATER STRATEGIES

- Continue the Combined Sewer Separation
- Upgrade Stormwater Storage
- Implement Green Infrastructure (GI) Opportunities For Stormwater Management
- Reduce Impervious Area

POWER & TRANSIT STRATEGIES

- Encourage the Resiliency of the Electrical Distribution System
- Enhance the Resiliency of the Transportation System
- Support Sustainable Energy Infrastructure
- Support a Resilient Telecommunication Network



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STRATEGIES: RESOURCES

Natural Resources: Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency, areas of sensitive habitat that are vulnerable, and areas that are important to community.

Historical and Cultural Resources: Assets that posses historical, cultural, archaeological or paleontological significance, including sites, contextual information, structures, districts, and objects significantly associated with or representative of earlier people, cultures, maritime heritage, and human activities and events.

EXAMPLE IMPACTS TO RESOURCES

MOST LIKELY HAZARDS

HURRICANES / TROPICAL STORMS

INLAND FLOODING

EXTREME TEMPERATURES

INVASIVE SPECIES

DROUGHT

<u>Public Safety</u>
- Downed trees

<u>Public Health</u>
- Vector-borne illness
- Recreation
- Harmful algal blooms

<u>Loss of Use</u>
- Playgrounds
- Open spaces
- Historic resources
- Art centers

<u>Environmental</u>
- Habitat loss
- Invasive species

COMMUNITY STRATEGIES

- Enhance Outdoor Thermal Comfort
- Seek Green Infrastructure Opportunities
- Expand and Improve Open Spaces
- Elevate or retrofit historic and culturally important buildings
- Create environmental corridors or areas of connected greenspace

ENVIRONMENTAL STRATEGIES

- Protect Fresh Pond Reservoir
- Provide For a Resilient Urban Forest
- Reduce Impervious Area
- Seek Green Infrastructure Opportunities
- Increase public education and outreach about the importance of native species and the dangers of invasive species

AGENDA

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SAVE THE DATE

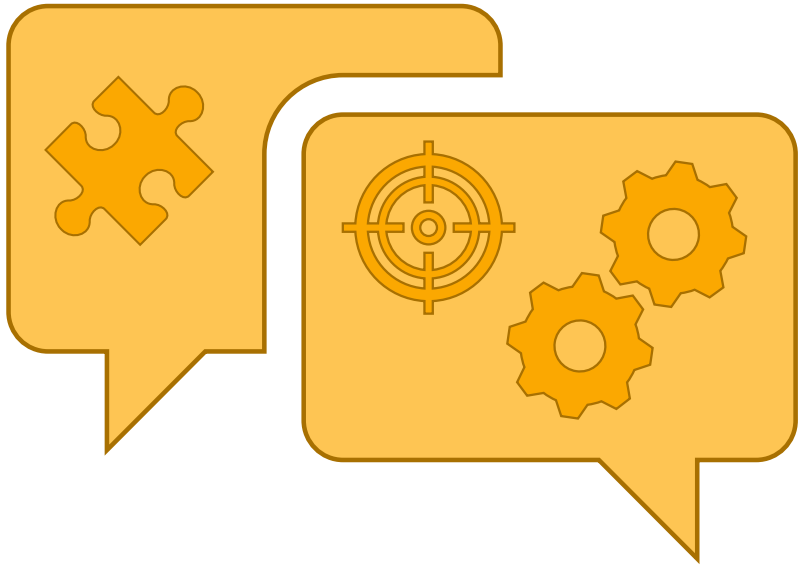
Workshop 3

When: July 25th

Time: 4:00 PM-5:30 PM

What: Prioritization of Mitigation Actions

Final workshop is two weeks from today!



TAKE THE SURVEY!

This input will help shape the **strategies, projects, policies,** and **decisions** the City makes regarding natural hazards.

Please share with your networks!

Hazard Mitigation Plan Update 2023

Thank You!

CITY OF CAMBRIDGE

Weston & Sampson SM

ASSET CATEGORY	ASSET TYPE	What hazard is this asset type (or specific asset) vulnerable to?	What are potential Mitigation Actions that could help?
STRUCTURES Built facilities that provide community lifeline services. A community lifeline enables the continuation of critical government and business functions and is essential to human health and safety or economic security.	Ambulance Service/Emergency Response	**Hurricanes/Tropical Storms**	**structural eval of buildings of a certain age**
	Bridges & Tunnels	**Inland Flooding**	how to coordinate with private facilities for emergency planning.
	Cambridge Water Treatment Plant	**Extreme Temperatures**	site specific resilience evaluation (electrical, backup electrical) - what would happen in an
	Community gathering places	**Severe Winter Storms/Nor'Easters**	
	Dams	**Earthquakes**	is there a plan in place if something were to disrupt? Ensure emergency plan exists. Be ready
	Elderly Care Services	**Coastal Flooding**	space available for additional shelters. can do a shelter assessment plan.
	Shelters (Emergency)	**Tsunami**	
	Faith Community Buildings	**Drought**	
	Food-Related Service/Grocery	**Wildfire**	
	Foundry	**Earthquakes**	
	Fresh Pond Water Treatment plant	**Tornadoes**	
	Gas Station/EV chargers*(for now)	**Landslides**	
	Hardware stores	**Invasive Species**	
	Libraries		
	Medical Facilities		
	Municipal Facilities		
	MWRA cottage farm WWTP facility		
	Payson Park (post treatment)		
	Pharmacies		
	Police/Fire Stations		
	Schools		
	Transfer stations		
PEOPLE Assets that serve populations that are more vulnerable to disaster (e.g., elderly, children, visiting populations) and/or serve densely populated areas.	Accommodating all needs, especially in emergencies	**Hurricanes/Tropical Storms**	**create campaigns for natural disasters (remember "stop drop and roll" and when you see a bear...we still remember these) what are tips we can share re: heat and other hazards. Catchy, plain language communication**
	Child and Youth Services	**Inland Flooding**	rindge ave swimming pool is a key resource when it's hot and the building AC is not working well. Ensure that the pools remain operational in power
	Community Organizations (local and regional)	**Extreme Temperatures**	other to support each other during extreme weather and other events...e.g. check-in on
	Dams	**Severe Winter Storms/Nor'Easters**	When it's extreemly hot and extreemly cold, are there ways to have neighborhood communications to foster improved resileicne. Build a map of neighbors to check on.
		Earthquakes	
		Coastal Flooding	
		Tsunami	

	Elderly Facilities	**Drought** **Wildfire**	Could something similar be done for elederly community for hot events. can't put AC in windows - buddy program
	Emergency Resources / Redundancy Planning	**Earthquakes**	
	Food distribution	**Tornadoes**	extend swimming pool hours
	Hospitals/Health Centers	**Landslides**	
	Housing	**Invasive Species**	"first time retrofitters" program like "first time homebuyers"
	Medication delivery		
	People with Disabilities		
	Public Pools		
	Schools		
	Shelter		
	Transportation Infrastructure		
	Trusted institutations / community centers		
	Unhoused people not in shelters		
	Waming and cooling centers		Informational page on hubs that can be used - go here to get wifi, go here to get a meal, needs to be accessable to any range of impairments.
SYSTEMS A collection of components that perform a critical service for the community. Systems are linear type assets. Systems may include horizontal assets associated with linear type assets.	Backup Generators @ Hospitals, nursing homes, assisted living, senior centers - community buildisngs - youth centers	**Hurricanes/Tropical Storms** **Inland Flooding**	
	Bus network	**Extreme Temperatures**	
	Cell Towers/Telephone Office	**Severe Winter Storms/Nor'Easters**	messaginging - loudspeaker. Door knocking program. All of life is so reliant on internet connection. May need reminder on old ways to communicate with one another. Way to get the word out to get to the community - groups,
	Citywide Wifi	**Earthquakes** **Coastal Flooding**	
	Energy System Power Plant	**Tsunami**	
	Hazardous materials and fuels	**Drought**	
	Major Roads (esp. critical streets that need to be maintained for emergency response - key routes and collectors (Cambridge bike plan and collectors). Memorial Drive - DCR. Route 2/ Fresh Pond Parkway.)	**Wildfire** **Earthquakes**	
	MWRA - Cottage Farm and Prison Point CSO facilities	**Tornadoes**	
	Police and Fire Communications and Vehicles	**Landslides**	

	Power Grid (ensuring power for Hospitals, police/fire communications, and backup generators)	**Invasive Species**	
	Train & Subway system		
	Water/Sewer/Stormwater		Messaging that the drinking water is okay to drink.
			Rapid depoyment signage so there is wayfinding in addition to where things are available.
RESOURCES Natural Resources: Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Areas of sensitive habitat that are vulnerable to hazard events, protection of areas that are important to community objectives, such as the protection of sensitive habitat, provide socio-economic benefits, etc. Historical and Cultural Resources: Assets that posses historical, cultural, archaeological or paleontological significance, including sites, contextual information, structures, districts, and objects significantly associated with or representative of earlier people, cultures, maritime heritage, and human activities and events.		**Hurricanes/Tropical Storms**	Public art, collaboratievely developed, can make publc spaces more welcoming, reiterate that if a park isn't welcoming in normal times, it won't be welcoming in an emergency.
		Inland Flooding	
		Extreme Temperatures	
		Severe Winter Storms/Nor'Easters	
	Arts and Cultural Facilities	**Earthquakes**	Provide public water for community gardens? The City has a farming program? share informatino on the farming program. People are relying ont hese. add shade structure?
	Community Gardens	**Coastal Flooding**	
		Tsunami	
		Drought	
	Historic Sites and Districts	**Wildfire**	
		Earthquakes	people do sports, yoga, dance, mutli use place. Important City make those places more wecloming and more accomodating to people.
		Tornadoes	Make parks more accomodating and welcoming. Drought would be a big concern - no trash pickup, no regulations enforced, dog walking, safety issues.
		Landslides	
		Invasive Species	
	Open Space (parks)		where to go during an earhtquake.
			Fire in churche at Prosect and Broadway - church, synogauge, mosque, sharing resouces. City can play a role in coordinating of
	Places of Worship		
	Restaurants, pharmacies, food markets, gas stations		

ASSET CATEGORY	ASSET TYPE	What hazard is this asset type (or specific asset) vulnerable to?	What are potential Mitigation Actions that could help?
STRUCTURES Built facilities that provide community lifeline services. A community lifeline enables the continuation of critical government and business functions and is essential to human health and safety or economic security.	Ambulance Service/Emergency Response	**Hurricanes/Tropical Storms** **Inland Flooding** **Extreme Temperatures** **Severe Winter Storms/Nor'Easters** **Earthquakes** **Coastal Flooding** **Tsunami** **Drought** **Wildfire** **Earthquakes** **Tornadoes** **Landslides** **Invasive Species**	**power structures have backup power/generators**
	Bridges & Tunnels		For inland flooding/coastal flooding, update flood maps to identify the areas that are most at risk of additional flooding
	Cambridge Water Treatment Plant		Pre storm - inspect infrastructure and make sure we clean out sediment and remove obstructions to allow stormwater to flow unimpeded
	Community gathering places		To enhance inventory of shelters (e.g. war memorial) - get polling places list bc they have been vetted for access, e.g. have working bathrooms (from Election Commission)
	Dams		Conduct inventory of muni buildings, schools, senior centers for power backups/generators, accessibility, evacuation capacity to build list.
	Elderly Care Services		For access disruptions (can't get to the central area), is there somewhere with backup resources/beds for sheltering in place
	Shelters (Emergency)		disruptions, what backups do you have? Explore a range of options, social media, TV, radio (incl people without smart phones)
	Faith Community Buildings		Impassable roads/isolated people means communication is essential - distribute info about channels where to get emergency info
	Food-Related Service/Grocery		Identify critical power loads within the buildings are identified and linked to backup (e.g. refrigerators)
	Foundry		Use clean energy solutions for power, solar, battery
	Fresh Pond Water Treatment plant		Evaluate resiliency of specific services on a case by case basis, e.g. Food pantries are often on the first floor and vulnerable to flooding
	Gas Station/EV chargers*(for now)		Coordinating with adjacent communities for event prep and response - community members use services across
	Hardware stores		
	Libraries		
	Medical Facilities		
	Municipal Facilities		
	MWRA Cottage Farm WWTP facility		
	MWRA Payson Park (post treatment)		
	Pharmacies		
	Police/Fire Stations		
	Schools		
	Transfer stations		
PEOPLE Assets that serve populations that are more vulnerable to disaster (e.g., elderly, children, visiting populations) and/or serve	Accommodating all needs, especially in emergencies	**Hurricanes/Tropical Storms** **Inland Flooding**	**people who need daily support (e.g. home health aid, dialysis, diabetes/insulin) - when their support networks may not be available (long term). e.g. Dialysis center and PCA**

densely populated areas.	Child and Youth Services	**Extreme Temperatures**	Encourage disability indicator 911 enrollment for list needing additional follow up response in an emergency
	Community Organizations (local and regional)	**Severe Winter Storms/Nor'Easters**	Increase emergency response personnel staffing and training on medical issues
	Dams	**Earthquakes**	Evaluate safe routes for people without cars who rely on other access (walk, bike, transit) - e.g. high points for flooding on a map
	Elderly Facilities	**Coastal Flooding**	Warming/cooling facilities
	Emergency Resources / Redundancy Planning	**Tsunami**	Outreach about financial measures to protect cooling and heating services
	Food distribution	**Drought**	Water fountains and cooling locations for people who are traveling on foot/bike during extreme heat
	Hospitals/Health Centers	**Wildfire**	
	Housing	**Earthquakes**	
	Medication delivery	**Tornadoes**	
	People with Disabilities	**Landslides**	
	Public Pools	**Invasive Species**	
	Schools		
	Shelter		
	Transportation Infrastructure		
	Trusted institutations / community centers		
	Unhoused people not in shelters		
	Waming and cooling centers		
SYSTEMS A collection of components that perform a critical service for the community. Systems are linear type assets. Systems may include horizontal assets associated with linear type assets.	Backup Generators @ Hospitals, nursing homes, assisted living, senior centers - community buildisngs - youth centers	**Hurricanes/Tropical Storms**	**Evaluate and develop redundancies for systems, e.g. water sewer pumps alternate and have a backup.**
	Bus network	**Inland Flooding**	Develop backup plans for transportation, MBTA staffing, which could include other/private shuttle services
	Cell Towers/Telephone Office	**Extreme Temperatures**	Backup/public wifi at the library, hotspots you can sign out.
	Citywide Wifi	**Severe Winter Storms/Nor'Easters**	(see above - resilient energy systems as backups)
	Energy System Power Plant	**Earthquakes**	Support existing gathering places for support - library, school - as opposed to new locations
	Hazardous materials and fuels	**Coastal Flooding**	Regular testing and checking of backup generators and power systems (every 6 mo) before emergency
	need to be maintained for emergency response - key routes and collectors	**Tsunami**	alerts, i.e. megaphone driving through the streets; e.g. phone tree; color coded flag system at muni buildings, fire
	MWRA - Cottage Farm and Prison Point CSO facilities	**Drought**	City communicate what the go-to information source people should use, e.g. air quality sites
	Police and Fire Communications and Vehicles	**Wildfire**	Access to T stations floods in Central St station - City could consider vulnerabilities of those sites

	Power Grid (ensuring power for Hospitals, police/fire communications, and backup generators)	**Earthquakes**	
	Train & Subway system	**Tornadoes**	
	Water/Sewer/Stormwater	**Landslides**	
		Invasive Species	
RESOURCES Natural Resources: Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Areas of sensitive habitat that are vulnerable to hazard events, protection of areas that are important to community objectives, such as the protection of sensitive habitat, provide socio-economic benefits, etc. Historical and Cultural Resources: Assets that posses historical, cultural, archaeological or paleontological significance, including sites, contextual information, structures, districts, and objects significantly associated with or representative of earlier people, cultures, maritime heritage, and human activities and events.	Arts and Cultural Facilities	**Hurricanes/Tropical Storms**	**with existing problems or projected impacts, identify potential grant funding/other funding sources, and pursue projects to secure the building, roof, fire prevention (smoke**
	Community Gardens	**Inland Flooding**	protecting/mitigating risks to and replacing public art assocated with public buildings, including Mass Cultural Council and other funding sources interested in the
		Extreme Temperatures	Engage City Arts Council in mitigation planning
		Severe Winter Storms/Nor'Easters	
		Earthquakes	
		Coastal Flooding	
		Tsunami	
		Drought	
	Historic Sites and Districts	**Wildfire**	inoculating and inventorying trees from invasive pests. Develop inventory of potential pests, which trees/plants would be most affected (and are they a priority) identify mechanisms to protect them, and strategies to replace trees with next successional item (e.g. sycamores on
		Earthquakes	identify areas for GI and reducing impervious surfaces to reduce flooding
		Tornadoes	Continue to address and reduce CSO issues and maintain effective communication about safe access (as with algae
		Landslides	Expanding shade structures, trees, splash pads at parks and open spaces for extreme heat days to enable family use
		Invasive Species	Protect/preserve golf course near water bodies - disruptions would affect people's recreation opportunities
	Open Space		
	Places of Worship		
	Restaurants, pharmacies, food markets, gas stations		

ASSET CATEGORY	ASSET TYPE	What hazard is this asset type (or specific asset) vulnerable to?	What are potential Mitigation Actions that could help?
STRUCTURES Built facilities that provide community lifeline services. A community lifeline enables the continuation of critical government and business functions and is essential to human health and safety or economic security.	Ambulance Service/ Emergency Response	**Hurricanes/Tropical Storms**	Most/All should have back up power. Public works has contract for city
	Bridges & Tunnels	**Inland Flooding**	eversource updates critical facilities annually
	Cambridge Water Treatment Plant	**Extreme Temperatures**	cambirgde housing authority(elder care services and shleters - have emergency back up in the
	Community gathering places		For extreme temps - dpw is conscious about roofing materials.
	Dams	**Severe Winter Storms/Nor'Easters**	
	Elderly Care Services	**Earthquakes**	
	Shelters (Emergency)		
	Faith Community Buildings	**Coastal Flooding**	
	Food-Related Service/Grocery	**Tsunami**	
	Foundry	**Drought**	
	Fresh Pond Water Treatment plant		
	Gas Station/EV chargers*(for now)	**Wildfire**	
	Hardware stores	**Earthquakes**	
	Libraries	**Tornadoes**	
	Medical Facilities		
	Municipal Facilities	**Landslides**	
	MWRA cottage farm WWTP facility	**Invasive Species**	
	Payson Park (post treatment)		
	Pharmacies		
	Police/Fire Stations		
	Schools		
	Transfer stations		
PEOPLE Assets that serve populations that are more vulnerable to disaster (e.g., elderly, children, visiting populations) and/or serve densely populated areas.	Accommodating all needs, especially in emergencies	**Hurricanes/Tropical Storms**	Create an emergency response higher ed and city collaboration
	Child and Youth Services	**Inland Flooding**	cambirgde housing authority(elder care services and shleters - have emergency back up in the buildings for life safety) One of the issues for high
	Community Organizations (local and regional)	**Extreme Temperatures**	using for colling centers and shelters during storms if they include commericaial kitchens. How
	Dams	**Severe Winter Storms/Nor'Easters**	Food for free opportunities
	Elderly Facilities	**Earthquakes**	when there is a declared event - eversource identified heating and cooling centers.
	Emergency Resources / Redundancy Planning	**Coastal Flooding**	eversource has super generators that could be available.
	Food distribution	**Tsunami**	dunkin donuts- identifying venders open all the time for needs for first responders.
	Hospitals/Health Centers	**Drought**	
	Housing		

	Medication delivery	**Wildfire**	
	People with Disabilities	**Earthquakes**	
	Public Pools	**Tornadoes**	
	Schools	**Landslides**	
	Shelter	**Invasive Species**	
	Transportation Infrastructure		
	Trusted institutations / community centers		
	Unhoused people not in shelters		
	Warming and cooling centers		
	Parks		
SYSTEMS A collection of components that perform a critical service for the community. Systems are linear type assets. Systems may include horizontal assets associated with linear type assets.	homes, assisted living, senior centers - community buildisngs - youth centers	**Hurricanes/Tropical Storms**	Shade structures, trees for bus stops
	Bus network	**Inland Flooding**	There are snow routes, but perhaps coordinate on additonal hazard routes.
	Cell Towers/Telephone Office	**Extreme Temperatures**	Materials and plan to close roads when they are impassable. Need an operations plan.
	Citywide Wifi	**Severe Winter Storms/Nor'Easters**	Coordinate with eversource on flooding related to power distribution system. Kendall power station
	Energy System Power Plant	**Earthquakes**	brookford street gas connection include flood resiliency
	Hazardous materials and fuels		facility at terminal road should be studied flood resiliency
	Major Roads (esp. critical streets that need to be maintained for emergency	**Coastal Flooding**	have a screening report for but not detailed- to be studied.
	MWRA - Cottage Farm and Prison Point CSO facilities	**Tsunami**	the city? if not this could be a pre hazard plan to distribute radios
	Police and Fire Communications and Vehicles	**Drought**	hardining regional radio towers
	Power Grid (ensuring power for Hospitals, police/fire communications,	**Wildfire**	more stormwater tanks - baldwin, cambridgeport. updating metering stations for combined sewers.
	Train & Subway system	**Earthquakes**	
	Water/Sewer/Stormwater	**Tornadoes**	
		Landslides	
		Invasive Species	
RESOURCES Natural Resources: Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Areas of sensitive habitat that are vulnerable to hazard events, protection of areas that are important to community	Arts and Cultural Facilities	**Hurricanes/Tropical Storms**	restore some of the neglected ponds , depaving
		Inland Flooding	historic resiliency guidance - refer council of library information resources
		Extreme Temperatures	where to hold deceased in mass casualty event.
		Severe Winter Storms/Nor'Easters	

areas that are important to community objectives, such as the protection of sensitive habitat, provide socio-economic benefits, etc. Historical and Cultural Resources: Assets that posses historical, cultural, archaeological or paleontological significance, including sites, contextual information, structures, districts, and objects significantly associated with or representative of earlier people, cultures, maritime heritage, and human activities and events.	Community Gardens	**Severe Winter Storms/Ice Events**	connection, and community - before/after/during - if these were lost, could lose community connections (Moses Youth Center, Cambridge
		Earthquakes	
		Coastal Flooding	
		Tsunami	
		Drought	
	Historic Sites and Districts	**Wildfire**	
		Earthquakes	hard copy documents - much of this is still paper. archive vaults of records at city hall and public works- study vulnerability of these vaults.
		Tornadoes	
		Landslides	Libraries and back-up copies of public records: Where are these stored? Are all of the library collections within City boundaries? Are there other historical document collections that need to be scanned? (Or an organization that needs help scanning docs)
		Invasive Species	
	Open Space(cemetaries, basketball courts, parks)		
	Places of Worship		
	Restaurants, pharmacies, food markets, gas stations		

City of Cambridge
2023 Hazard Mitigation Plan Update
Hazard Mitigation Planning Team
July 11, 2023
6:00 PM to 7:30 PM

NOTES HMPT WORKSHOP 2

Summary

Twenty-two participants joined the workshop virtually and brainstormed Mitigation Actions that would prevent the impacts discussed in Workshop #1. The Mitigation Actions used almost the same categories as the assets: Structure, People, Systems, and Resources. The workshop format started with an overview presentation of the Hazard Mitigation Plan, assets, and Mitigation Actions. Then, there was a short introductory presentation on Mitigation Actions for Structures followed by a brainstorming exercise where participants were broken into groups to create Mitigation Actions for Structures. This format (presentation then breakout group brainstorming activity) repeated for all four categories and resulted in Mitigation Actions in all four categories.

Key Findings

- Key Mitigation Actions for *Structures* included coordinated emergency planning, a shelter assessment plan, and back-up power/generator plans.
- Key Mitigation Actions for *People* included public campaigns for hazard preparedness, neighbor buddy system and community connections, and warming/cooling centers or resources.
- Key Mitigation Actions for *Systems* included non-electrical communications systems (i.e. loudspeaker or door-knocking), redundancies in the water supply system, and energy system flood resiliency.
- Key Mitigation Actions for *Resources* included improving parks and public pools, incorporating public art into resiliency projects, and assessing tree vulnerability to pests.

City of Cambridge
2023 Hazard Mitigation Plan Update
Hazard Mitigation Planning Team
July 11, 2023
6:00 to 7:30 PM

AGENDA HMPT WORKSHOP 3

4:00 PM **Welcome & Introductions**

- Introductions + Ground Rules

4:10 PM **Overview & Mitigation Actions**

- HMP Overview
- HMPT Workshop #1 + 2 Recap – hazards, assets, and actions
- What are hazard mitigation actions?
- Example mitigation actions completed in Cambridge
- Mitigation Actions for HMP 2023

4:20 PM **Mitigation Actions: Prioritization Process**

- Introduction to Prioritization Process

4:25 PM **Mitigation Actions: Prioritization Activity**

- Doing the Prioritization Process

5:20 PM **Final Thoughts & Next Steps**

- Further Feedback Opportunities
- Public Survey

5:30 PM **Conclude**

Hazard Mitigation Plan Update 2023

HMPT Workshop 3
July 25, 2023

CITY OF CAMBRIDGE

Weston & Sampson SM

AGENDA

- Welcome & Introductions
- Overview & Previous HMPT Workshops
- Mitigation Actions: **Prioritization Overview**
- Mitigation Actions: **Prioritization Activity**
- Final Thoughts & Next Steps
- Conclude

AGENDA

- Welcome & Introductions
- Overview & Previous HMPT Workshops
- Mitigation Actions: **Prioritization Overview**
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- Final Thoughts & Next Steps
- Conclude

WELCOME

Introduce yourself in the ***chat***

HMPT ***Facilitators*** *will help lead the workshop*

City Officials *leading this project are here today*

Leila Mekias
Climate Resilience Project Planner

Robin Seidel
Project Manager, Weston & Sampson

Janet Moonan
Project Technical Lead, Weston & Sampson

Joanna Nadeau
Senior Project Planner, Weston & Sampson

Emily Judson
Resiliency Planner, Weston & Sampson

GROUND RULES

- One mic, one person speaks at a time
- Step up, step back – share the air
- Be as present as you can
- Take away stories, not names
- Be respectful, be kind
- Speak from the heart, listen from the heart
- Trust you will know what to say

HMP TEAM

City Staff

Steering Committee

Group of key City staff responsible for making final planning decisions. Steering Committee Meetings will guide the planning process, endorse draft Goals, and members will participate in Hazard Mitigation Planning Workshops.

Stakeholders

Hazard Mitigation Planning Team (HMPT)

Group of stakeholders bringing a wide range of local expertise and perspectives. The group will include advocates, residents, business-owners, state and local agency representatives, and people from various other organizations.

Outreach

Outreach Team

City team who can help with in-person and virtual outreach and engagement events. This could include activity at local community organizations, schools, events, door-to-door outreach, and others engagement.

Public Engagement

Public Meetings will be an opportunity to educate about the HMP, share progress, and gather feedback and ideas. Results from these meetings and other feedback will be integrated into the final report. The group will include advocates, residents, business-owners, state and local agency representatives, and people from various other organizations.

The HMPT Members are key players in the overall engagement strategy

AGENDA

- Welcome & Introductions
- Overview & Previous HMPT Workshops
- Mitigation Actions: Prioritization Overview
- Mitigation Actions: Prioritization Activity
- Final Thoughts & Next Steps
- Conclude

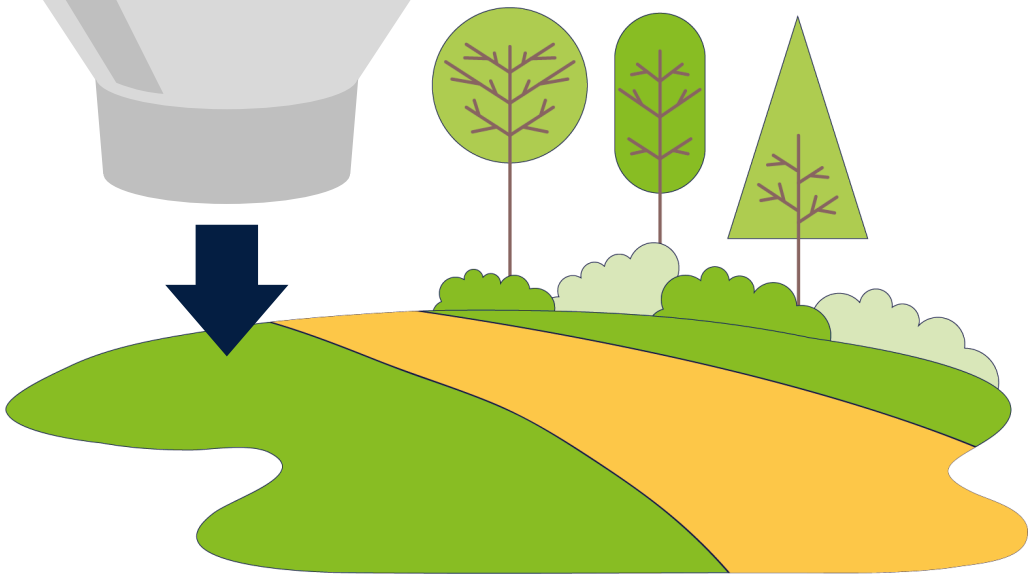
WHY ARE WE HERE TODAY?

Your input today will directly impact the **Mitigation Actions** and how these actions can be **implemented** effectively and equitably.

WHAT IS HAZARD MITIGATION?

Reduce impacts from natural hazards…

…through plans, projects, and services.



NATURAL HAZARDS

HURRICANES / TROPICAL STORMS

INLAND FLOODING

EXTREME TEMPERATURES

SEVERE WINTER WEATHER / NOR'EASTERS

COASTAL FLOODING

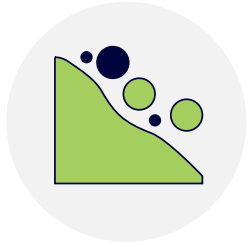
TSUNAMI

DROUGHT

WILDFIRE

EARTHQUAKES

TORNADOES



LANDSLIDES

INVASIVE SPECIES

HOW DO NATURAL HAZARDS AFFECT…

PEOPLE

Assets that serve populations that are more vulnerable to disaster (e.g., elderly, children, visiting populations) and/or serve densely populated areas.

STRUCTURES

Built facilities that provide community lifeline services. A community lifeline enables the continuation of critical government and business functions and is essential to human health and safety or economic security.

SYSTEMS

A collection of components that perform a critical service for the community. Systems are linear type assets. Systems may include horizontal assets associated with linear type assets.

NATURAL, HISTORICAL, & CULTURAL RESOURCES

Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Assets that posses historical, cultural, archaeological or paleontological significance

ACTIVITIES

Activities that have Value to the Community

HAZARD MITIGATION ACTIONS

A mitigation action is a measure, project, plan, or activity proposed to reduce current and future vulnerabilities.

Before an event

Local code and regulations
Maintenance
Proactive Structural Projects

During an event

Warnings
Protection of critical facilities
Emergency response

Following an event

Clean up
Restoration
Enhancement

COMMUNICATIONS

This actions will create resilience for the City of Cambridge (ability to withstand and swiftly recover from an extreme event). These actions will support adaptation to climate change.

AGENDA

- Welcome & Introductions
- Overview & Previous HMPT Workshops
- Mitigation Actions: **Prioritization Overview**
- Mitigation Actions: **Prioritization Activity**
- Final Thoughts & Next Steps
- Conclude

MITIGATION ACTION: PRIORITIZATION PROCESS OVERVIEW

1. Consider the **Risks and Vulnerabilities** facing the City & City **Goals**

2. Identify the **top Categories and Actions**

3. Project Team and Steering Committee to **review the results**

4. Finalize Prioritization Groups: **Low, Medium, High**

CONSIDER RISKS AND VULNERABILITIES

Probability of Occurrence

Consequence of Occurrence

Higher Probability / Lower Consequence

- Wildfire/Brushfire
- Invasive Species
- Drought

Higher Probability / Higher Consequence

- Severe Winter Weather/Nor'easters
- Extreme Temperatures
- Inland Flooding
- Hurricanes/Tropical Storms

Lower Probability / Lower Consequence

- Landslides

Lower Probability / Higher Consequence

- Coastal Flooding
- Tsunami
- Tornado
- Earthquakes

CITY'S 2023 HMP MITIGATION GOALS

1. Equitably ***Protect*** Health and Safety of the Community
2. Promote Public Awareness and Resilience through ***Communication***
3. ***Coordinate and Collaborate*** in Hazard Mitigation Planning and Climate Adaptation
4. ***Invest in and Plan for*** Priority Hazard Mitigation Implementation
5. Improve Capacity to ***Monitor*** Existing Changes

AGENDA

- Welcome & Introductions
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- Mitigation Actions: **Prioritization Overview**
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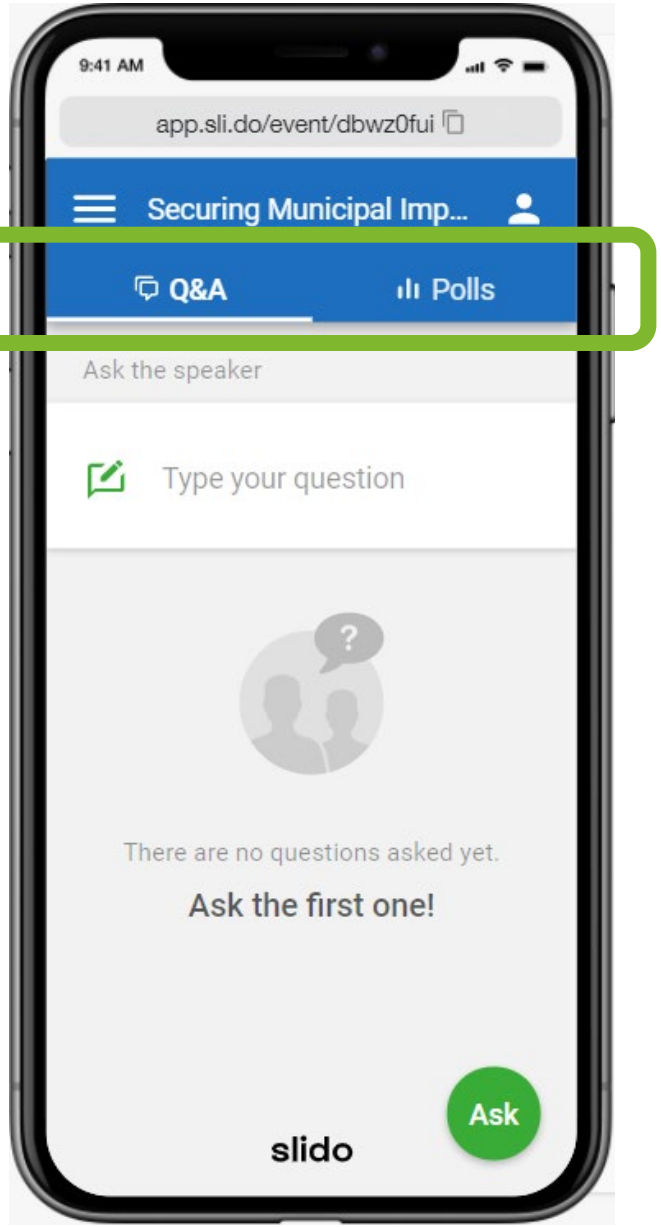
- Conclude

JOIN US ON SLIDO!

1. Get your phone ready
2. Follow instructions or use the QR code:

Or type URL:
Slido.com/Cambridge3



You can move between the Q&A tab and the polls tab!

ACTION CATEGORY: COMMUNICATIONS

Action A.1: Develop an enhanced communication plan and program related natural hazards (e.g., communications about resilience hubs and resources, a program for outdoor messaging, rapid deployment signage for wayfinding in emergency, etc.) in collaboration with community groups

Action A.2: Develop an annual media campaign about signing up for code red notifications

Action A.3: Provide a central location on the City's website to provide up-to-date notification and items such as extreme weather, air quality alerts, etc.

Action A.4: Purchase emergency radios for critical staff to utilize when an emergency event is expected where power and cell phone service may be compromised. Develop a plan for distribution and use.

Action A.5: Harden regional radio towers

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Which of the following actions should be highest priority? Choose as many as you like.

(A)

ⓘ Start presenting to display the poll results on this slide.

RESULTS
COMMUNICATIONS

A1:Develop an enhanced communication plan and program related natural hazards in collaboration with community groups

A2:Develop an annual media campaign about signing up for code red notifications

A3:Provide a central location on the City's website to provide up-to-date notification and items such as extreme weather, air quality alerts, etc.

A4:Purchase emergency radios for critical staff to utilize when an emergency event is expected where power and cell phone service may be compromised. Develop a plan for distribution and use.

A5: Harden regional radio towers

ACTION CATEGORY:
DRINKING WATER / SNOW REMOVAL

Action B.1: For components of the drinking water system (e.g., interconnections to MRWA, sluice gates at Winter Street Gatehouse, etc.), evaluate replacement of manually operated components with remote operated components, and flood proof doors/electrical components.

Action B.2: Hardening of Pason Park water storage tanks to protect from flooding

Action B.3: Improve/update cybersecurity measures for public water supply system

Action B.4: Design, permit, and construct flood walls for Fresh Pond reservoir to protect from saltwater intrusion

Action B.5: Upgrade deicing / snow removal equipment, including smaller equipment that is able to accommodate bicycle facilities

Action B.6: Create an emergency snow response plan which identifies overflow snow stockpile locations and salt storage.

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Which of the following actions should be highest priority? Choose as many as you like. (B)

ⓘ Start presenting to display the poll results on this slide.

RESULTS:

DRINKING WATER / SNOW REMOVAL

B1: For components of the drinking water system (e.g., interconnections to MRWA, sluice gates at Winter Street Gatehouse), evaluate replacement of manually operated components with remote operated components, and flood proof doors/electrical components.

43 %

B2: Hardening of Pason Park water storage tanks to protect from flooding

21 %

B3: Improve/update cybersecurity measures for public water supply system

86 %

B4: Design, permit, and construct flood walls for Fresh Pond reservoir to protect from saltwater intrusion

36 %

B5: Upgrade deicing / snow removal equipment, including smaller equipment that is able to accommodate bicycle facilities

36 %

B6: Create an emergency snow response plan which identifies overflow snow stockpile locations and salt storage.

29 %

ACTION CATEGORY:

HOMES + HOMEOWNERS / SHELTERS / PUBLIC HEALTH

Action C.1: Develop a program to provide funding to property owners located in the 2070 10% flood area according to the City's flood viewer to make resiliency improvements to their properties.

Action C.2: Develop and update materials to support homeowners in completing retrofits related to flooding & heat (e.g., trainings, educational materials, and/or funding assistance)

Action C.3: Implement a policy to provide notification at point of sale/point of rental regarding anticipated future status in City flood viewer

Action C.4: Develop regulations of new basement apartments in flood zones

Action C.5: Complete a Shelter Assessment Plan

Action C.6: Create a list of health services which are operational during extreme events for community reference(i.e. dialysis centers)

Action C.7: Identify locations to hold deceased in mass casualty event.

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Which of the following actions should be highest priority? Choose as many as you like. (C)

ⓘ Start presenting to display the poll results on this slide.

RESULTS:

HOMES + HOMEOWNERS / SHELTERS / PUBLIC HEALTH

C1: Develop a program to provide funding to property owners located in the 2070 10% flood area according to the City's flood viewer to make resiliency improvements to their properties.

38 %

C2: Develop and update materials to support homeowners in completing retrofits related to flooding & heat (e.g., trainings, educational materials, and/or funding assistance)

44 %

C3: Implement a policy to provide notification at point of sale/point of rental regarding anticipated future status in City flood viewer

50 %

C4: Develop regulations of new basement apartments in flood zones

63 %

C5: Complete a Shelter Assessment Plan

63 %

C6: Create a list of health services which are operational during extreme events for community reference(i.e. dialysis centers)

94 %

C7: Identify locations to hold deceased in mass casualty event.

31 %

ACTION CATEGORY:
COMMUNITY FACILITIES & STRUCTURES

Action D.1: Evaluate resiliency of community services on a case by case basis, e.g. food pantries are often on the first floor and vulnerable to flooding

Action D.2: Work with large property owners on resiliency assessments and emergency power needs.

Action D.3: Update the climate change vulnerability assessment to include up-to-date climate information and new facilities and identify recommendations for municipal facility improvements for resiliency.

Action D.4: Identify municipally owned buildings with more than 8 floors to perform assessment of water vulnerability during power outages

Action D.5: Ensure renovations of buildings with vulnerability populations (such as elderly housing and care facilities) incorporating resiliency strategies such as raising heating/cooling equipment

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Which of the following actions should be highest priority? Choose as many as you like. (D)

ⓘ Start presenting to display the poll results on this slide.

RESULTS:
COMMUNITY FACILITIES & STRUCTURES

D1: Evaluate resiliency of community services on a case by case basis, e.g. Food pantries are often on the first floor and vulnerable to flooding

D2: Work with large property owners on resiliency assessments and emergency power needs.

D3: Update the climate change vulnerability assessment to include up-to-date climate information and new facilities and identify recommendations for municipal facility improvements for resiliency.

D4: Identify municipally owned buildings with more than 8 floors to perform assessment of water vulnerability during power outages

D5: Ensure renovations of buildings with vulnerability populations (such as elderly housing and care facilities) incorporating resiliency strategies such as raising heating/cooling equipment

ACTION CATEGORY:
COOLING + TREE CANOPY

Action E.1: Implement actions of Cambridge Urban Forest Master Plan (e.g., increase urban canopy on private property, increase public education on the benefits and proper care of trees on private property, etc.)

Action E.2: Identify areas for green stormwater infrastructure and reducing impervious surfaces

Action E.3: Integrate resiliency strategies and considerations into the City of Cambridge Open Space Plan update

Action E.4: Complete study evaluate shade needs (other than trees) referred to as "The Shade Study", and implement recommendations (e.g., adding shade structures)

Action E.5: Install water fountains and cooling features locations along bus/bike routes

Action E.6: Purchase portable emergency generators to power cooling facilities such as sprays pad and pools during prolonged heat waves and power outages.

Action E.7: Extend swimming pool operational hours.

Action E.8: Identify Cambridge housing- community rooms to use as cooling centers and shelters during storms if they include commercial kitchens.

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Which of the following actions should be highest priority? Choose as many as you like. (E)

ⓘ Start presenting to display the poll results on this slide.

RESULTS:

COOLING + TREE CANOPY

E1: Implement actions of Cambridge Urban Forest Master Plan (e.g., increase urban canopy on private property, increase public education on the benefits and proper care of trees on private property, etc.)

E2: Identify areas for green stormwater infrastructure and reducing impervious surfaces

E3: Integrate resiliency strategies and considerations into the City of Cambridge Open Space Plan

E4: Complete study evaluate shade needs (other than trees) referred to as "The Shade Study", and implement recommendations (e.g., adding shade structures)

E5: Install water fountains and cooling features locations along bus/bike routes

E6: Purchase portable emergency generators to power cooling facilities such as sprays pad and pools during prolonged heat waves and power outages.

E7: Extend swimming pool operational hours.

E8: Identify Cambridge housing- community rooms to use as cooling centers and shelters during storms if they include commercial kitchens.

ACTION CATEGORY:
STORMWATER & SEWER

Action F.1: Update and Improve Floodplain Mapping (Cambridge Flood Viewer)

Action F.2: Undertake interventions as a regional collaboration at Charles River and Amelia Earhart Dam to reduce overtopping/flanking

Action F.3: Design and construct stormwater holding tanks for Baldwin and Cambridgeport neighborhoods

Action F.4: City led program to install valves to mitigate basement backups of stormwater/sewage due to wet weather events

Action F.5: Improve collection and conveyance system at area east of 2nd Street and north of Charles Street (area #27)

Action F.6: Implement additional stormwater management measures: School, Pine, Cherry and Windsor Streets (area #26)

Action F.7: Complete Cambridgeport stormwater management program: Newton, Green, Franklin and Sidney Streets (CAM 017, area #28)

Action F.8: Design and construct updates to metering stations for Combined Sewers

Action F.9: Inspect and maintain targeted infrastructure pre-storm events (e.g. remove sediment and obstructions to allow stormwater to flow unimpeded)

slido

Which of the following actions should be highest priority? Choose as many as you like. (F)

ⓘ Start presenting to display the poll results on this slide.

RESULTS:
STORMWATER & SEWER

F1: Update and Improve Floodplain Mapping (Cambridge Flood Viewer)

F2: Undertake interventions as a regional collaboration at Charles River and Amelia Earhart Dam to reduce overtopping/flanking

F3: Design and construct stormwater holding tanks for Baldwin and Cambridgeport neighborhoods

F4: City led program to install valves to mitigate basement backups of stormwater/sewage due to wet weather events

F5: Improve collection and conveyance system at area east of 2nd Street and north of Charles Street (area #27)

F6: Implement additional stormwater management measures: School, Pine, Cherry and Windsor Streets (area #26)

F7: Complete Cambridgeport stormwater management program: Newton, Green, Franklin and Sidney Streets (CAM 017, area #28)

F8: Design and construct updates to metering stations for Combined Sewers

F9: Inspect and maintain targeted infrastructure pre-storm events (e.g. remove sediment and obstructions to allow stormwater to flow unimpeded)

ACTION CATEGORY:
ENERGY & BACK UP POWER

Action G.1: Collaborate with energy providers to protect critical community infrastructure

Action G.2: Work the MBTA on identifying and protecting critical power to the systems (i.e. substations)

Action G.3: Encourage installation of solar photovoltaic systems, cogeneration, and other energy supplies

Action G.4: Encourage energy efficiency in buildings through zoning requirements and community outreach

Action G.5: Evaluate use of Microgrid(s) for critical facilities and implement recommendations

Action G.6: Coordinate with Eversource on flooding related to power distribution system. Kendall power station will be flood resilient.

Action G.7: Prioritize clean energy solutions for power such as solar, battery, geothermal, etc. where feasible.

slido

Which of the following actions should be highest priority? Choose as many as you like. (G)

ⓘ Start presenting to display the poll results on this slide.

RESULTS:

ENERGY & BACK UP POWER

G1: Collaborate with energy providers to protect critical community infrastructure

57 %

G2: Work the MBTA on identifying and protecting critical power to the systems (i.e. substations)

50 %

G3: Encourage installation of solar photovoltaic systems, cogeneration, and other energy supplies

29 %

G4: Encourage energy efficiency in buildings through zoning requirements and community outreach

43 %

G5: Evaluate use of Microgrid(s) for critical facilities and implement recommendations

57 %

G6: Coordinate with Eversource on flooding related to power distribution system. Kendall power station will be flood resilient.

21 %

G7: Prioritize clean energy solutions for power such as solar, battery, geothermal, etc. where feasible.

86 %

ACTION CATEGORY:
TRANSPORTATION + EVACUATION / COMMUNITY PARTNERSHIPS

Action H.1: Coordinate with the MBTA on backup plans for transportation

Action H.2: Develop a City-wide operations plan DPW and Police for how to respond to flooding.

Action H.3: Coordinating with adjacent communities for hazard preparation and response

Action H.4: Create an emergency response higher education and city collaboration

Action H.5: Support and seek funding sources for protecting/mitigating risks to and replacing public art associated with public buildings, including Mass Cultural Council and other funding sources interested in the overlap between emergency response/preparedness and art

Action H.6: Engage City Arts Council in mitigation planning

slido

Which of the following actions should be highest priority? Choose as many as you like. (H)

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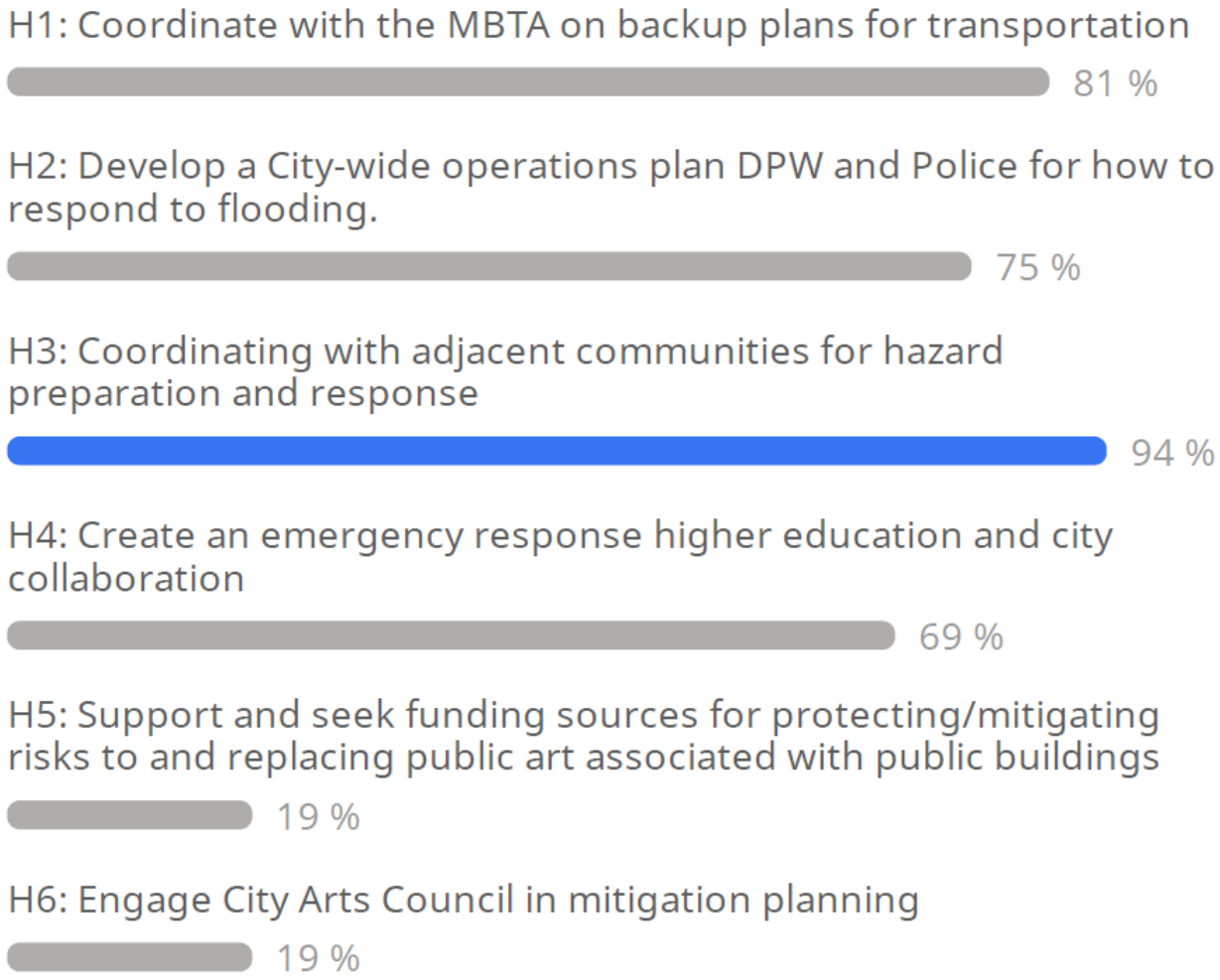
RESULTS

TRANSPORTATION + EVACUATION / COMMUNITY PARTNERSHIPS



ACTION CATEGORY:
HISTORIC & DOCUMENT PRESERVATION / EARTHQUAKE, BRUSHFIRE, INVASIVE SPECIES MANAGEMENT

Action I.1: Develop a historic resources resilience plan

Action I.2: Perform a vulnerability assessment of vaults where hard copy records are kept.

Action I.3: Prepare an Earthquake Emergency Plan

Action I.4: Conduct maintenance activities to monitor and reduce brushfire risks

Action I.5: Prepare a Pest Vulnerability Matrix or similar pest and disease threat assessment and management options report utilizing 2014 street tree inventory data

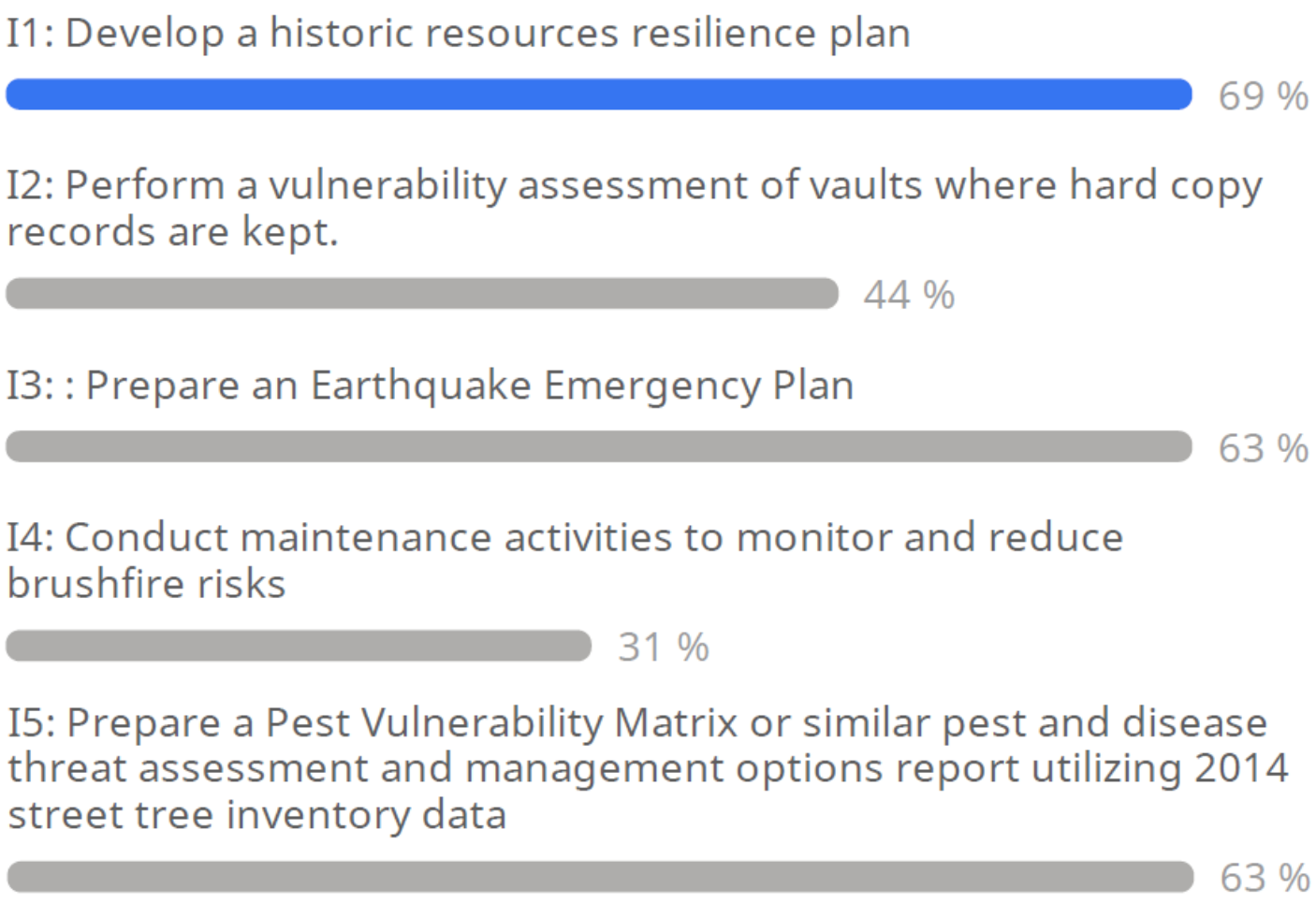
slido

Which of the following actions should be highest priority? Choose as many as you like. (I)

ⓘ Start presenting to display the poll results on this slide.

RESULTS:

HISTORIC & DOCUMENT PRESERVATION / EARTHQUAKE, BRUSHFIRE, INVASIVE SPECIES MANAGEMENT



ACTION CATEGORY:
EQUITABLE EMERGENCY RESPONSE PLANNING

Action J.1: Ensure Emergency Response Plan is multi-lingual

Action J.2: Encourage disability indicator 911 enrollment for list needing additional follow up response in an emergency

Action J.3: Increase emergency response personnel staffing and training on medical issues

Action J.4: Provide backup/public Wi-Fi at the library, hotspots you can sign out.

Action J.5: Create contracts for supplying emergency responders with food/ refreshments

slido

Which of the following actions should be highest priority? Choose as many as you like. (J)

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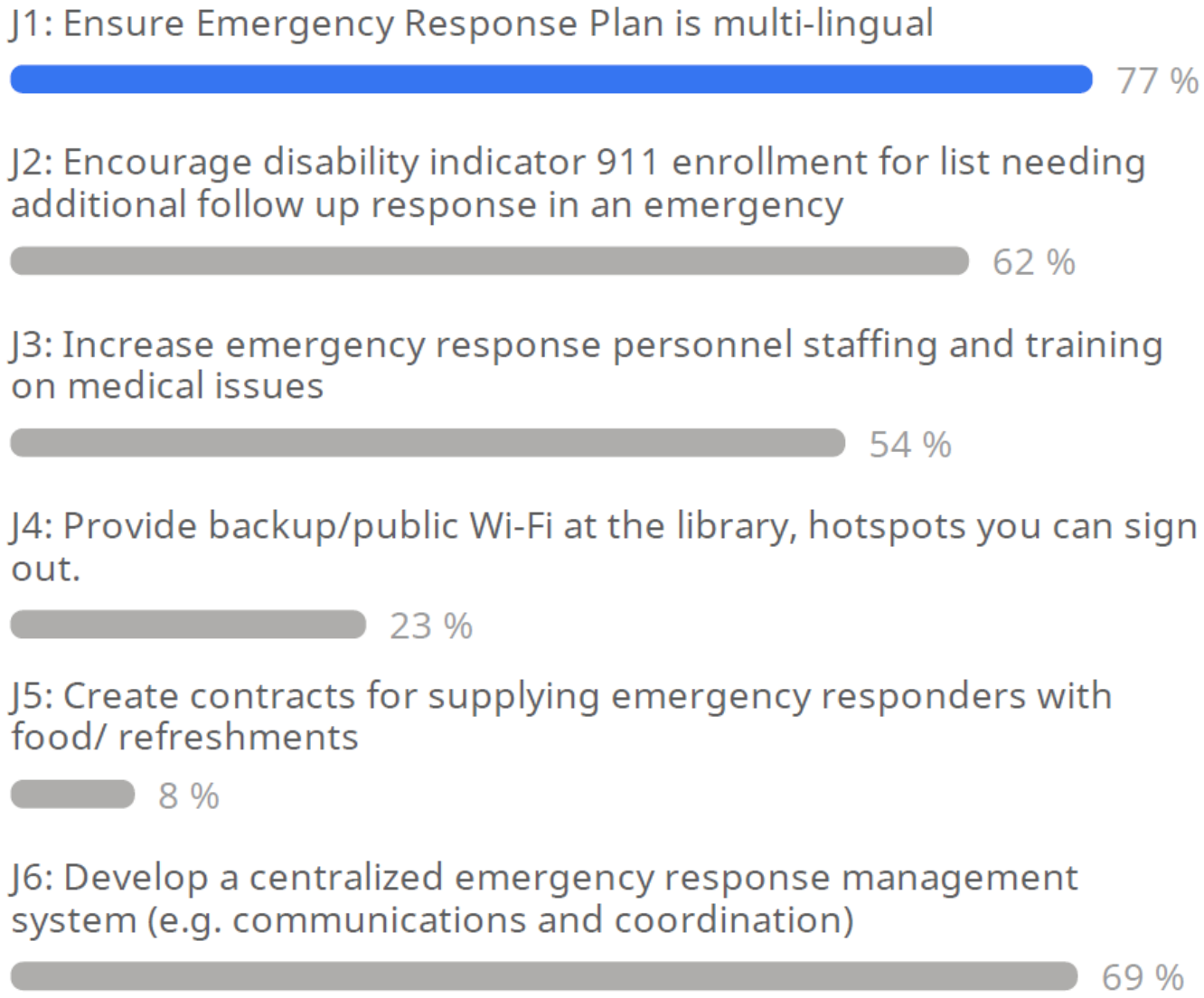
RESULTS:
EQUITABLE EMERGENCY RESPONSE PLANNING

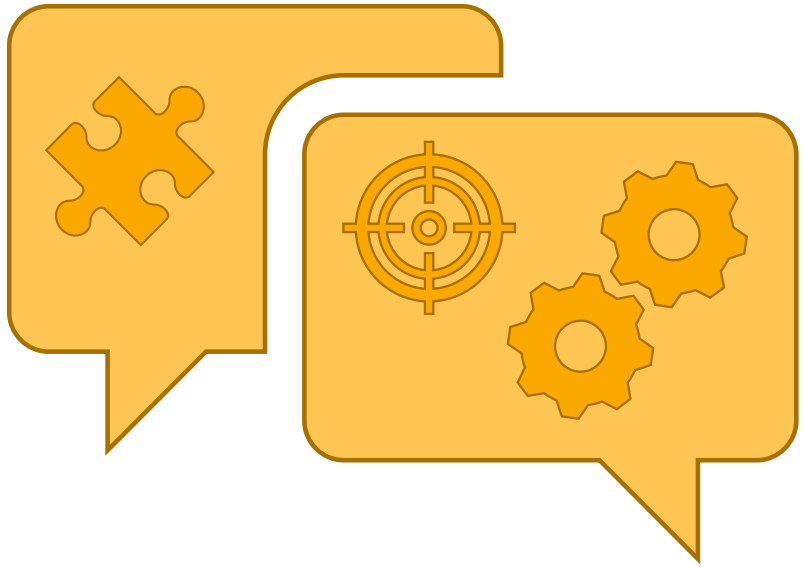


AGENDA

- Welcome & Introductions
- Overview & Previous HMPT Workshops
- Mitigation Actions: **Prioritization Overview**
- Mitigation Actions: **Prioritization Activity**
- Final Thoughts & Next Steps
- Conclude

PUBLIC MEETING

Virtual: Sept. 13 from 12PM - 1PM
In-Person & Virtual: Sept. 13 from 6PM-7PM



TAKE THE SURVEY!

This input will help shape the **strategies, projects, policies,** and **decisions** the City makes regarding natural hazards.

Please share with your networks!

Hazard Mitigation Plan Update 2023

Thank You!

CITY OF CAMBRIDGE

Weston & Sampson SM

City of Cambridge
2023 Hazard Mitigation Plan Update
Hazard Mitigation Planning Team
July 25, 2023
4:00 to 5:30 PM

NOTES HMPT WORKSHOP 3

Attendees

1. Ali Sorrels
2. Melissa Castillo
3. Nahid Chowdhury
4. Celeste DePalma
5. Lindsay Diaz
6. Eric
7. Julie Greenwood-Torelli
8. Julie Wood
9. Jennifer Letourneau
10. Leila Mekias
11. Mikayla Criger
12. Nancy Porter
13. Pasang Lhamo
14. Susanne Rasmussen
15. Sherry Bernard
16. Michele Scott
17. Steven Nutter
18. Suzanne Blake
19. Rachel Tanenhaus
20. Peter Vellucci
21. Catherine Woodbury
22. Jason W Wright

General Notes

- Shelters for emergencies
    - Include assessing how people get there
    - Include what kinds of catastrophes they will be using them for because different people will come and different shelters will be appropriate or not
    - And assess how to know if we need them because sometimes no one shows up

- Public Arts with enhancing resilience work is already happening (H5 + H6)

- Add action: Continue to engage with the Charles River Climate Compact - regional collaboration

- Include historic and other cultural resources in public art funded projects

- Coordinating with higher education on emergencies is already happening

- Tree inventory: change 2014 to latest data

- Add action: create centralized emergency response plan, centralized emergency response management between departments

- People with disabilities rely on government programs but also have good reason to not trust government (in response to disability registry), maybe action could actually be training staff and emergency responders

Chat Votes

- A1 + A3
- B3
- C6 then C5 then C3
- D1, D3, D5
- E2, E8
- All F – all are important
- F1, F2, F6, F7, F8, F9
- G1, G5, G7
- H1, H2, H3, H4
- I1

Appendix C

HMP Fact Sheet and Public Survey Results

CAMBRIDGE HAZARD MITIGATION PLAN

Have you wondered if the City is prepared to withstand these events?

Are you concerned about rising heat and unusually warm winters?

Are you concerned about more extreme storms, hurricanes, and weather events?

Are you, or someone close to you, vulnerable to interruptions in electricity, transportation, or access to shelter?

What is the City Doing?

The City of Cambridge is working hard now to prepare for a more resilient and safe community. The City is updating its Hazard Mitigation Plan, which will study risks from natural hazards and introduce strategies to address these hazards now and in the future. The City will be incorporating community feedback, vulnerability data, and City planning goals.

Natural hazards are likely to become more severe and more frequent due to projected climate change. The HMP seeks to document vulnerabilities and strengths related to historic natural hazards and projected climate change. Based on this analysis and community input, the HMP will outline projects and policies to improve resilience and reduce the potential social and economic losses resulting from natural hazards.

What Risks Does Cambridge Face?

- Hurricanes / storms
- Extreme temperatures
- Severe winter weather / nor'easters
- Drought
- Flooding
- Invasive species
- Climate Change
- Brush fire

Share Your Thoughts!

Public feedback is an essential component to ensure the hazard mitigation and climate adaptation planning process reflects your input. **You can share your experiences of living in Cambridge through this short, 5-minute survey, to help the City understand how it can improve.** We look forward to hearing your experiences, ideas, and concerns.

tinyurl.com/CambridgeSurveyHMP

Are you concerned about rising heat, unusually warm winters, and other extreme events?

The City of Cambridge is working hard to prepare for a more resilient and safe community by updating its Hazard Mitigation Plan, which will study risks and introduce strategies to address natural hazards now and in the future.

Share your experiences of living in Cambridge to help the City understand how it can improve.
Please take this short, 5-minute survey to share your insights.

Scan the QR code or type in the link to access the online survey.

tinyurl.com/CambridgeSurveyHMP

The City of Cambridge is updating its Hazard Mitigation Plan for a more resilient, safe, and prepared community.

Share your experiences of living in Cambridge to help the City understand how it can improve. Please take this short, 5-minute survey to share your insights.

tinyurl.com/CambridgeSurveyHMP

1.1 Public Survey Results

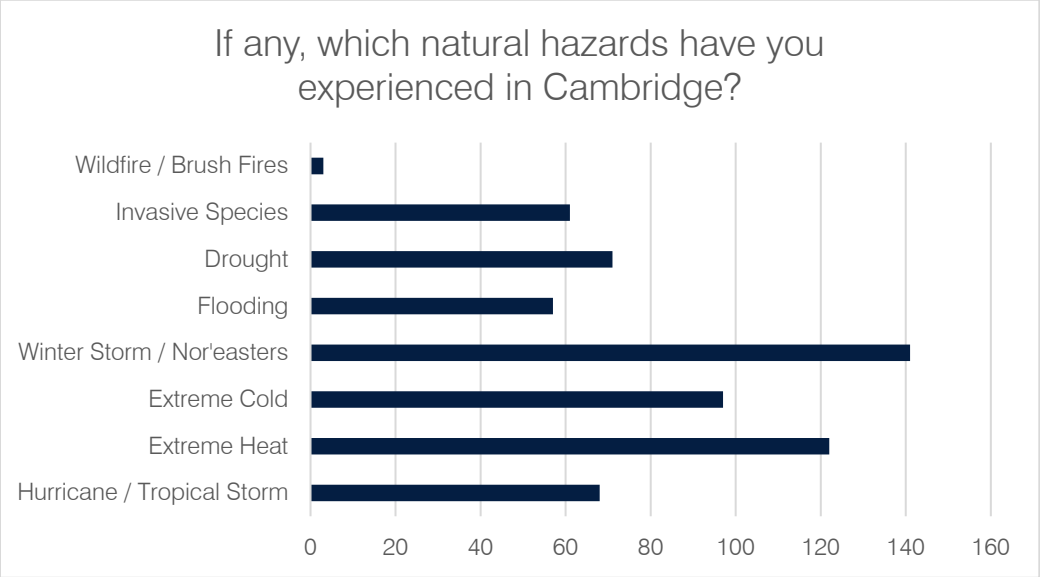
The Hazard Mitigation Plan Public Survey was distributed to community members through virtual, hard copy, and community outreach network methods. These included the City Daily Update Email, City social media, virtual and hard copy flier distribution, and promotion in partnership with Cambridge Community Corp, the Climate Leaders, and the Community Engagement Team. The survey was also distributed through the Hazard Mitigation Planning Team and Steering Committee networks.

Over 150 residents responded to the survey in July 2023. All the responses were in English, although additional languages were provided. All Cambridge neighborhoods were represented among the Survey respondents. A variety of ages, racial identities, and amount of time spent living in Cambridge were also represented among the Survey respondents. A full report of survey responses can be found in Appendix C.

Below is a full compilation of the results.

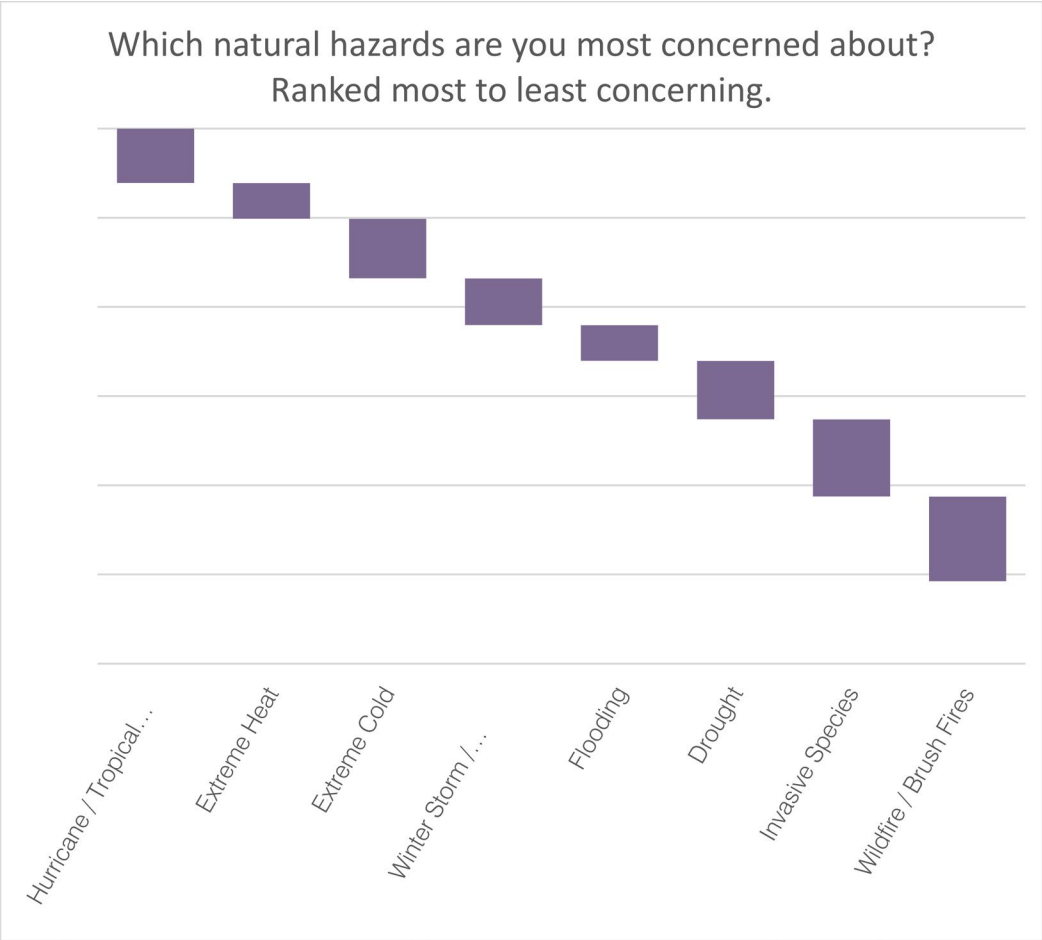
1.1.1 | If any, which natural hazards have you experienced in Cambridge?

Answered: 149
Skipped: 6



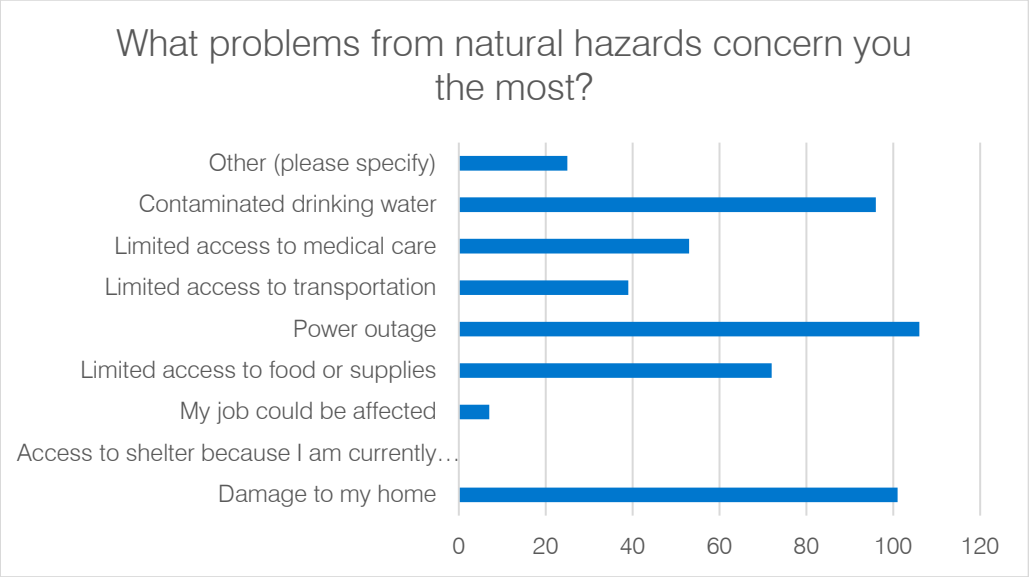
1.1.2 | Which natural hazards are you most concerned about? Rank 1 for most concerned and 8 for least concerned. You can drag the responses or use the arrow buttons to change the order.

Answered: 141
Skipped: 14



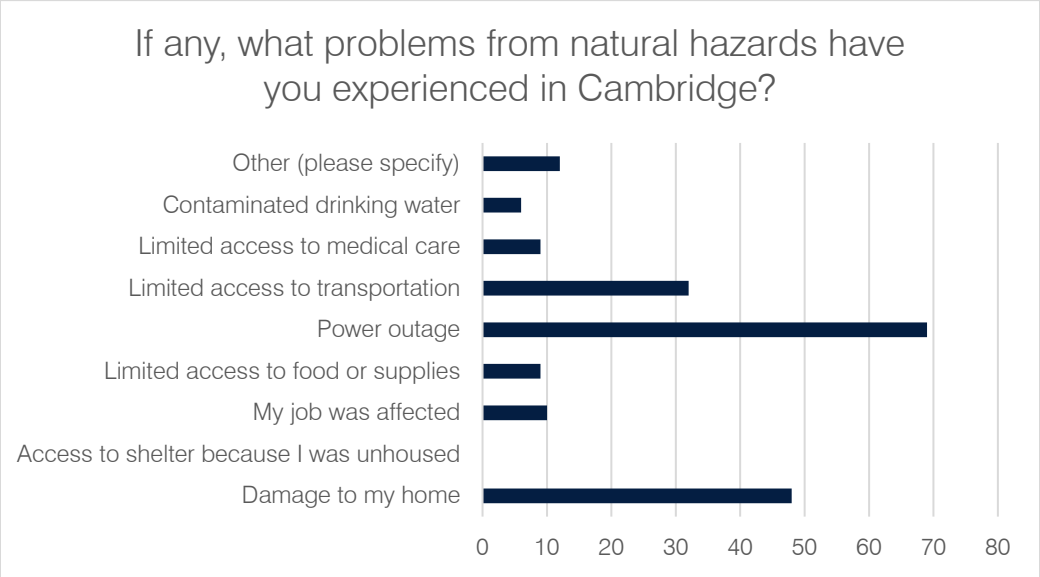
1.1.3 | What problems from natural hazards concern you the most?

Answered: 138
Skipped: 17



1.1.4 | If any, what problems from natural hazards have you experienced in Cambridge?

Answered: 96
Skipped: 59



1.1.5 | Tell us about your experiences with natural hazards and how they have impacted your life.

Answered: 60
Skipped: 95

- A great deal of stress due to heavy rains that cause leaks into my living space
- n/a
- basement flooded
- Heavy rains caused water damage in our apt; wildfire smoke kept us inside; a polar vortex caused our boiler to fail and a carbon monoxide leak
- Any natural hazards that affect public transportation or make it risky to walk anywhere have impacted my life. I have mobility issues that limit my activities.
- Plenty of memories of taping up the windows for a hurricane. Trying to figure out how to remove the excess snow from the eaves, or where to put the 'new' snow to keep the driveway and sidewalk clear. Having my back go out trying to clear the ice-berm the snowplows would leave across the driveway, blocking emergency egress from the house.
- The large tree in front of my house came down in the hurricane in 1985.
- Consideration of where to buy property due to potential flooding.
- We had a tree go down in a hurricane and smash our fence, shed, rip up private road made of vintage bricks the road cant afford to fix, and expose our gas line. the city cut off the part of the tree over the road and we were left to find someone to remove the tree despite the gas line and it was hard, our neighbor's same tree is threatening to hit our house but they cant afford the aborist required to assess or remove if approved and it could kills us, we lost cars when flooded and it appeared to be a badly routed sewer issue, camb took down the two trees next to our house without replacing them, heating up our yard, we had a 12 alarm fire four blocks away (may have been human caused), the T broke down during the snowpocalypse and our house leaked from ice dams, we can not get the black swallow wort, norway maple seedlings, bittersweet to stop coming up in our yard, and the river where I row keeps having toxic run off and algae and invasive weeds, and there are no safe places to go in wind storms - we have no basement.
- There was floods in my building and now insurance has risen spectacularly
- Major blizzards have disrupted daily life and work, with power outages, mountains of snow to shovel, digging out the car, difficulty navigating on foot due to relentless ice that's never fully addressed by community.
- I used to live in an apartment without air conditioning, and it could get miserably hot in the summers. Extremes of heat and cold or heavy snow make it difficult and unpleasant for me to get around. I don't have a car, and I still have to walk to or from the bus stop or T station and wait for the bus in bad weather conditions.
- a few months ago there were thought to be 'forever chemicals' in cambridge water supply , when we switched temporarily to boston's supply... we got a water filter
- NA
- Not much impact yet. I fear more drastic impacts in the future.

- The first floor of my home in the Port was flooded about a decade ago. I'm worried about it happening again. Six of us live here, and our kitchen is on the first floor.
- I've been in Cambridge since the fall of 1991 -- just after Hurricane Bob blew through. My experience in the city between then and now has been very good with respect to natural hazards and I've experience minimal disruption. The city does a very good job of dealing with big snow storms, which are the primary natural hazard I've experienced. I was most affected by the April Fool's Day storm and the 100+ inch winters, but the impacts were largely just inconveniences. There have also been instances of flooding. In one case I hydro-locked my car's engine driving through a deeper-than-I-thought puddle at the intersection of Columbia and Bishop Allen. I have only experienced minor basement flooding after extremely heavy rains.
- No impact yet, but storms and weather extremes seem to be more common.
- Recent wildfire smoke affected my health
- only COVID, but I was an essential worker so still had a job
- Very little impact, actually. During our recent three year drought my garden suffered. There have been very few power outages. My concerns lie more with the unhoused.
- Dead birds and trees from man/nature caused loss of habitat; dangerous air quality from fires elsewhere
- Mostly second hand from friends in New Orleans and California and other things I have learned. -being stuck inside, isolation (esp for older adults) -unhoused and poor being affected most, often w racial intersections - environmental damage/local ecosystems affected
- During extreme weather, MBTA is usually impacted and often my internet access is as well. And I am concerned about the water since they found too much PFAS in it recently.
- My basement has flooded twice when we had storms that dumped 7-8 inches in 48 hours.
- I have not experienced extreme natural hazards that have impacted my life. I'm not sure what to expect
- This past winter we experienced a cold snap of -9 F. A heating pipe in my house froze solid and burst, causing flooding and damage. It would have been worse, but we had stayed up all night running hair dryers on other pipes to keep them from freezing as well. (Our toilets wouldn't flush because of ice in the pipes.) Even with the heat working nonstop some rooms got as cold as 50 F and the walls were colder. I ended up staying in the bathroom with the heated floor as the only place warm enough. If I had been ill at the time or if the power had gone out, it would have been much worse. What will happen next time?
- Our basement flooded right years ago with 2-6" of water. We lost a few items but most was already in plastic bins or elevated.
- I grew up in an area with frequent hurricanes and have experienced a few powerful named storms and the aftermath left behind
- After damage from hurricane Sandy, I installed a generator running on city gas. Also, my car has been damaged twice by falling tree limbs.
- worries about elders in community
- Trees /limbs falling on house and garage . One summer two years ago I had to replace my garage roof twice because of fallen huge limbs from neighbors trees
- As above. Few people seem to make the connection between the natural world (insects and plants especially) and the survival of humans. I speak for these because they cannot

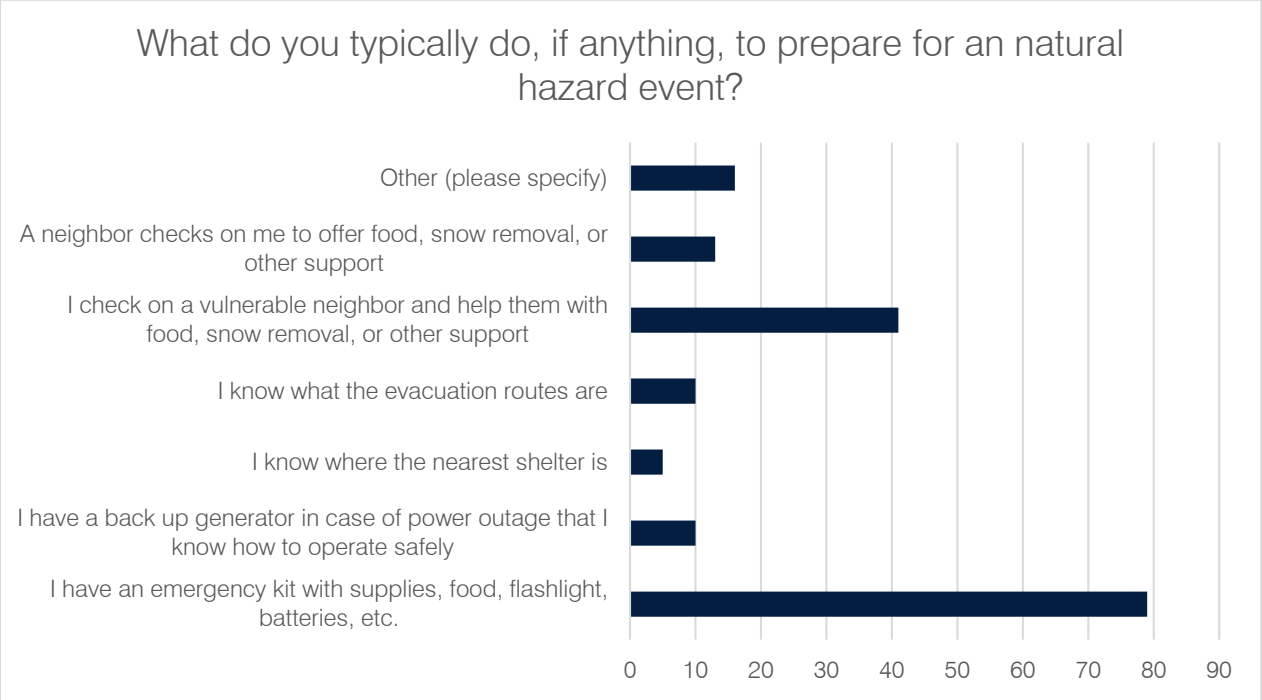
speak for themselves and I see the decline in the quality of the ecosystem on a daily basis. Just looking on any street there is obvious the damage to trees - not just falling but also greater succeptibility to pest and disease. And drought and at least the city/state should be able to water trees during a drought. What a waste. Doing things like building more cooling shelters is fine but does not address the root of the problem.

- It's a hoax.
- I've never personally experienced a natural hazard where I felt particularly in danger except extreme heat. Not everyone has access to A.C. or understands how dangerous heat can be.
- Power outages lasting a few days in cold weather. Fortunately, had a gas-fired fireplace that did not need electricity to keep at least part of the house warm.
- Heat alert - like today!- keeps my family inside, and I worry about residents without AC. All extremes of temperature or drought have damaged to trees and plants nearby. Flooding has caused damage to my home, also creates hazards for young children
- I have been relatively unaffected other than costs to repair home & fences, but am still concerned about wider hazards to buildings, utilities, common areas, and underground utilities
- Blizzards can't get out at all very deep snow heat sometimes causes power to fail which is very uncomfortable
- Major rainstorm in 2010ish dropped 6 inches of rain in just a few hours. High winds blew off my chimney cap, so we had water damage from water entering via the chimney and spreading through the walls (but basement stayed dry. Yeah French drain and dump pump). This caused about 25k in damage (we had to remove all plaster/insulation on that side of the house). If we hadn't had the cash reserves to act immediately, it would have also been a huge mold/mildew issue.
- none really - maybe occasional brief power outage
- Mostly nor'easters and associates regional issues.
- No great impact yet.
- Most of my neighbors have basements and have had floods that destroyed appliances etc. We do not have a basement but lack storage. Our neighborhood electrical power has been affected often by issues with the transformer that powers our block, despite requests to update and secure. I worry that the infrastructure here is not adequate for homes to exclusively use electricity - nor am I convinced that electric power is free of fossil fuels or reliant.
- Frozen pipes, T shutdowns, difficult driving conditions
- Home flooding due to flash flood conditions (extremely heavy rain).
- The street I previously lived on flooded frequently. My primary mode is walking so that made it hard to get around. Walking and outdoor exercise are also less viable in extreme heat, during poor aqi days, or on icy, unshoveled sidewalks.
- Our electricity went out 2 winters ago on the coldest day. Because our heat is electric, we had to leave our home until Eversource fixed the issue in the street.
- Winter Blizzards with over 6ft of snow
- water in the basement
- I have had water damage at three different addresses in Cambridge. Repair costs are high and not always covered by insurance.

- A tree collapsed in front of my house. My basement floods. I have fallen on the ice. I am sensitive to extreme temperatures. I am elderly and poor and I live alone.
- I forgot the year but I suffered snow storm makes problem in my life to take medical access.
- Mainly through gardening, seeing the changes and lack of constancy over the past forty years. The $1000 water bills one year and the floods the next. No peaches this year.
- It’s impact of my job.
- flooding in basement and combined sewage overflows
- Less transmission, pure water and less food.
- I work at MIT's Humanitarian Supply Chain Lab and help FEMA respond to natural hazards. Its my day job. I've lived in the Caribbean. Been in earthquakes, hurricanes, floods...
- n/a
- During hurricane Sandy a tree fell on my house. Not in Cambridge.

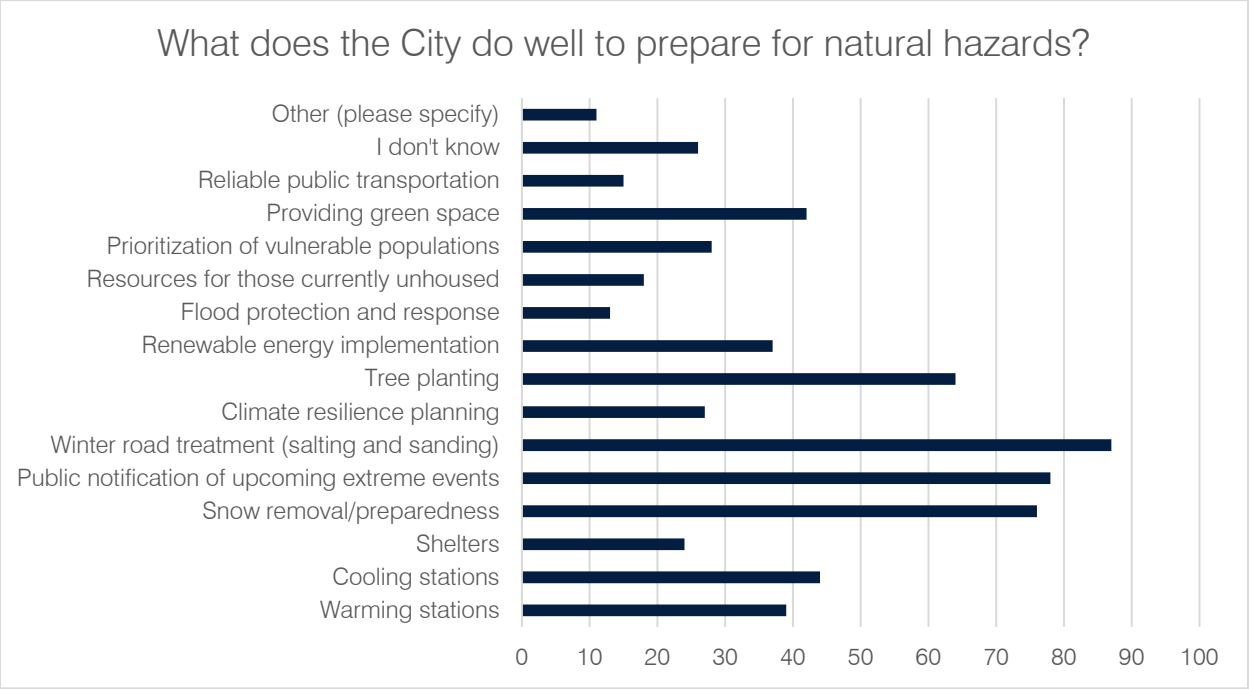
1.1.6 | What do you typically do, if anything, to prepare for a natural hazard event?

Answered: 103
Skipped: 52



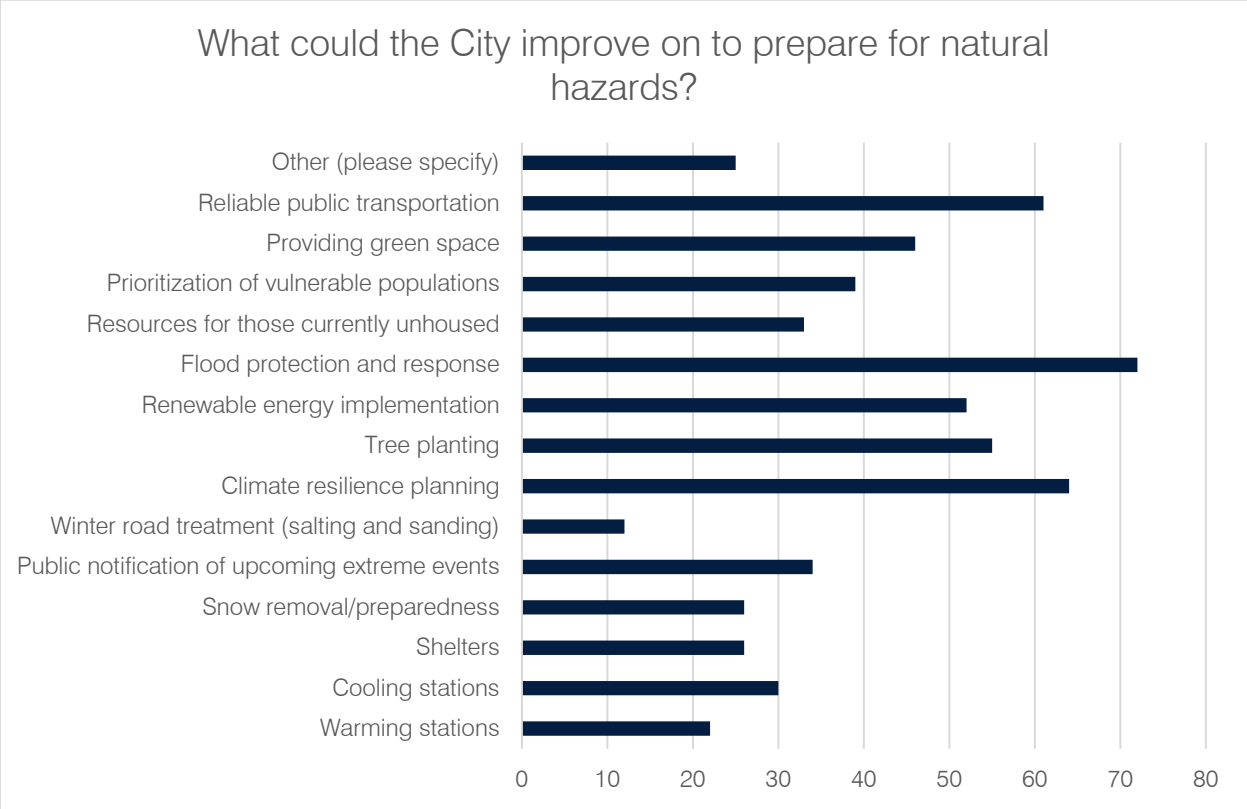
1.1.7 | What does the City do well to prepare for natural hazards?

Answered: 133
Skipped: 22



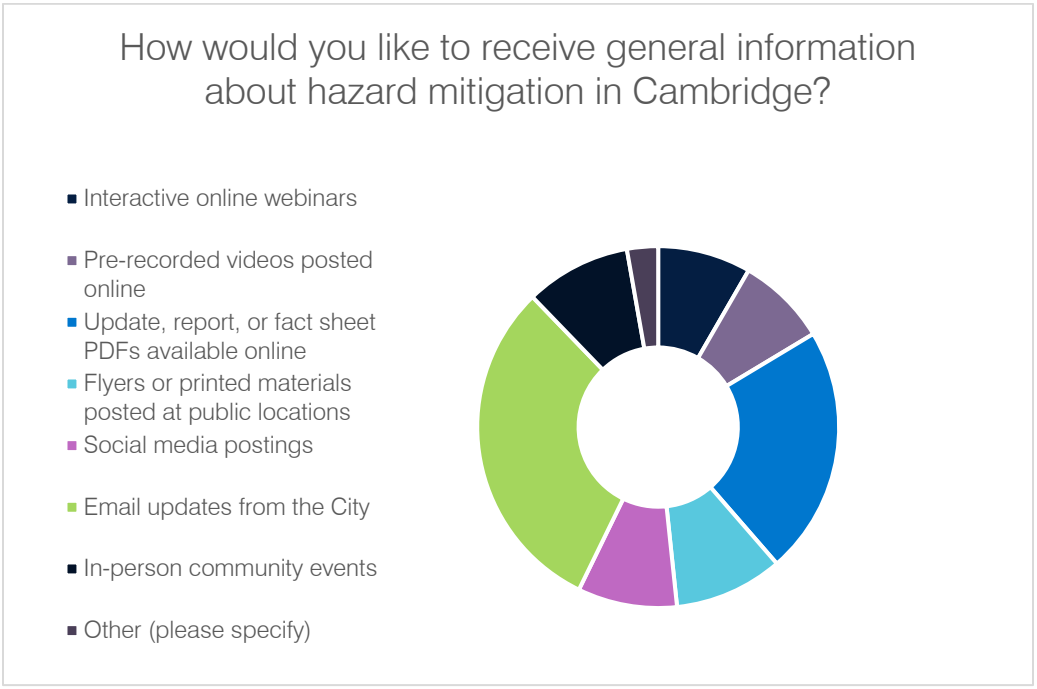
1.1.8 | What could the City improve on to prepare for natural hazards?

Answered: 128
Skipped: 27



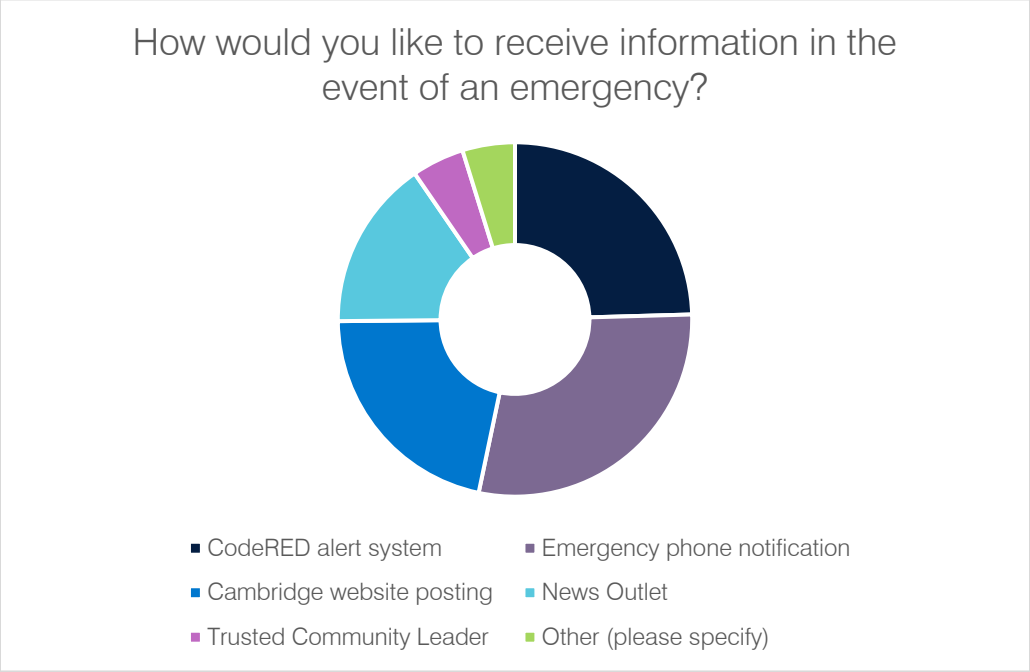
1.1.9 | How would you like to receive general information about hazard mitigation in Cambridge?

Answered: 129
Skipped: 26



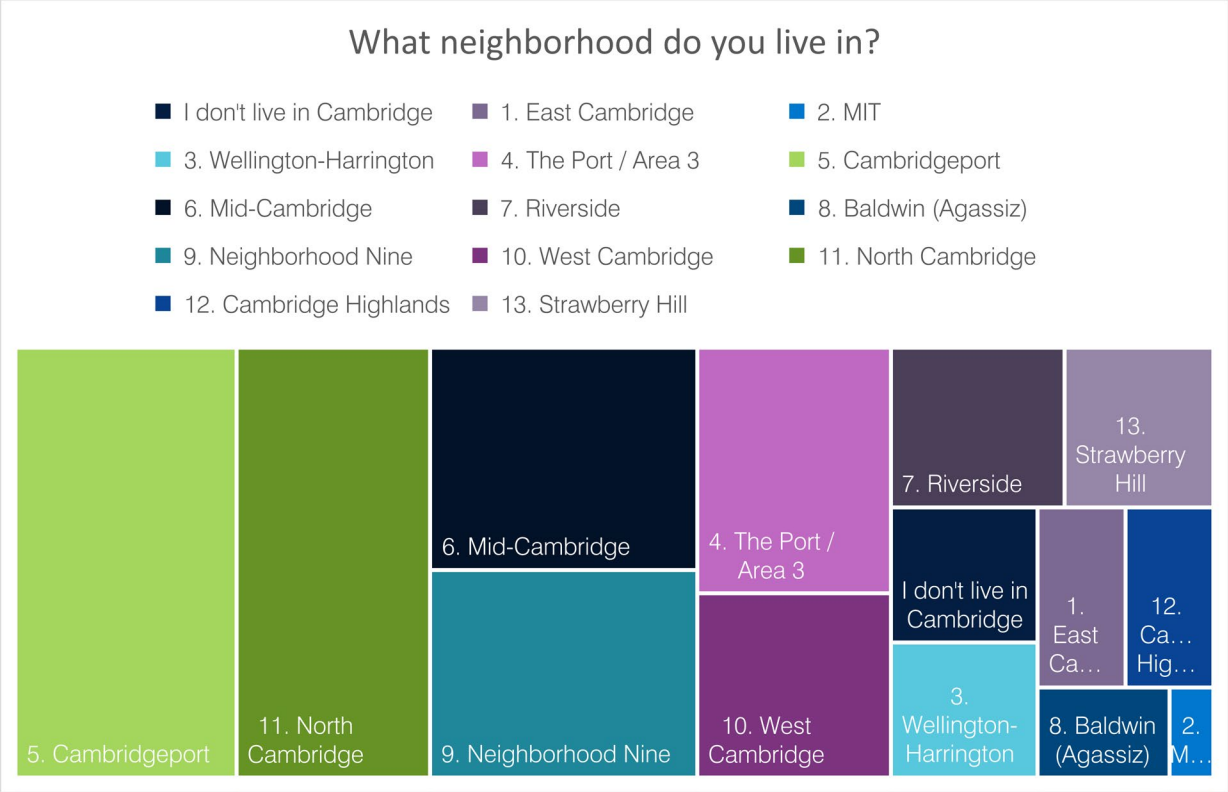
1.1.10 | How would you like to receive information in the event of an emergency? Check all that apply. You can sign up to receive CodeRED alerts here.

Answered: 129
Skipped: 26



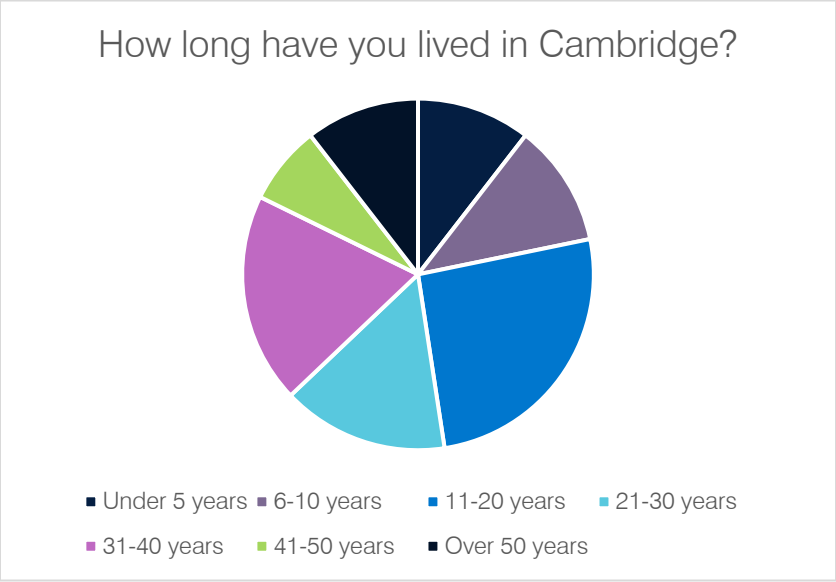
1.1.11 | What neighborhood do you live in?

Answered: 130
Skipped: 25



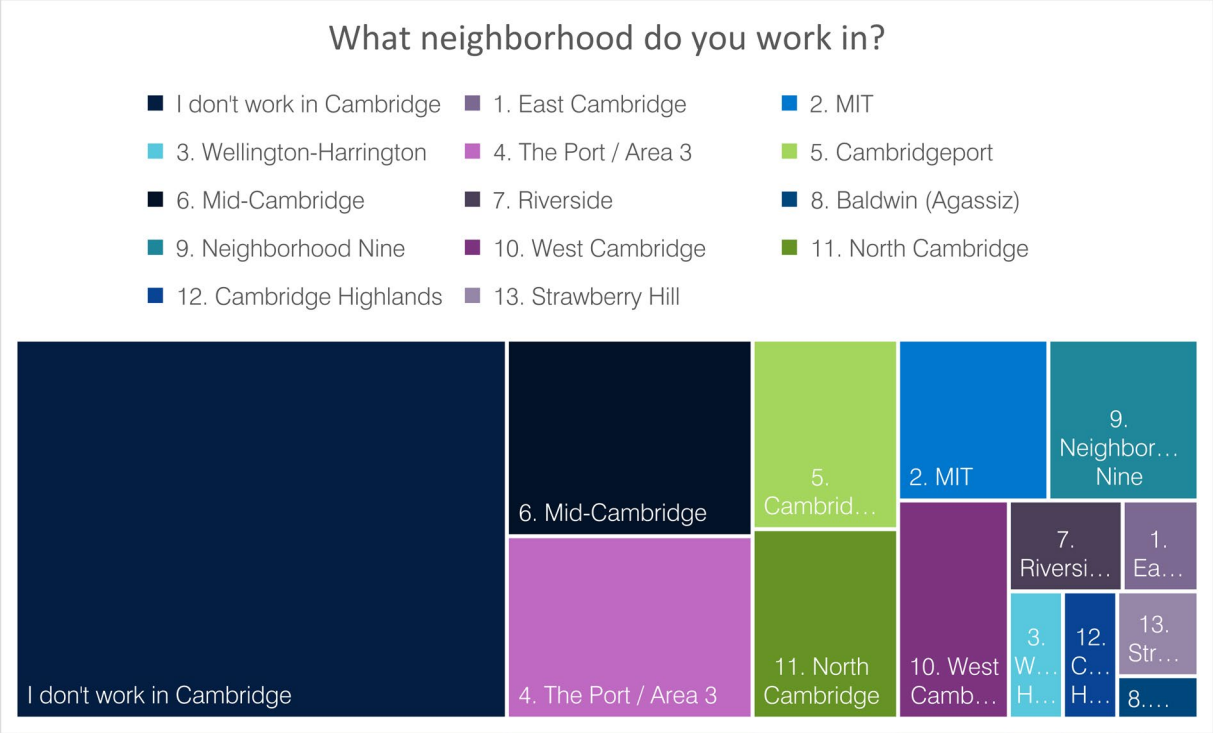
1.1.12 | How long have you lived in Cambridge?

Answered: 124
Skipped: 31



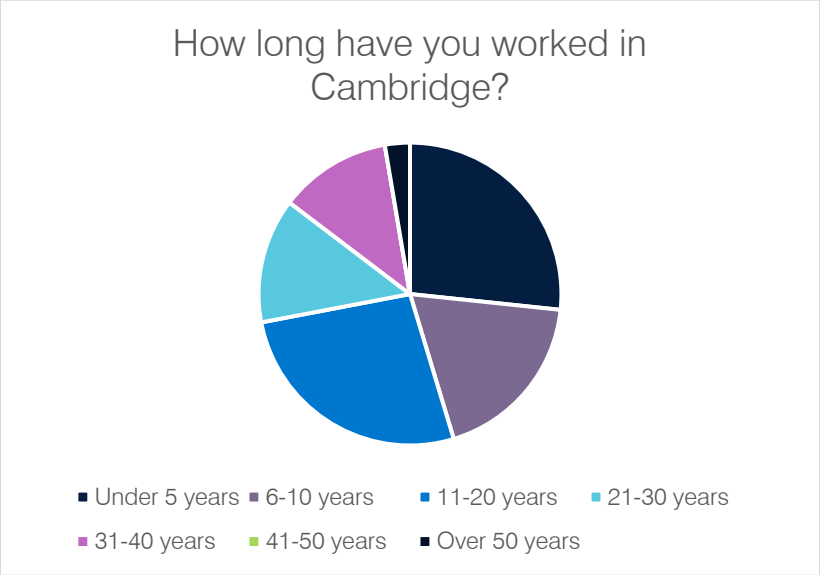
1.1.13 | What neighborhood do you work in?

Answered: 130
Skipped: 25



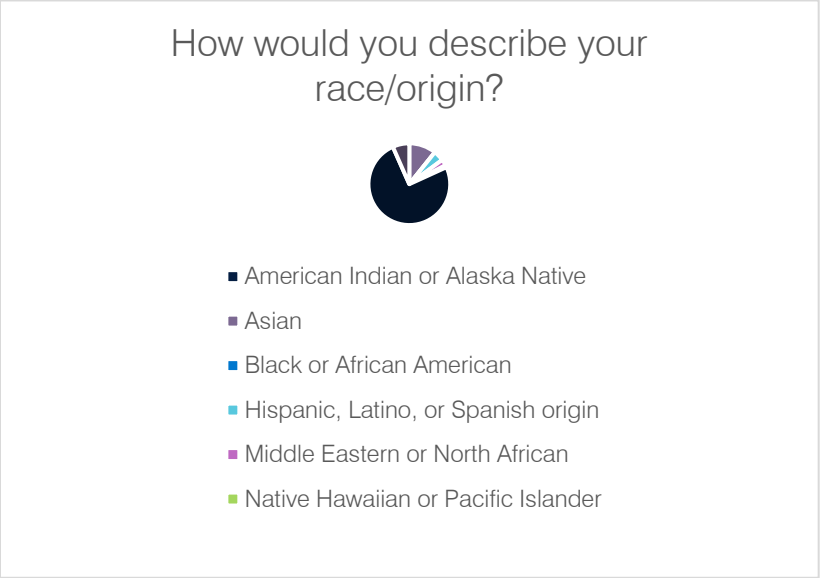
1.1.14 | How long have you worked in Cambridge?

Answered: 75
Skipped: 80



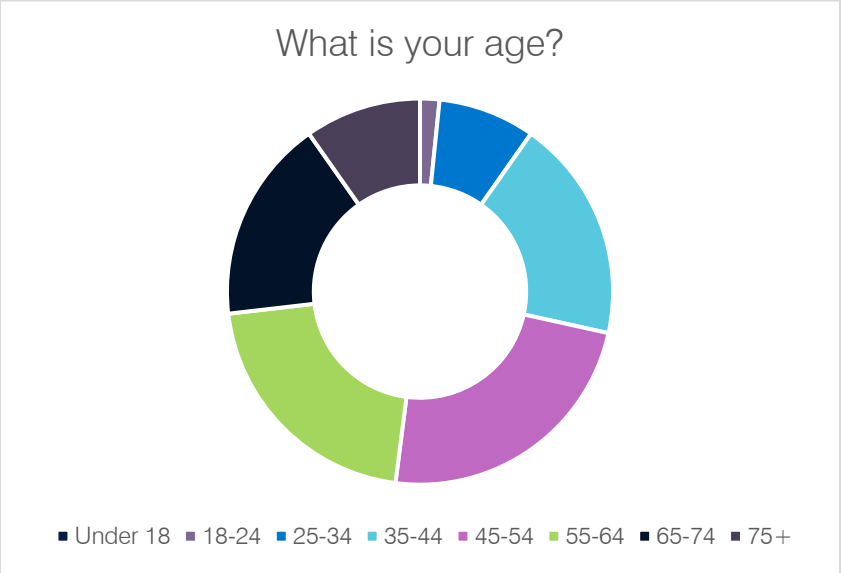
1.1.15 | How would you describe your race/origin?

Answered: 118
Skipped: 37



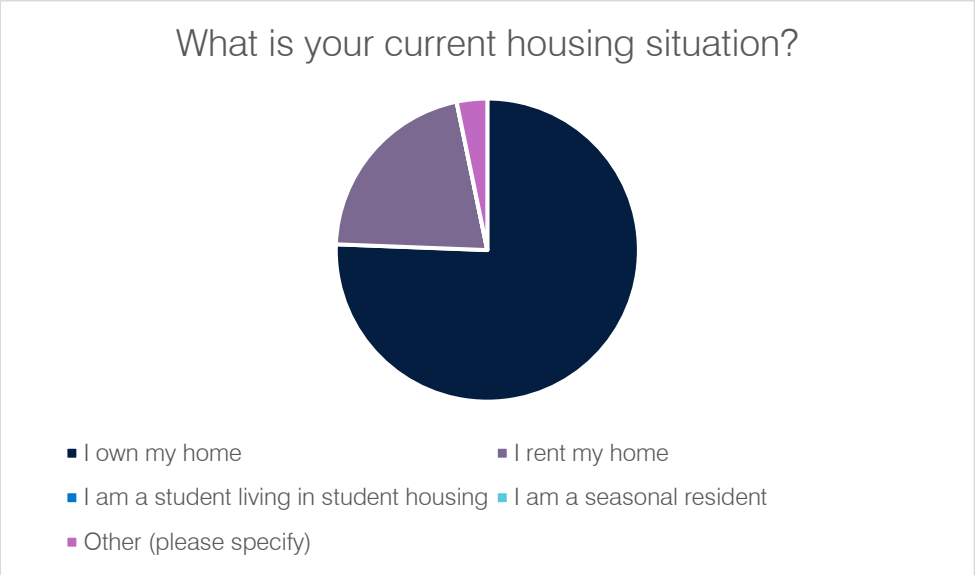
1.1.16 | What is your age?

Answered: 123
Skipped: 32



1.1.17 | What is your current housing situation?

Answered: 123
Skipped: 32



1.1.18 | What else would you like us to know about hazards that you or others face in Cambridge?

Answered: 53
Skipped: 102

- Rats are still a problem. I'm seeing fewer than a year ago but they are a big pest
- n/a
- Cambridge is wonderful. But the climate changes we are seeing are scary. We need to more swiftly move from fossil fuel and take all remediation steps we can.
- Constantly changing traffic patterns. No reliable public transportation that is accessible to people with mobility issues. No real understanding of the needs of older people who can't ride bicycles, or handle giant recycling bins.
- Global warming is going to accelerate faster than we can really imagine.
- North Cambridge is most proximally affected by sewage overflows from the combined system.
- Do we consider sea level rise and knock-on effects from that to fall explicitly under flooding? It would seem that challenges from that and salt-water contamination wouldn't be exactly the same as excess rainfall, for instance.
- welling up of ground water
- Increasing numbers of fast moving people on motorized vehicles such as scooters, skateboards, bicycles in pedestrian and bicycle lanes with lack of adherence to stopping and yielding. This makes it unsafe to walk and to drive. My sense is that there is no regulation of these forms of transport which take place off roadways.
- What the city is doing right now. What the initiatives are.
- I think there should be more warnings and info made available about air quality issues due to the current Canadian wildfires. Most people I talk to seem not to be aware of those hazards. It would also be good to provide sun/rain shelter at more bus stops.
- In the hottest summer on record I appreciate Cambridge is thinking of how to survive in this new normal
- I feel relatively safe in my neighborhood, but there are heat islands in other neighborhoods that I feel need to be mitigated for the future.
- I feel I have been very fortunate regarding natural hazards that have occurred while I have lived in Cambridge. I am concerned that we are due for a strong hurricane and don't have a good understanding of what kinds of risks we would face in that scenario and what the city's response would look like. As the climate shifts, I worry about water -- both too much of it and too little of it. While I put invasive species low on my list relative to the other possible hazards, I would like to see Cambridge work toward eradication of tree of heaven -- regardless of the current restrictions on tree removals -- and Japanese knotweed. It would also be helpful to develop a resource to match residents with snow removal options. Right now, as a homeowner, it's difficult to travel at any point during the winter due to the need to be present to shovel in case of snow.

- emphasize pets staying with owners also -- need specific plan for physically and/or mentally disabled
- Food insecurity, which is not a hazard for the purposes of this survey, but is hazardous. I appreciate that natural disasters are part of the City's planning, but even more I appreciate our future free pre-K funding, our tree planting, the construction of safer bike lanes, our affiliation with Food for Free, etc.
- Combined sewer system backups and flooding should be in these hazards.
- Cant find link but some city water or other departments give seeds of native plants to citizens to mitigate some ecosystem problems around water.
- Unreliable public transport is very impactful
- Add requirements for landowners (like Condos) to install dry wells to manage suface water. Allow owners to attach surface water drainage to the surface water side of the drainage/sewer system. If there is an annual fee that is fine.
- Cambridge has a high water table. Severe flooding is a distinct possibility if the Charles River Dam fails in a storm surge. So how is it going to be protected, and what are the flood mitigation plans?
- My answers might seem like an error. But, the things Cambridge is doing well are things I want Cambridge to be doing more of. Hazard Mitigation should center those most impacted by systemic barriers. Personally, I'd like to understand what to expect/prepare for for the expected flood that will come to our neighborhood in the future with global warming.
- I would love if there was some help from the city that that trees on private property that are part of the city canopy could receive. We treat for the emerald ash borer every year and take other steps to maintain our trees but many in our neighborhood have been lost to neglect. If only there were a way the city could aid in their maintenance?
- I'm most worried about long term flooding risk for low-lying neighborhoods such as riverside and Kendall, due to sea level rise from climate change.
- When you do snow removal, please clear school bus stops and corners of public houses. it would be good for people that we got our houses before this crazy market, to have support from the city to help us keep our houses in good condition, not everyone that own a house in Cambridge are high income families.
- Mobility for non-handicapped seniors
- biohazards from labs, possible radiation exposure, concerned about the aging telephone landline system, the poles, electrical wires etc, the drains that tend to get blocked by leaves in the fall, growing reliance on web based interactions when cellular service as well as landlines could be interrupted in a disaster.
- I am concerned about climate change above all other issues.
- Effects of Charles river rise/ocean rise
- I think having climate resilience and investing in trees and renewable resources is the way to go
- I appreciate your asking for input. Thank you. Please find a way to stop people cutting down large trees. Planting new ones does not compare to preserving the old ones.
- It's a hoax.

- Reminder that hazards don't affect everyone evenly. Many in Cambridge that are most vocal also have a ton of money, which during hazardous events can mean safety and easier ability to rebuild/adapt. Do not forget to target efforts to help those most vulnerable please
- It seemed like the initial survey questions missed asking about hazards to health - humans, pets, wildlife, yes and plants. Those are the biggest concerns. Urban heat mitigation is critical, let's be creative about all the ways that residents, homeowners and the city can do this. Don't forget air quality (wildfires!) And increased flooding as seas rise.
- Air quality is definitely degraded not only by motor vehicles! No one seems to have any concerns about trendy wood-fired pizza ovens, or how much fuel of every type the restaurant industry wastes, just as an example
- It's confusing to have the city prepare a hazard mitigation plan and also a climate change plan. Seems like a lot of overlap.
- The biggest hazard is cars. Eliminate parking - plant trees in that space instead of constantly making the sidewalks narrower. Make owning a care more expensive via excise/fees. Make parking on city streets MUCH more expensive. It should be a minimum of $100/month for resident parking - and even that is a bargain for at least 100 Sq ft of space.
- more about flooding and actual likelihood of some event similar to Montpelier VT happening in Cport, also how rising oceans might impact Cport
- What are the evacuation routes in Cambridge in case of a natural disaster? Do we have a plan?
- We will increasingly be having heavy rainstorms during winters when there is a lot of snow at curbsides. There needs to be a better effort to promptly clear drains. Also, isolated bike routes are sometimes extremely hazardous after snow and freezing rain - those need to be thoroughly cleared as quickly as are roadways; otherwise they are endangering bicyclists.
- Provide a list of shelters, cooling stations, and warming centers, and make sure they are in all sections of the city not just central square, use every public school as a shelter, cooling center, and warming center.
- This city is collapsing under its own weight, we alone cannot solve the housing crisis or global warming, please stop blaming the citizens of Cambridge before you look at the city's wastage of resources and taxpayer's dollars.
- One question mentioned evacuation routes. I don't know which routes they are or how to find them. I contacted a city department years ago asking and was told that info couldn't be released for security reasons, which seems dubious. Does the city have established evacuation routes, and how can they public learn what they are?
- Traffic !!! Cars buses bikes
- Uneven sidewalks are a hazard and there are too many of them around Cambridgeport.
- Air quality is an issue we need to prepare for. My child's daycare doesn't have a policy related to outdoor time when air quality is bad. That's a problem. We need more aggressive cooling work done. We need to push Harvard and MIT to help us get onto a sustainable grid faster. This can be part of their research and teaching missions! Put the pressure on these places NOW!
- The city government's mania for building more, more, more and taller, taller, taller and ever closer together is making it hotter, reducing absorption of stormwater, reducing sunlight for

green growing things, and displacing groundwater as foundations go deeper and deeper for taller buildings. At some point, it may also increase fire hazards as well. We think that talking about heat islands while creating more of them isn't hypocritical and counterproductive. We think that storage tanks can replace natural absorption of storm water. We think that refusing to protect solar panels legally won't come back to bite us. We think that shading out trees and making it harder and harder to find anywhere to plant them is perfectly fine; I still remember someone saying, "If you want to see a tree, you can go to Concord." We think that it's okay that the only place we work hard to preserve open space is in Lincoln or Lexington or other places that aren't Cambridge, because we care about our reservoirs in the suburbs more than we care about the people who live in Cambridge and need open space and greenery.

- It is especially hard for the elderly and disabled and poor who live alone. Thank you for your consideration.
- Thank you for giving us information about Cambridge weather.
- I'd like to better understand the whole water system in Cambridge.
- Longer winter time and in this summer very humid.
- Food and medical services problems
- Leaking city building.

HAZARD MITIGATION PLAN UPDATE 2023

The City of Cambridge is currently updating their Hazard Mitigation Plan and has drafted these proposed actions. **The City would like your input on these actions, feedback on improvement, missing actions, actions that should be removed, or questions about actions.**

Each action is a project, plan, or coordination effort that the City will undertake (or has already started) to address **one or multiple hazards** and **support one or multiple Goals** laid out in the Plan.

The five key goals of the plan are:
1. Protect - Equitably *Protect* Health and Safety of the Community
2. Communication - Promote Public Preparedness and Resilience through *Communication*
3. Coordinate and Collaborate - *Coordinate and Collaborate* among City Departments and with Community Partners on Hazard Mitigation Planning & Climate Adaptation
4. Sustainably Invest - Plan for & *Sustainably Invest* in Priority Hazard Mitigation Implementation
5. Monitor & Respond - Improve Capacity to *Monitor* Natural Hazards and *Respond* to Changes

The hazards that the plan is focused on mitigating are:
1. Hurricanes/Tropical Storms
2. Inland Flooding
3. Extreme Temperatures
4. Severe Winter Weather/Nor'easters
5. Coastal Flooding
6. Tsunami
7. Drought
8. Wildfire
9. Earthquakes
10. Tornadoes
11. Landslides
12. Invasive Species

For more information, please visit:
https://www.cambridgema.gov/CDD/climateandenergy/naturalhazardmitigationplan

1. Below are Draft Mitigation Actions that the City would like your feedback on. Please click on the mitigation actions you would like to comment on and proceed to leave your feedback in the following step. Please feel free to leave comments for as many actions as you would like.

   Mark only one oval.

   - ◯ Develop program for enhanced staffing for disaster recovery *Skip to question 2*
   - ◯ Perform a study to evaluate the replacement of manually operated components with remote operated components, including the evaluation of cybersecurity vulnerability of the public water supply system *Skip to question 3*
   - ◯ Integrate resiliency strategies and considerations into implementation of open space projects. *Skip to question 4*
   - ◯ Extend swimming pool operational hours and season *Skip to question 5*
   - ◯ Collaborate with Cambridge public housing authority and community centers to identify community rooms to use as cooling centers and shelters during storms *Skip to question 6*
   - ◯ Develop an operations plan for DPW and Police on how to respond to flooding *Skip to question 7*
   - ◯ Create an emergency response higher education and city collaboration plan *Skip to question 8*
   - ◯ Perform a vulnerability assessment of vaults where hard copy records are kept *Skip to question 9*
   - ◯ Conduct maintenance activities to monitor and reduce brushfire risks *Skip to question 10*
   - ◯ Prepare a Tree Pest Vulnerability Matrix or similar pest and disease threat assessment and management options report utilizing the most recent tree inventory *Skip to question 11*
   - ◯ Conduct study to identify how to engage with the disability community during an emergency. *Skip to question 12*
   - ◯ Develop an annual media campaign about signing up for code red notifications *Skip to question 13*
   - ◯ Provide a central location on the City's website to provide up-to-date notification and items such as extreme weather, air quality alerts, etc. *Skip to question 14*
   - ◯ Identify areas for green stormwater infrastructure and reducing impervious surfaces *Skip to question 15*
   - ◯ Perform a study to identify how to best protect Fresh Pond reservoir from saltwater intrusion *Skip to question 16*
   - ◯ Prepare an Earthquake Emergency Plan *Skip to question 17*

- [ ] Develop an enhanced communication plan and program related natural hazards in collaboration with community groups *Skip to question 18*
- [ ] Purchase emergency radios for critical staff to utilize when an emergency event is expected where power and cell phone service may be compromised. Develop a plan for distribution and use. *Skip to question 19*
- [ ] Upgrade deicing / snow removal equipment, including smaller equipment that is able to accommodate bicycle facilities and pedestrian paths *Skip to question 20*
- [ ] Install water fountains and cooling features locations along bus/bike routes *Skip to question 21*
- [ ] Evaluate use of Microgrid(s) for critical facilities and implement recommendations *Skip to question 22*
- [ ] Undertake interventions as a regional collaboration at Charles River and Amelia Earhart Dam to reduce overtopping/flanking *Skip to question 23*
- [ ] Improve collection and conveyance system in the Port Neighborhood *Skip to question 24*
- [ ] Complete in-progress stormwater management program: Green, Franklin + Sidney Streets, School, Pine, Cherry and Windsor Streets *Skip to question 25*
- [ ] Update and improve the City's HeatViewer with best available information *Skip to question 26*
- [ ] Update and Improve Floodplain Mapping* (Cambridge Flood Viewer) *Skip to question 27*
- [ ] Develop and update materials to support homeowners in completing retrofits related to flooding & heat (e.g., trainings, & educational materials on funding assistance) *Skip to question 28*
- [ ] Develop an emergency community support reference guide which provides a list of health services which are operational during extreme events for community reference(i.e. dialysis centers) *Skip to question 29*
- [ ] Update the climate change vulnerability assessment to include up-to-date climate information and new facilities and identify recommendations for municipal facility improvements for resiliency, including an updated flood duration study using MC-FRM *Skip to question 30*
- [ ] Implement actions of Cambridge Urban Forest Master Plan *Skip to question 31*
- [ ] Complete study to evaluate shade needs (other than trees) referred to as "The Shade Study", and implement recommendations (e.g., adding shade structures) *Skip to question 32*
- [ ] Encourage energy efficiency in buildings through zoning requirements and community engagement and support *Skip to question 33*
- [ ] Prioritize clean energy solutions for power such as solar, battery, geothermal, etc. where feasible *Skip to question 34*

- [ ] Coordinate with the MBTA their efforts to protect critical regional transit infrastructure in Cambridge *Skip to question 35*
- [ ] Coordinating with adjacent communities for hazard preparation and response *Skip to question 36*
- [ ] Continue to engage with the Charles River Climate Compact and Mystic River Watershed Association on regional collaboration *Skip to question 37*
- [ ] Begin to develop a central emergency response plan and centralize emergency response within the city *Skip to question 38*
- [ ] Design and construct updates to metering stations for Combined Sewers *Skip to question 39*
- [ ] Collaborate with energy providers to protect critical community infrastructure *Skip to question 40*
- [ ] Each department shall ensure identified staff have been trained in ICS and NIMS and continuing education and training shall be determined by each department head or training division.
- [ ] Succession planning should be integrated into the City's Continuity of Operations Plan (COOP) and revisited on a yearly basis by June 30 of every year and updated to reflect staff changes and required trainings for staff identified as part of the planning process.

Action 1: Develop program for enhanced staffing for disaster recovery

Timeframe to Start: 1-2 years
Associated Goal(s): #5 Monitor & Respond
Hazards: All

2. Please leave comments for this action below.
   After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 2: Perform a study to evaluate the replacement of manually operated components with remote operated components, including the evaluation of cybersecurity vulnerability of the public water supply system

Timeframe to Start: 1-2 years
Associated Goal(s): #5 Monitor & Respond
Hazards: All

3. Please leave comments for this action below.
   After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 3: Integrate resiliency strategies and considerations into implementation of open space projects.

Timeframe to Start: 1-2 years
Associated Goal(s): #1 Protect
Hazards: Extreme Heat, Precipitation Flooding, Drought

4. Please leave comments for this action below.
   After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 4: Extend swimming pool operational hours and season

Timeframe to Start: 1-2 years
Associated Goal(s): #1 Protect
Hazards: Extreme Heat

5. Please leave comments for this action below.
   After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 5: Collaborate with Cambridge public housing authority and community centers to identify community rooms to use as cooling centers and shelters during storms

Timeframe to Start: 1-2 years
Associated Goal(s): #1 Protect
Hazards: All

6. Please leave comments for this action below.
   After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 6: Develop an operations plan for DPW and Police on how to respond to flooding

Timeframe to Start: 1-2 years
Associated Goal(s):

#1 Protect, #5 Monitor & Respond

Hazards:

Precipitation Flooding, Coastal Flooding

7. Please leave comments for this action below.
   After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 7: Create an emergency response higher education and city collaboration plan

Timeframe to Start: 1-2 years
Associated Goal(s):

#3 Coordinate & Collaborate, #5 Monitor & Respond

Hazards: All

8. Please leave comments for this action below.
   After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 8: Perform a vulnerability assessment of vaults where hard copy records are kept

Timeframe to Start: 2-5 years
Associated Goal(s):

#3 Coordinate & Collaborate, #5 Monitor & Respond

Hazards:

Precipitation Flooding, Coastal Flooding

9. Please leave comments for this action below.
   After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 9: Conduct maintenance activities to monitor and reduce brushfire risks

Timeframe to Start: 1-2 years
Associated Goal(s):

#5 Monitor & Respond

Hazards:

Brushfire

10. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 10: Prepare a Tree Pest Vulnerability Matrix or similar pest and disease threat assessment and management options report utilizing the most recent tree inventory

Timeframe to Start: 2-5 years
Associated Goal(s):

4. Sustainably Invest, #5 Monitor & Respond

Hazards:

Invasive Species

11. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 11: Conduct study to identify how to engage with the disability community during an emergency.

Timeframe to Start: 1-2 years
Associated Goal(s): #1 Protect
Hazards: All

12. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 12: Develop an annual media campaign about signing up for code red notifications

Timeframe to Start: 1-2 years
Associated Goal(s):

#2 Communication

Hazards: All

13. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 13: Provide a central location on the City's website to provide up-to-date notification and items such as extreme weather, air quality alerts, etc.

Timeframe to Start: 1-2 years
Associated Goal(s):

#2 Communication

Hazards: All

14. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 14: Identify areas for green stormwater infrastructure and reducing impervious surfaces

Timeframe to Start:

in-progress/ongoing

Associated Goal(s):

#4 Sustainably Invest

Hazards:

Precipitation Flooding

15. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 15: Perform a study to identify how to best protect Fresh Pond reservoir from saltwater intrusion

Timeframe to Start:

2-5 years
Associated Goal(s):

#1 Protect, #3 Coordinate & Collaborate, #4 Sustainably Invest

Hazards:

Coastal Flooding

16. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 16: Prepare an Earthquake Emergency Plan

Timeframe to Start:

2-5 years

Associated Goal(s):

#1 Protect, # Monitor & Respond

Hazards:

Earthquake

17. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 17: Develop an enhanced communication plan and program related natural hazards in collaboration with community groups

Timeframe to Start:

2-5 years

Associated Goal(s):

#2 Communication

Hazards: All

18. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 18: Purchase emergency radios for critical staff to utilize when an emergency event is expected where power and cell phone service may be compromised. Develop a plan for distribution and use.

Timeframe to Start:

1-2 years

Associated Goal(s):

#5 Monitor & Respond

Hazards:

All

19. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 19: Upgrade deicing / snow removal equipment, including smaller equipment that is able to accommodate bicycle facilities and pedestrian paths

Timeframe to Start:

in progress

Associated Goal(s):

#5 Monitor & Respond

Hazards:

Winter Storms

20. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 20: Install water fountains and cooling features locations along bus/bike routes

Timeframe to Start:

Ongoing

Associated Goal(s):

#1 Protect, # Monitor & Respond

Hazards:

Extreme Heat

21. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 21: Evaluate use of Microgrid(s) for critical facilities and implement recommendations

Timeframe to Start:

2-5 years

Associated Goal(s):

#5 Monitor & Respond

Hazards:

All

22. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 22: Undertake interventions as a regional collaboration at Charles River and Amelia Earhart Dam to reduce overtopping/flanking

Timeframe to Start:

in-progress

Associated Goal(s):

#3 Coordinate & Collaborate, #4 Sustainably Invest

Hazards:

Coastal Flooding

23. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 23: Improve collection and conveyance system in the Port Neighborhood

Timeframe to Start:

In progress

Associated Goal(s):

#1 Protect, # Monitor & Respond

Hazards:

Precipitation Flooding

24. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 24: Complete in-progress stormwater management program: Green, Franklin + Sidney Streets, School, Pine, Cherry and Windsor Streets

Timeframe to Start:

Less than 1 year

Associated Goal(s):

#1 Protect, #4 Sustainably Invest

Hazards: Precipitation Flooding

25. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 25: Update and improve the City's HeatViewer with best available information

Timeframe to Start:

2-5 years
Associated Goal(s):

#2 Communication
Hazards:

Extreme Heat

26. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 26: Update and Improve Floodplain Mapping* (Cambridge Flood Viewer)

Timeframe to Start:

in progress

Associated Goal(s):

#2 Communication
Hazards:

Precipitation Flooding, Coastal Flooding

27. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 27: Develop and update materials to support homeowners in completing retrofits related to flooding & heat (e.g., trainings, & educational materials on funding assistance)

Timeframe to Start:

2-5 years

Associated Goal(s):

#1 Protect

Hazards:

Extreme Heat, Precipitation Flooding, Coastal Flooding

28. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 28: Develop an emergency community support reference guide which provides a list of health services which are operational during extreme events for community reference(i.e. dialysis centers)

Timeframe to Start:

1-2 years

Associated Goal(s):

#1 Protect, #2 Communications

Hazards:

All

29. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 29: Update the climate change vulnerability assessment to include up-to-date climate information and new facilities and identify recommendations for municipal facility improvements for resiliency, including an updated flood duration study using MC-FRM

Timeframe to Start:

2-5 years
Associated Goal(s):

#3 Coordinate & Collaborate

Hazards:

Extreme Heat, Precipitation Flooding, Coastal Flooding

30. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 30: Implement actions of Cambridge Urban Forest Master Plan

Timeframe to Start:

in progress/ongoing

Associated Goal(s):

#1 Protect, #4 Sustainably Invest

Hazards:

Extreme Heat, Precipitation Flooding, Drought

31. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 31: Complete study to evaluate shade needs (other than trees) referred to as "The Shade Study", and implement recommendations (e.g., adding shade structures)

Timeframe to Start:

in progress
Associated Goal(s):

#1 Protect
Hazards:

Extreme Heat

32. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 32: Encourage energy efficiency in buildings through zoning requirements and community engagement and support

Timeframe to Start:

Less than 1 year

Associated Goal(s):

#5 Monitor & Respond

Hazards:

Extreme Heat, Extreme Cold

33. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 33: Prioritize clean energy solutions for power such as solar, battery, geothermal, etc. where feasible

Timeframe to Start:

Less than 1 year

Associated Goal(s):

#5 Monitor & Respond

Hazards:

All

34. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 34: Coordinate with the MBTA their efforts to protect critical regional transit infrastructure in Cambridge

Timeframe to Start:

Less than 1 year

Associated Goal(s):

#3 Coordinate & Collaborate, #4 Sustainably Invest

Hazards:

All

35. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 35: Coordinating with adjacent communities for hazard preparation and response

Timeframe to Start:

1-2 years

Associated Goal(s):

#3 Coordinate & Collaborate

Hazards:

All

36. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 36: Continue to engage with the Charles River Climate Compact and Mystic River Watershed Association on regional collaboration

Timeframe to Start:

in-progress

Associated Goal(s):

#3 Coordinate & Collaborate

Hazards:

Precipitation Flooding, Coastal Flooding, Extreme Heat

37. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 37: Begin to develop a central emergency response plan and centralize emergency response within the city

Timeframe to Start:

Less than 1 year

Associated Goal(s):

#3 Coordinate & Collaborate

Hazards:

All

38. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 38 Design and construct updates to metering stations for Combined Sewers

Timeframe to Start:

in-progress

Associated Goal(s):

#5 Monitor & Respond

Hazards:

Precipitation Flooding

39. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 39: Collaborate with energy providers to protect critical community infrastructure

Timeframe to Start:

Less than 1 year

Associated Goal(s):

#3 Coordinate & Collaborate, #4 Sustainably Invest

Hazards:

All

40. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 40: Each department shall ensure identified staff have been trained in ICS and NIMS and continuing education and training shall be determined by each department head or training division.

Timeframe to Start:

1-2 years

Associated Goal(s):

#3 Coordinate & Collaborate, #5 Monitor & Respond

Hazards:

All

41. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

Action 41: Succession planning should be integrated into the City's Continuity of Operations Plan (COOP) and revisited on a yearly basis by June 30 of every year and updated to reflect staff changes and required trainings for staff identified as part of the planning process.

Timeframe to Start:

1-2 years

Associated Goal(s):

#3 Coordinate & Collaborate, #5 Monitor & Respond

Hazards:

All

42. Please leave comments for this action below.
After you submit your comments for this action, you can click "submit another response" to leave comments on more actions. Thank you for your participation!

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Google Forms

MITIGATION ACTIONS PUBLIC SURVEY RESULTS

November 1, 2023

Public Survey – Mitigation Actions

Introduction

On November 1, 2023, the City of Cambridge released a Public Survey to gather input on the Mitigation Actions included in the Natural Hazard Mitigation Plan Update 2023. All actions were included, and respondents had the opportunity to provide comments on an unlimited number of actions through the survey. Out of the 42 Actions, 8 received comments from the public. Below is a documentation of the Mitigation Actions that received comments, content of the comments, and the City response in the Plan.

Mitigation Action numbering correlates to the Survey numbering.

Mitigation Action #3:

Action:

Integrate resiliency strategies and considerations into implementation of open space projects.

Public Comment:

Heat is a dangerous aspect of climate change which is increasing in severity and one of the best solutions is to plant more trees. Cambridge is building large cisterns to hold flood waters, but is not doing a very good job at planting trees.

How Comment is Addressed in NHMP:

The hazard profile for Extreme Heat is discussed in detail in Chapter 3 and the vulnerabilities caused by Extreme Heat are detailed in Chapter 5. Mitigation Actions that address Extreme Heat include implementation of the Urban Forest Master Plan, stormwater and green infrastructure improvements, additional water fountains and shading to bike routes, among several heat-related actions.

Mitigation Action #4:

Action:

Extend swimming pool operational hours and season.

Public Comments:

This would be terrific. It would also be good to optimize usage by DHSP summer camps versus other Cambridge residents. Often the camps have the Gold Star Pool reserved but are not actually using it.

Please extend season thanks

How Comment is Addressed in NHMP:

One of the mitigation actions included in Chapter 7 (#21) is to extend swimming pool operational hours and season. As part of undertaking this action, we will consider other pool locations and coordination needs.

Mitigation Action #5:

Action:

Collaborate with Cambridge public housing authority and community centers to identify community rooms to use as cooling centers and shelters during storms

Public Comment:

You should also work with CHA to build more housing with wraparound services to help unhoused people get off the street and into secure housing with A/C.

How Comment is Addressed in NHMP:

Many of the City Departments who support the unhoused populations in Cambridge participated in the development of the NHMP. While building new housing as suggested in the comment is not an action in the plan, many of the actions in this plan support heat resilience for priority populations.

Mitigation Action #14:

Action:

Identify areas for green stormwater infrastructure and reducing impervious surfaces

Public Comment:

This is a clear area where Cambridge is falling short. Boston has elevated green infrastructure to a cabinet level position, while Cambridge appears to be prioritizing gray infrastructure. Jerry's Pond is a clear example where City investment could contribute funds to de-pave 2-3 acres of land which is paved around the pond and plant 150-175 trees along Rindge Ave. Instead, the City is content contributing $0 to improve the developer's vision which appears to be heading towards 15-20 trees on Rindge and far more limited de-paving.

How Comment is Addressed in NHMP:

The hazard profile for Extreme Heat and Extreme Precipitation is discussed in detail in Chapter 3 and the vulnerabilities are detailed in Chapter 5. Mitigation Actions that address green infrastructure include Identify areas for green stormwater infrastructure and reducing impervious surfaces, Implement actions of Cambridge Urban Forest Master Plan, and Integrate resiliency strategies and considerations into implementation of open space projects.

Mitigation Action #20:

Action:

Install water fountains and cooling feature locations along bus/bike routes

Public Comment:

We need more water bottle refill stations as well as drinking fountains.

How Comment is Addressed in NHMP:

Implementation of this action will consider a variety of water features to support pedestrians and bicyclists.

Mitigation Action #22:

Action:

Undertake interventions as a regional collaboration at Charles River and Amelia Earhart Dam to reduce overtopping/flanking.

Public Comment:

Thank you for your focus on this as sea levels and water ways levels rise.

How Comment is Addressed in NHMP:

No further action needed.

Mitigation Action #30:

Action:

Implement actions of Cambridge Urban Forest Master Plan

Public Comment:

The City is falling short on protecting and expanding the tree canopy. Having observed the canopy since the early 1990s, it has been a slow and steady decline with the loss of large legacy trees and an insufficient number of new, smaller plantings. There are few opportunities to plant large numbers of trees, particularly in environmental justice

neighborhoods and Jerry's Pond is one such example which the City appears to be missing. Where else can we plant 150-175 trees in an EJ neighborhood? The UFMP specifically calls out EJ neighborhoods and suggests that we need to rethink our streets and sidewalks to plant more trees. Jerry's Pond could be one such location.

How Comment is Addressed in NHMP:

The hazard profile for Extreme Heat and Extreme Precipitation is discussed in detail in Chapter 3 and the vulnerabilities are detailed in Chapter 5. Mitigation Actions that address green infrastructure include Identify areas for green stormwater infrastructure and reducing impervious surfaces, Implement actions of Cambridge Urban Forest Master Plan, and Integrate resiliency strategies and considerations into implementation of open space projects.

Mitigation Action #32:

Action:

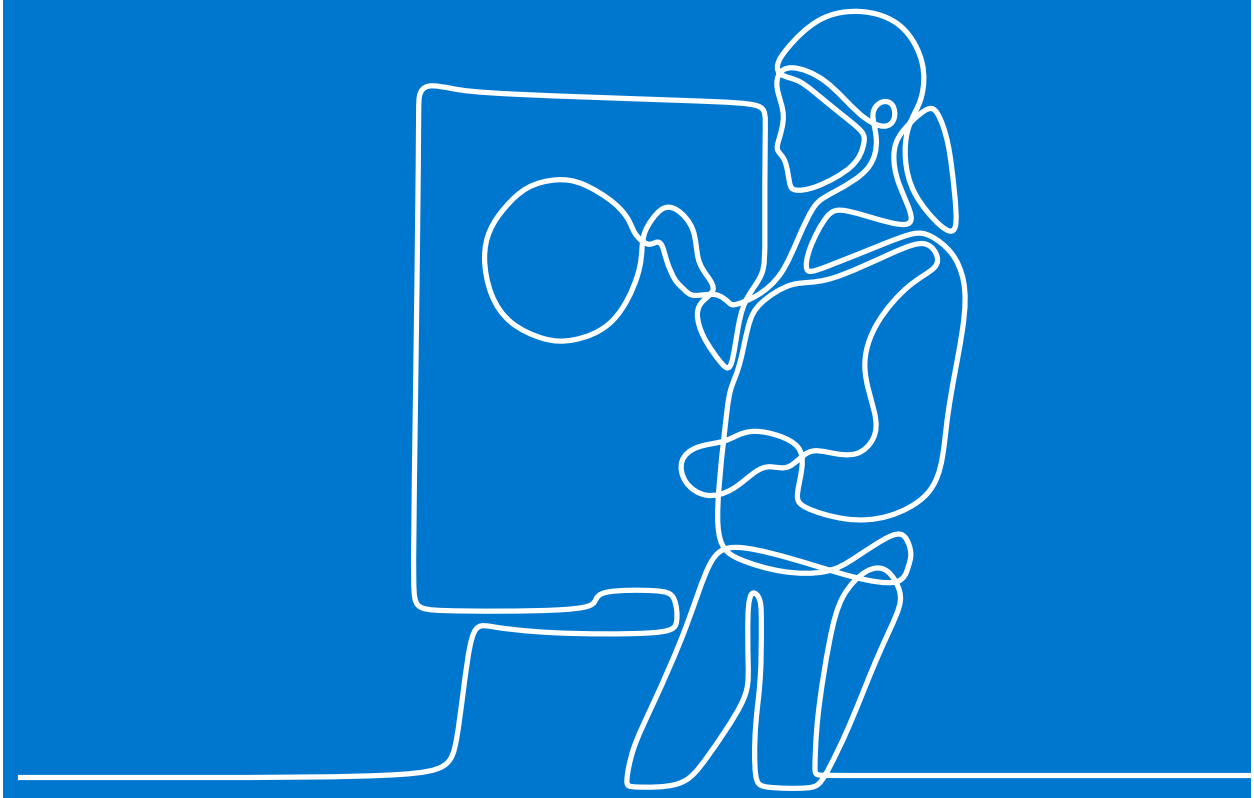
Encourage energy efficiency in buildings through zoning requirements and community engagement and support.

Public Comment:

All of these actions need to be sensitive to the need to avoid driving up housing costs. Passing unfunded mandates onto landlords drives up the rents and displaces residents to other municipalities that are not as focused on mitigation and prevents climate refugees from being able to afford to live in Cambridge.

How Comment is Addressed in NHMP:

No further action needed.



Appendix D

Public Meeting Materials

Are you concerned about rising heat, unusually warm winters, and other extreme events?

The City of Cambridge is working hard to prepare for a more resilient and safe community by updating its Hazard Mitigation Plan, which will study risks and introduce strategies to address natural hazards now and in the future.

Join us for a public meeting to learn more about the Plan and make your voice heard!

TUESDAY

JUNE 13
6PM

Register using the QR code and link at right. After registering, you will receive a Zoom link to attend virtually via email.

To request an interpreter for this event, please call 617-349-4396 by June 2, 2023

tinyurl.com/CambridgeHMPrsvp2

Are you concerned about rising heat, unusually warm winters, and other extreme events?

Join us for a public meeting to learn more about the Plan and make your voice heard!

JUNE
13
6PM

Register using the QR code and link at right. After registering, you will receive a Zoom link to attend virtually via email.

tinyurl.com/CambridgeHMPrsvp1

Hazard Mitigation Plan Update 2023

Public Meeting
June 13, 2023

CITY OF CAMBRIDGE

Weston & Sampson SM

WELCOME

Introduce yourself in the ***chat***

This meeting is being ***recorded***

For questions, please use the ***Q&A Function***

Susanne Rasmussen
Director of Environmental and Transportation Planning

Leila Mekias
Climate Resilience Project Planner

Robin Seidel
Project Manager, Weston & Sampson

Emily Judson
Resiliency Planner, Weston & Sampson

Also Joining Us Tonight:

Jim Wilcox
Department of Public Works

Sam Lipson
Cambridge Public Health Department

Chief Colin S. Walsh
Fire Department

Janet Moonan
Project Technical Lead, Weston & Sampson

AGENDA

- Welcome & Introductions
- Overview of the Hazard Mitigation Plan
- Natural Hazards in Cambridge
- Project Goals and Community Assets
- Next Steps and Discussion
- Conclude

AGENDA

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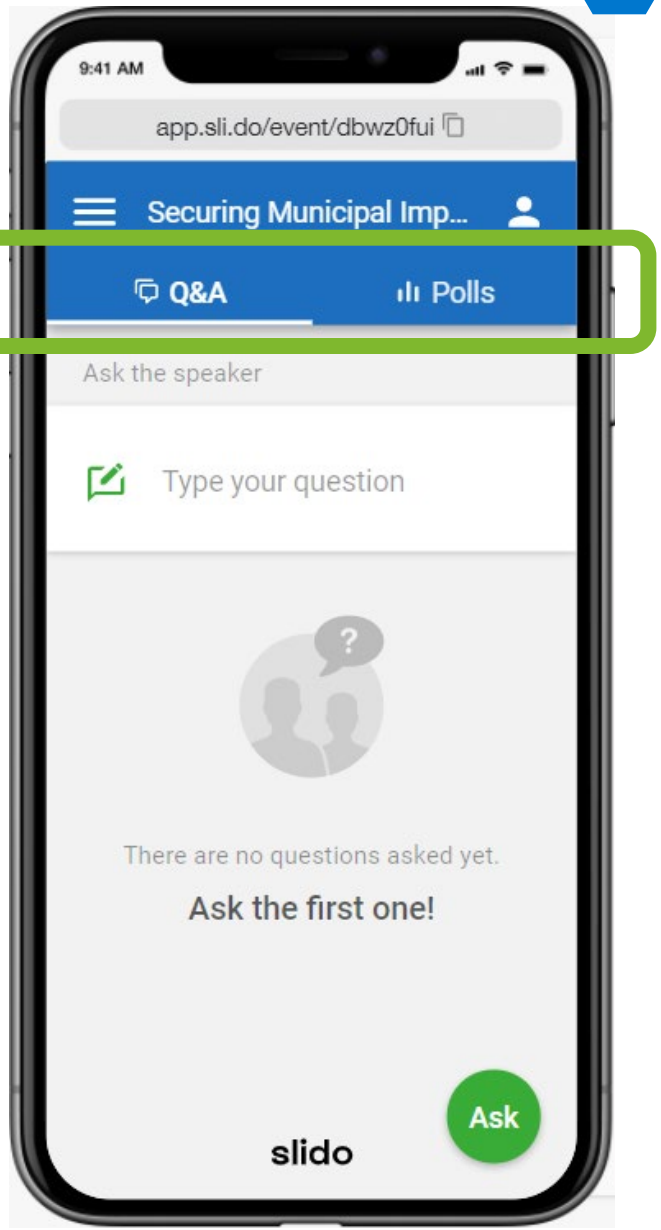
- Conclude

JOIN US ON SLIDO!

1. Get your phone ready
2. Follow instructions or use the QR code



You can move between the Q&A tab and the polls tab!

What do you love about Cambridge?

AGENDA

- Welcome & Introductions
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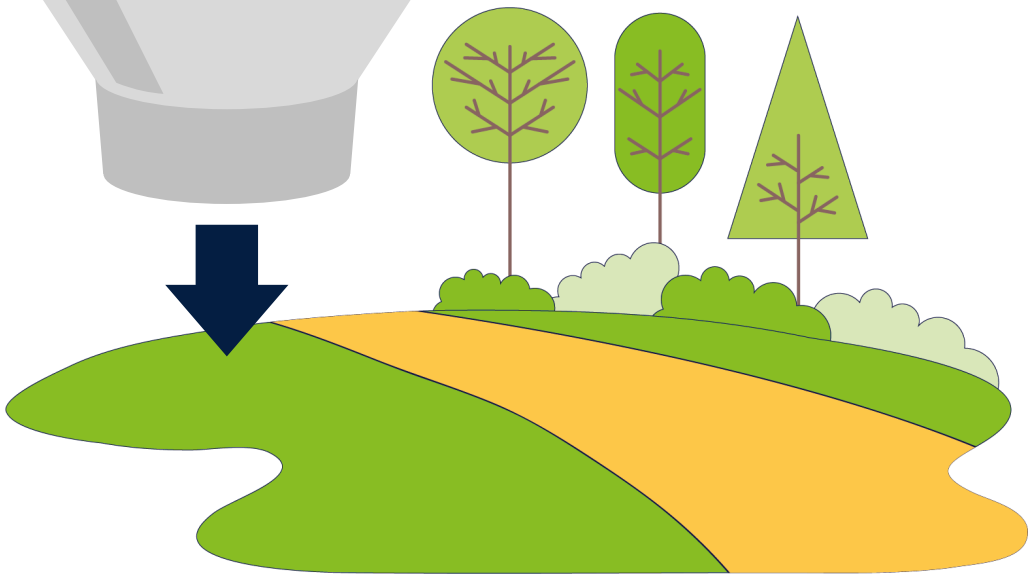
- Conclude

WHAT IS HAZARD MITIGATION?

Reduce impacts from natural hazards…

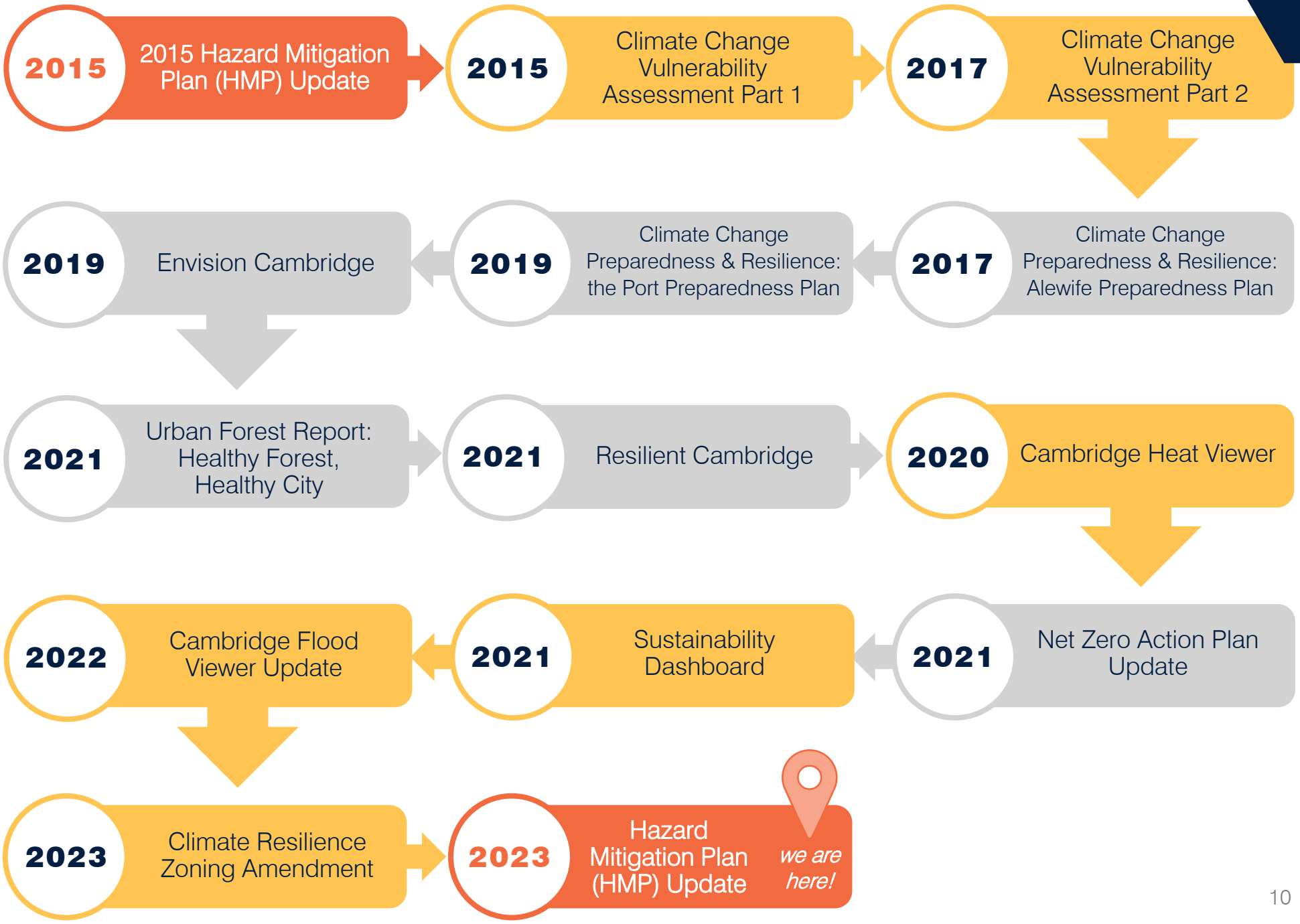
…through plans, projects, and services.



VALUE OF HAZARD MITIGATION PLANNING

EVERY $1 SPENT ON MITIGATION

SAVES $6 ON DISASTER RECOVERY



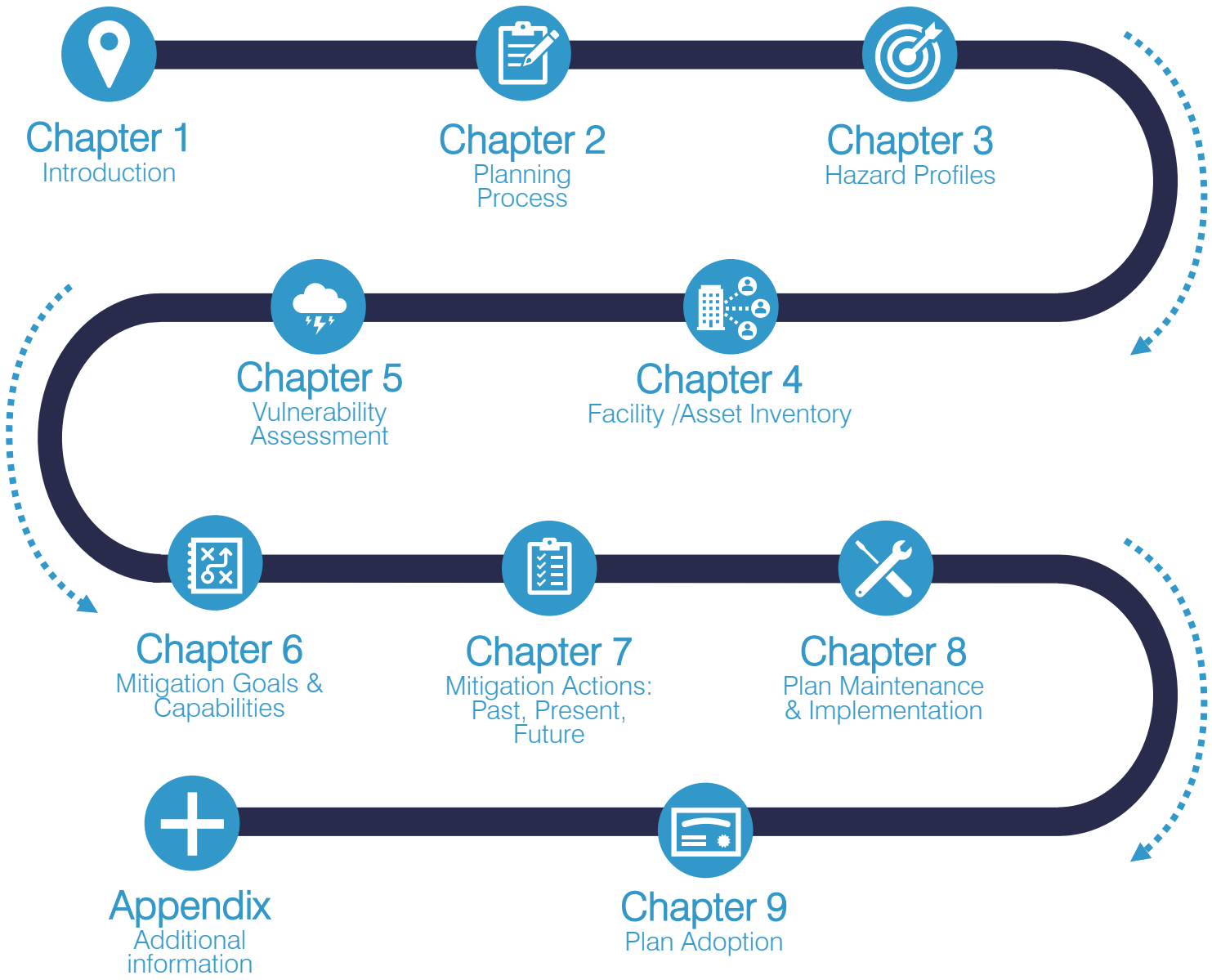
How the HMP is different from other efforts!

HMPs

City Plans

City Actions

HMP OVERVIEW



HMP OVERVIEW

WHY ARE WE HERE TODAY?

AGENDA

- Welcome & Introductions
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HAZARD PROFILES

HURRICANES / TROPICAL STORMS

INLAND FLOODING

EXTREME TEMPERATURES

SEVERE WINTER WEATHER / NOR'EASTERS

COASTAL FLOODING

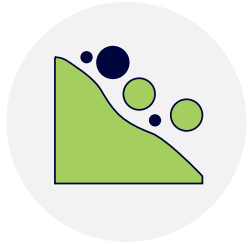
TSUNAMI

DROUGHT

WILDFIRE

EARTHQUAKES

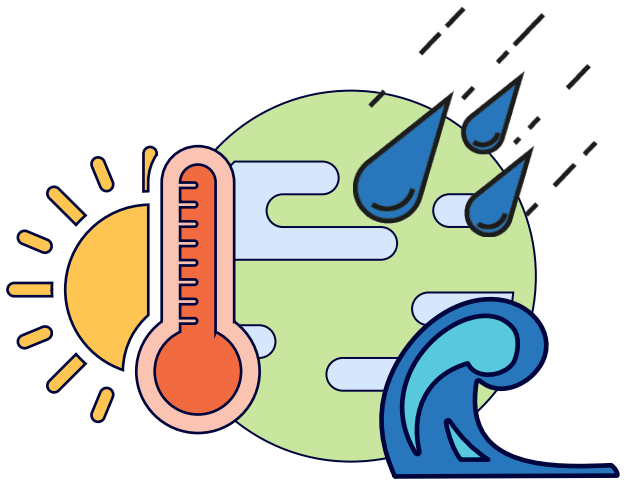
TORNADOES



LANDSLIDES

INVASIVE SPECIES

CLIMATE CHANGE



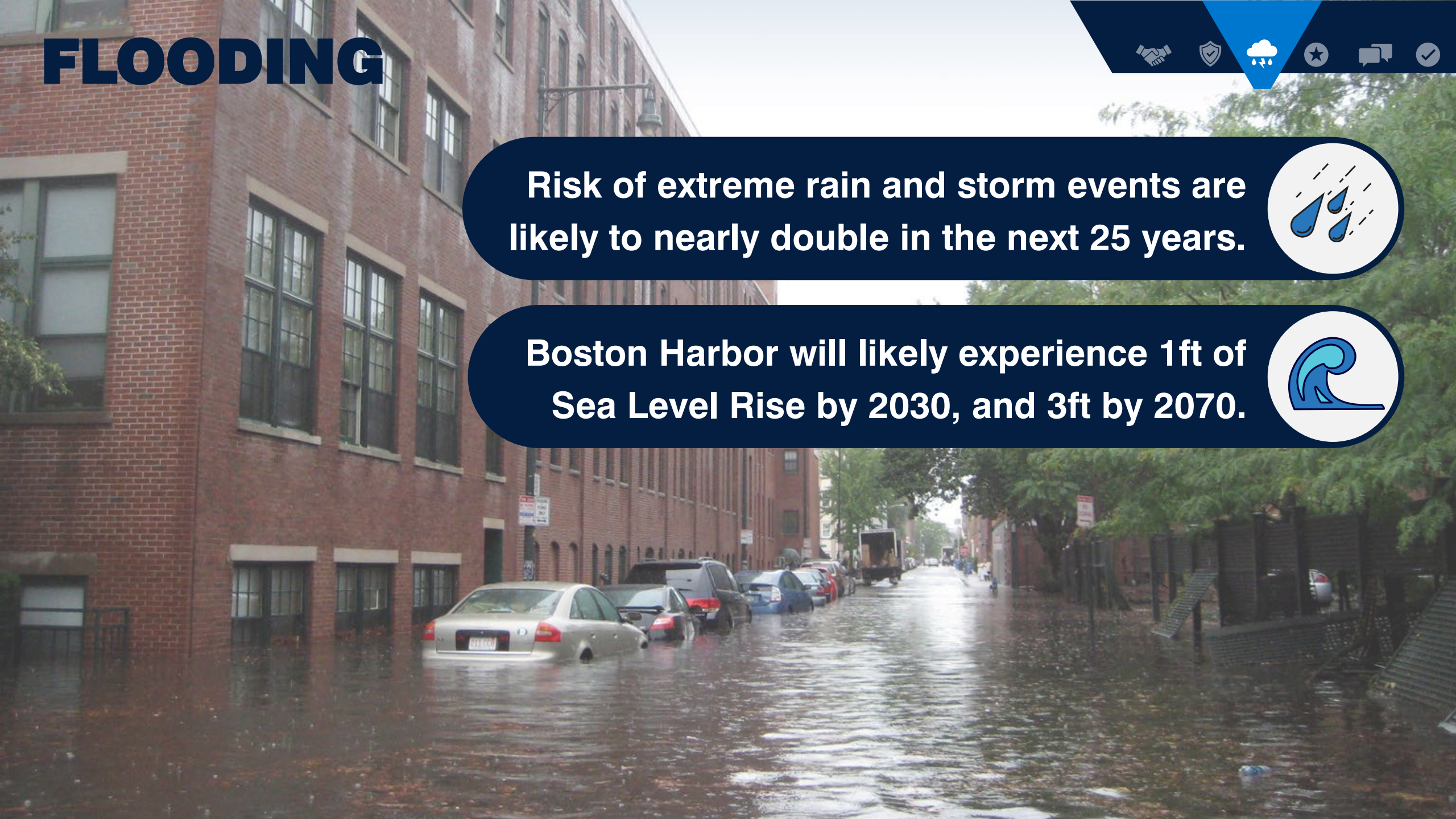
Climate is the average course or condition of the weather over a period of decades.

Climate change is manifested by **sea level rise and storm surge, extreme precipitation, and extreme heat.**

Cambridge is designed and built for the climate of the past. We must have a plan that looks forward.

- Resilient Cambridge Report

FLOODING

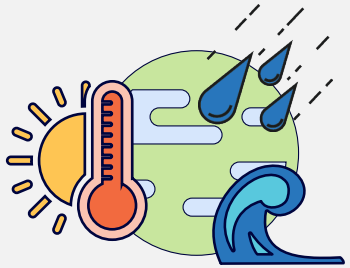


Risk of extreme rain and storm events are likely to nearly double in the next 25 years.

Boston Harbor will likely experience 1ft of Sea Level Rise by 2030, and 3ft by 2070.

FLOODING IMPACTS

- Buildings and infrastructure
- Evacuations
- Emergency responders
- Businesses and deliveries
- Power outage and energy
- Food availability and supply chain
- Shelters and people without housing
- Ecosystem and soil stability
- Water quality



Climate Change is expected to worsen flooding and impacts associated with flooding, especially for those with other environmental, health, and economic difficulties.

FLOODING

What are your experiences with flooding in Cambridge?

Answers:

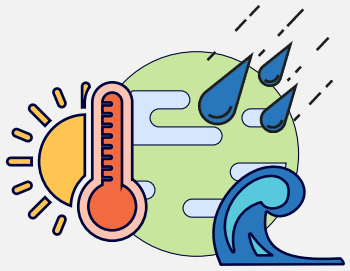
- Splashed by cars when walking
- Driving conditions
- Street puddles not draining
- Water coming almost over Curb to sidewalks
- Wet socks
- My basement floods sometimes
- Some plants dying
- Have not experienced flooding in cambridge
- storm drains not draining

HEAT

The number of days above 90° is expected to reach 30 days by 2030 and 60 days by 2070.

HEAT IMPACTS

- Buildings and infrastructure
- Schools and learning loss
- Health, injuries, and mortality
- Air quality and wildfires
- Stress on energy systems
- People outdoors or without housing
- Animal and plant loss
- Drought and Water Supply



Climate Change is expected to worsen heat trends and impacts associated with heat, especially for those with other environmental, health, and economic difficulties.

HEAT

How do you and your family stay cool when it's hot out?

Answers:

- Ceiling fans
- Air conditioning Water parks
- stay in shade
- Take kids to the park
- Windows shit shades down in day, AC as needed
- stay inside
- Stay indoors in ac
- Splash pads

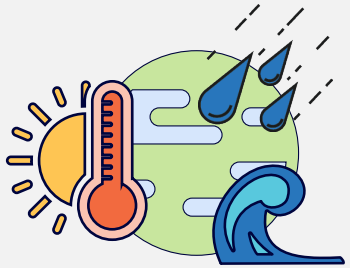
SEVERE WINTER WEATHER

In Winter 2015, the City experienced a record-breaking 108.6 inches of snow.

Photo Credit: Peter Enyeart, 2015-02-15 Cambridge Snow Trek 009

SEVERE WINTER IMPACTS

- Buildings and infrastructure
- Repair costs and construction delays
- Health, injuries, and mortality
- Business and deliveries
- Power outage
- Food availability
- Shelter and displacement
- Ecosystem and habitats
- Re-shaping the river



Climate Change is expected to worsen severe winter weather and associated impacts, especially for those with other environmental, health, and economic difficulties.

SEVERE WINTER WEATHER

What's the biggest challenge for you and your family when it snows?

Answers:

- Visibility issues due to snow mountains on Cambridge streets
- 冻伤和摔倒
- Buses not arriving on time
- Walking to work on icy sidewalks
- can't bike in the snow
- Unshoveled sidewalks
- Difficulty on sidewalks
- icy streets
- Shoveling driveway
- Sidewalks not being cleaned
- Shoveling
- shoveling the sidewalk
- Slipping and falling while commuting
- Power outage
- Train delays

AGENDA

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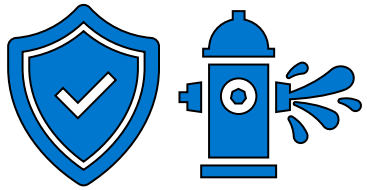
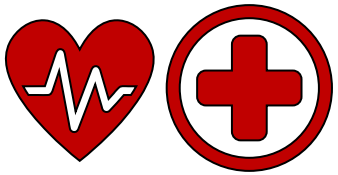
MITIGATION GOALS

Protect	Equitably ***Protect*** Health and Safety of the Community
Communication	Promote Public Preparedness and Resilience through ***Communication***
Coordinate & Collaborate	***Coordinate and Collaborate*** among City Departments and with Community Partners on Hazard Mitigation Planning & Climate Adaptation
Sustainably Invest	Plan for & ***Sustainably Invest*** in Priority Hazard Mitigation Implementation
Monitor & Respond	Improve Capacity to ***Monitor*** Natural Hazards and ***Respond*** to Changes

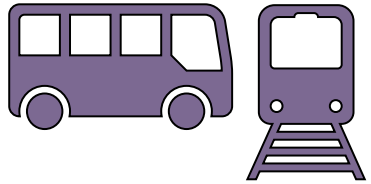
COMMUNITY ASSETS



Safety & Security



Health & Medical

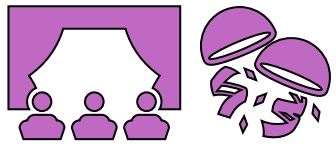


Transportation

Food, Water, Shelter

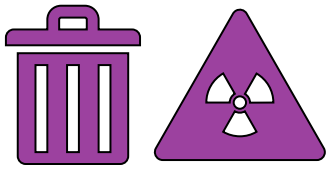
Parks & Greenspace

Communications

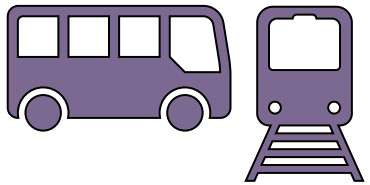
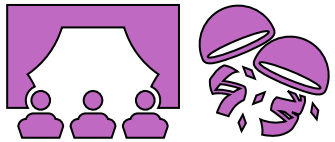


Cultural, Historic, & Events

Energy



Hazardous Material

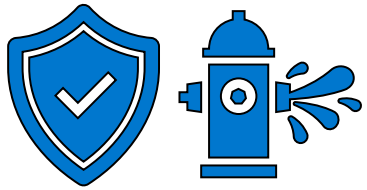



Which events are important for community resilience?

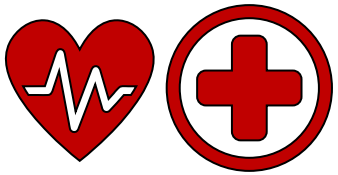
Answers:

- YWCA
- Settlement Houses (MFNH, CCC)
- Farmers market
- farmers market
- Fairs
- Dragon boat races

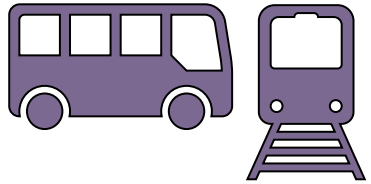
COMMUNITY ASSETS



Safety & Security



Health & Medical

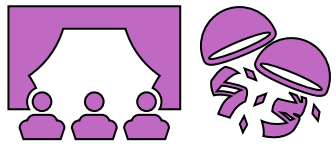


Transportation

Food, Water, Shelter

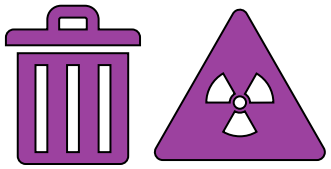
Parks & Greenspace

Communications

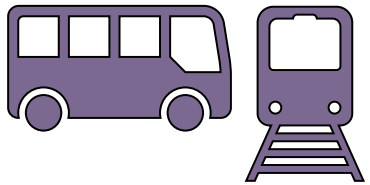
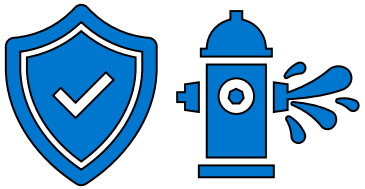


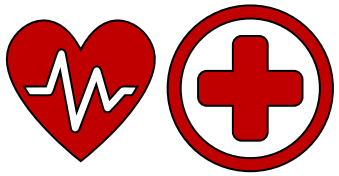
Cultural, Historic, & Events

Energy



Hazardous Material



As you deal with extreme weather events, what buildings or services do you need to access?

Answers:

- City buildings (heating, cooling centers)
- Dunks
- pharmacy
- Grocery store
- gas station
- Gas station
- Electrical or plumbing help
- grocery store
- Offices
- Market

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- Welcome & Introductions
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NEXT STEPS

- **Develop Actions**
- **Assess Capabilities**
- **Integrate Public Feedback**
- **Analyze Community Assets**

TAKE THE SURVEY!

Your input will help shape the **strategies, projects, policies,** and **decisions** the City makes regarding natural hazards.

Stay connected by visiting the City's website and look out for the final public meetings in September.

Questions or comments?

Hazard Mitigation Plan Update 2023

Thank You!

CITY OF CAMBRIDGE

Weston & Sampson SM

HAZARD MITIGATION PLAN 2023 UPDATE
PUBLIC MEETING #1
ATTENDANCE AND RECORDING

June 13, 2023

Attendees

City of Cambridge

- Leila Mekias, CDD
- Susanne Rasmussen, CDD
- Deputy Chief Colin Walsh, Fire Dept.
- Jim Wilcox, DPW
- Crystal Rosa, Human Rights Commission
- Sam Lipson, CPHD
- Vedad Konjic, CPS Facilities
- Nancy Porter, CPHD
- Marlees Owayda
- Rachel Williams, IT
- Denise Garcia
- Annie, Mandarin Interpreter
- Rachel Tanenhaus, CCPD

Members of the Public

- Amelia Joselow
- Fabiola Alikpokou
- Guoying Liu
- Jessica Sgrignuoli
- Nahid Chowdhury
- Pe Kutcher
- Qumrunnessa A Huda
- Sharmila Chandrasekaran
- Unknown Number

Weston & Sampson

- Robin Seidel, Project Manager
- Jennie Moonan, HMP Technical Lead
- Emily Judson, Resiliency Planner

Recording

To view the recording, please click on the following link and enter the passcode if prompted: https://cambridgema.zoom.us/rec/share/R39YO7zeTqhd_c8Ss-LCZzswTPXt-sVPgQuxiWed3kB5sl0ryAeOMEghY66WYNjj.paaasHEPnUFXQWQj?startTime=1686693879000

Passcode: 0cfHef&n

Learn more by viewing the public meeting recording at:

www.cambridgema.gov/CDD/climateandenergy/naturalhazardmitigationplan

The City of Cambridge is updating its Hazard Mitigation Plan for a more resilient, safe, and prepared community.

Share your experiences of living in Cambridge to help the City understand how it can improve. Please take this short, 5-minute survey to share your insights.

tinyurl.com/CambridgeSurveyHMP

Hazard Mitigation Plan Update 2023

Public Meeting
October 25, 2023

CITY OF CAMBRIDGE

Weston & Sampson SM

WELCOME

Introduce yourself in the chat

This meeting is being recorded

For questions, please use the Q&A Function

Susanne Rasmussen
Director of Environmental and Transportation Planning

Leila Mekias
Climate Resilience Project Planner

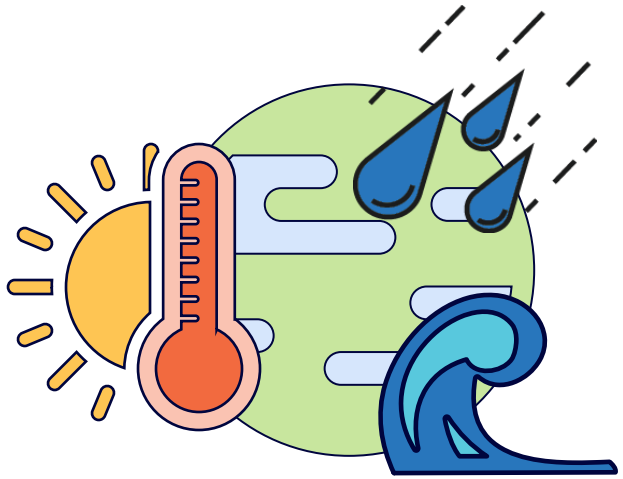
Robin Seidel
Project Manager, Weston & Sampson

Jennie Moonan
Project Technical Lead, Weston & Sampson

AGENDA

- Climate Change
- Hazard Mitigation Planning Overview
- 2023 HMP Scope of Work & Chapters Overview
- Next Steps and Discussion
- Conclude

CLIMATE CHANGE



Climate is the average course or condition of the weather over a period of decades.

Climate change is manifested by **sea level rise and storm surge, extreme precipitation, and extreme heat.**

Cambridge is designed and built for the climate of the past. We must have a plan that looks forward.

- Resilient Cambridge Report

FLOODING

Risk of extreme rain and storm events are likely to nearly double in the next 25 years.

Boston Harbor will likely experience 1ft of Sea Level Rise by 2030, and 3ft by 2070.

HEAT

The number of days above 90° is expected to reach 30 days by 2030 and 60 days by 2070.

SEVERE WINTER WEATHER

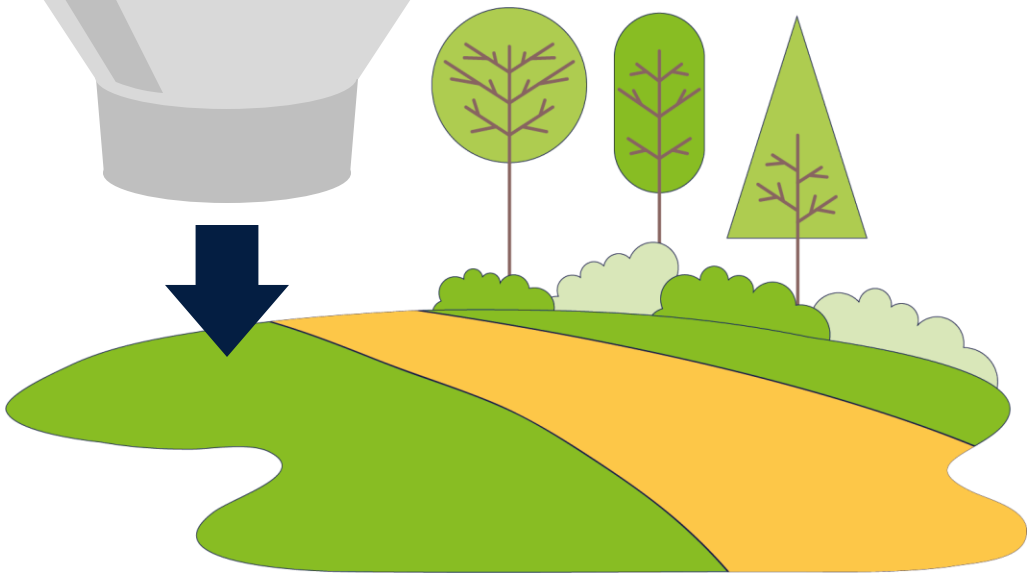
In Winter 2015, the City experienced a record-breaking 108.6 inches of snow.

Photo Credit: Peter Enyeart, 2015-02-15 Cambridge Snow Trek 009

WHAT IS HAZARD MITIGATION?

Reduce impacts from natural hazards…

…through plans, projects, and services.

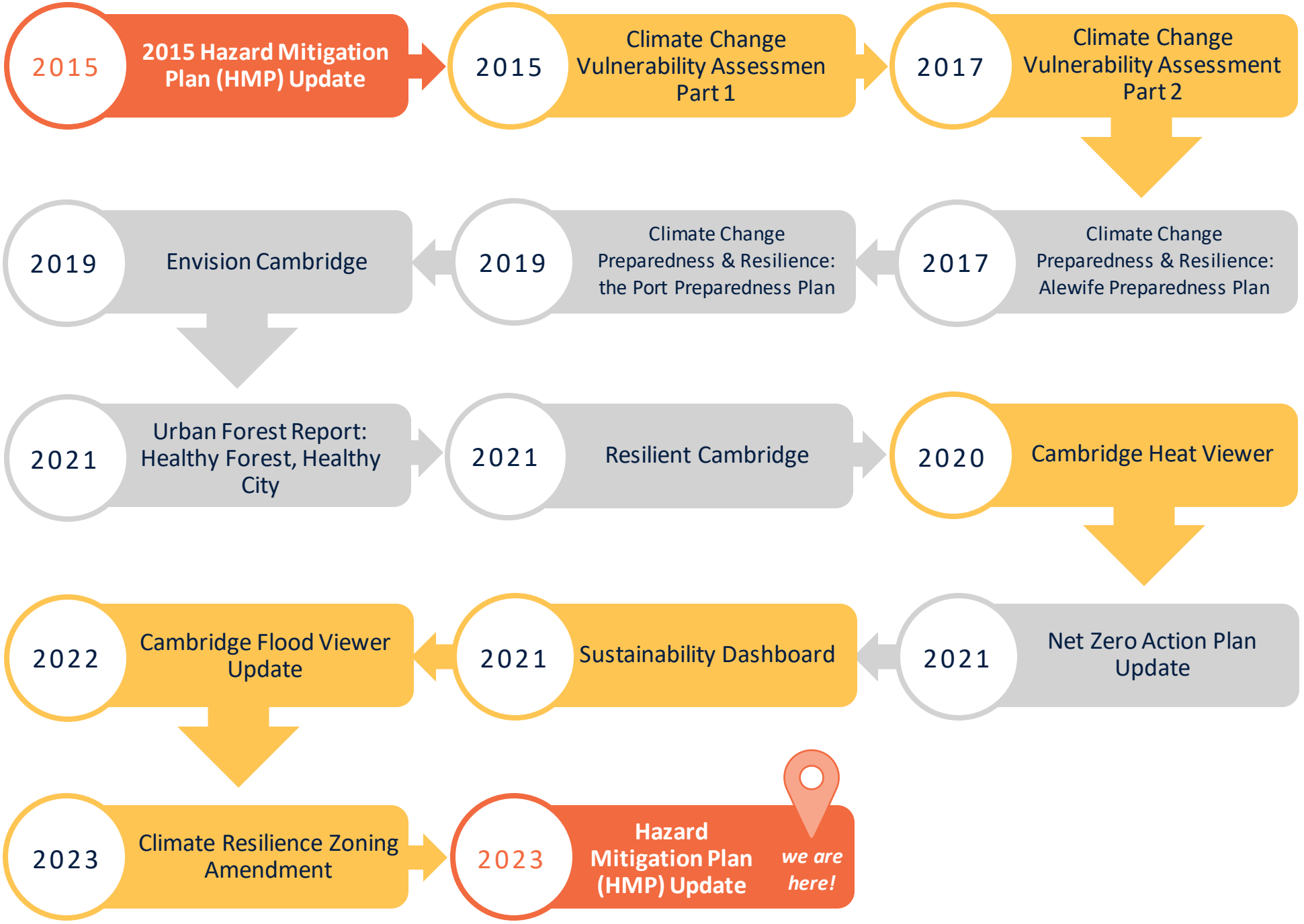


VALUE OF HAZARD MITIGATION PLANNING

EVERY $1 SPENT ON MITIGATION

SAVES $6 ON DISASTER RECOVERY

How the HMP is different from other efforts!



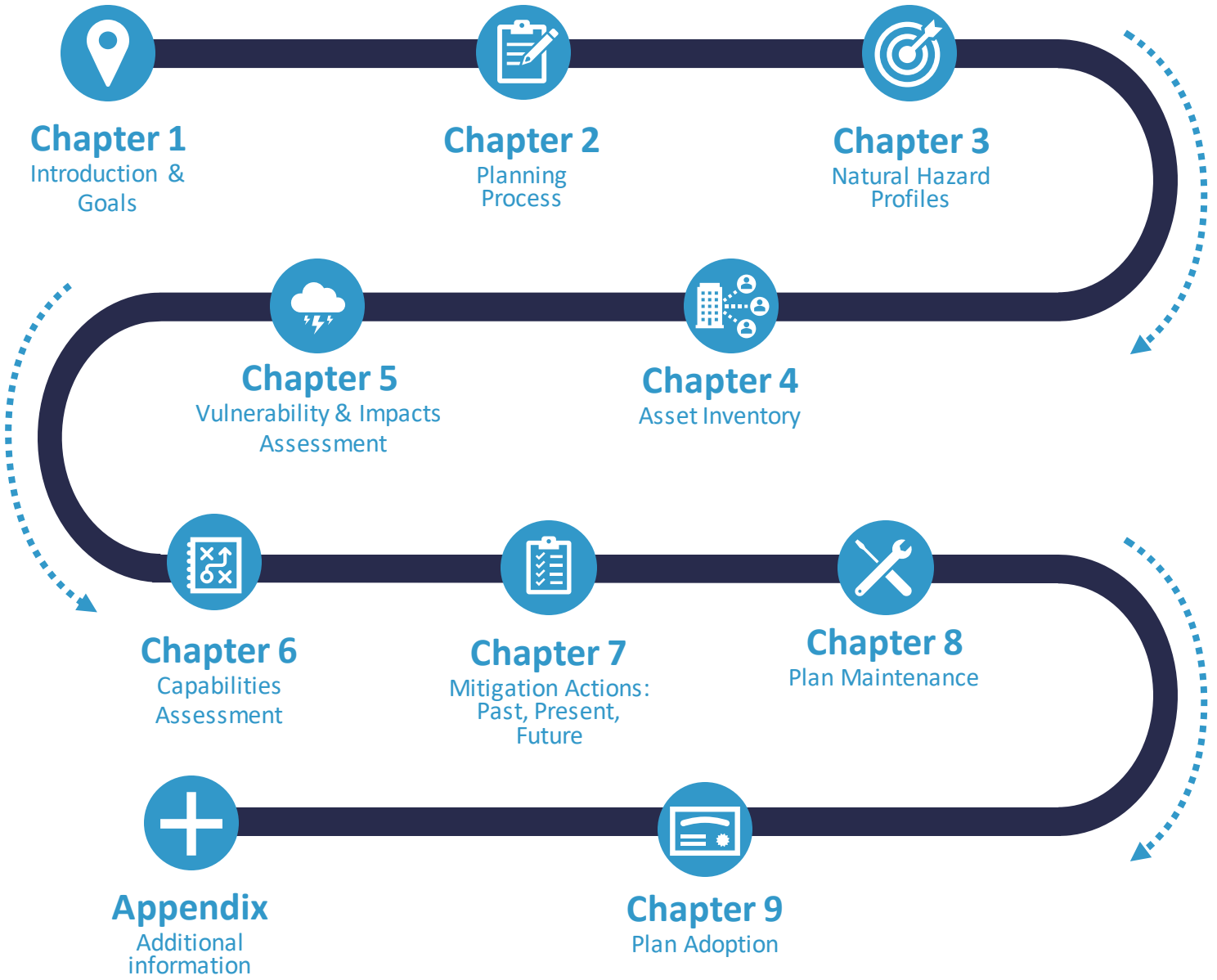
HMPs

City Plans

City Actions

Questions?

NHMP OVERVIEW



CH 1: INTRODUCTION & GOALS

MITIGATION GOALS:

Protect	Equitably ***Protect*** Health and Safety of the Community
Communication	Promote Public Preparedness and Resilience through ***Communication***
Coordinate & Collaborate	***Coordinate and Collaborate*** among City Departments and with Community Partners on Hazard Mitigation Planning & Climate Adaptation
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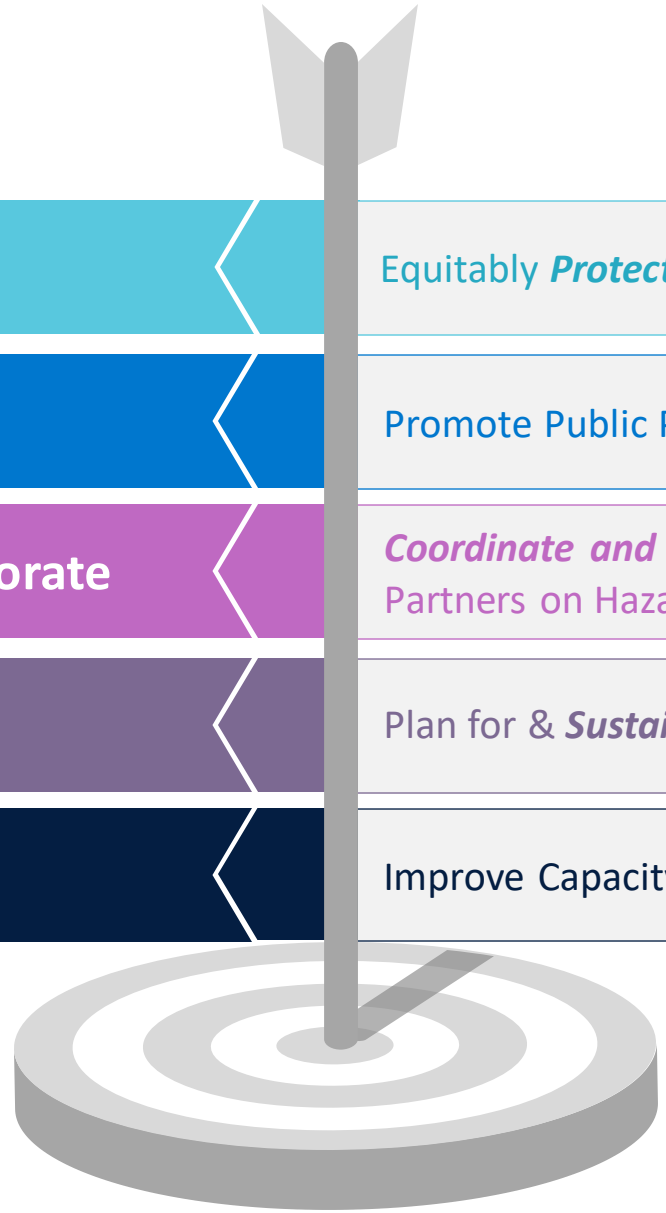
Monitor & Respond	Improve Capacity to ***Monitor*** Natural Hazards and ***Respond*** to Changes



CH 2: PLANNING PROCESS

City Staff

Steering Committee

19 key City staff

who guides the planning process and endorse draft Goals

6 Monthly Meetings & 3 Workshops

Stakeholders

Hazard Mitigation Planning Team (HMPT)

90 stakeholders

including advocates, residents, business-owners, state and local agency representatives, and people from various other organizations.

3 Workshops

Public

Public Engagement

Everyone

Results from public meetings and other feedback are integrated into the final report.

3 Public Meetings
150+ Survey Responses

CH 3: NATURAL HAZARD PROFILES

HURRICANES / TROPICAL STORMS

INLAND FLOODING

EXTREME TEMPERATURES

SEVERE WINTER WEATHER / NOR'EASTERS

COASTAL FLOODING

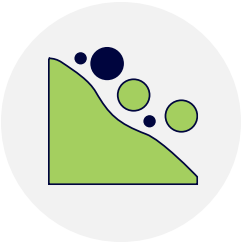
TSUNAMI

DROUGHT

WILDFIRE

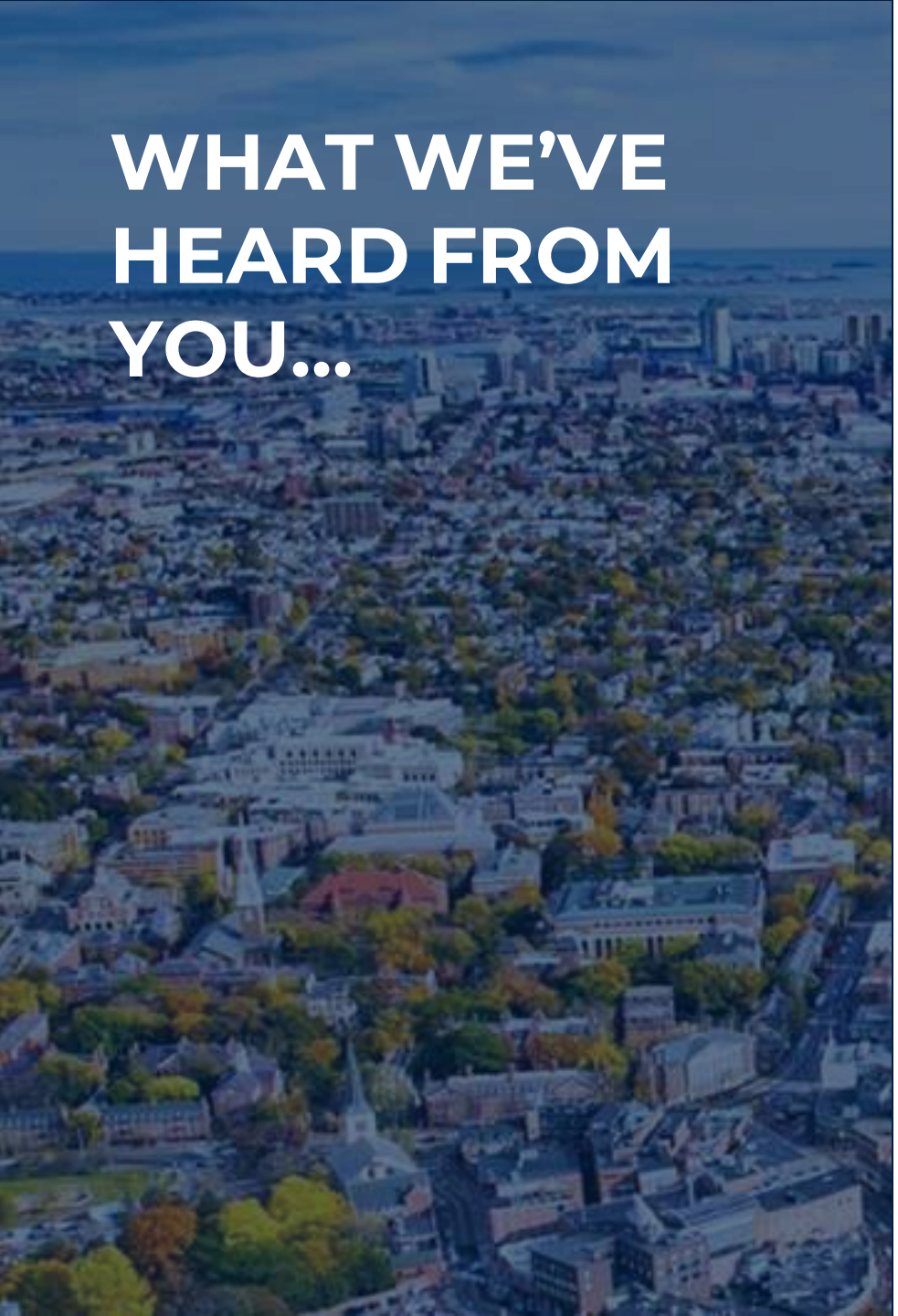
EARTHQUAKES

TORNADOES



LANDSLIDES

INVASIVE SPECIES



WHAT WE'VE HEARD FROM YOU…

Summary of Public Survey Results

Most concerning natural hazards

1. **Flooding**
2. **Extreme heat**
3. **Winter Storms / Nor'easters**

Most concerning impact of natural hazards

1. **Power outages (>75%)**
2. **Damage to the home (72%)**
3. **Contaminated drinking water (69%)**
4. **Limited access to food or supplies (>50%)**

CH 3: NATURAL HAZARD PROFILES

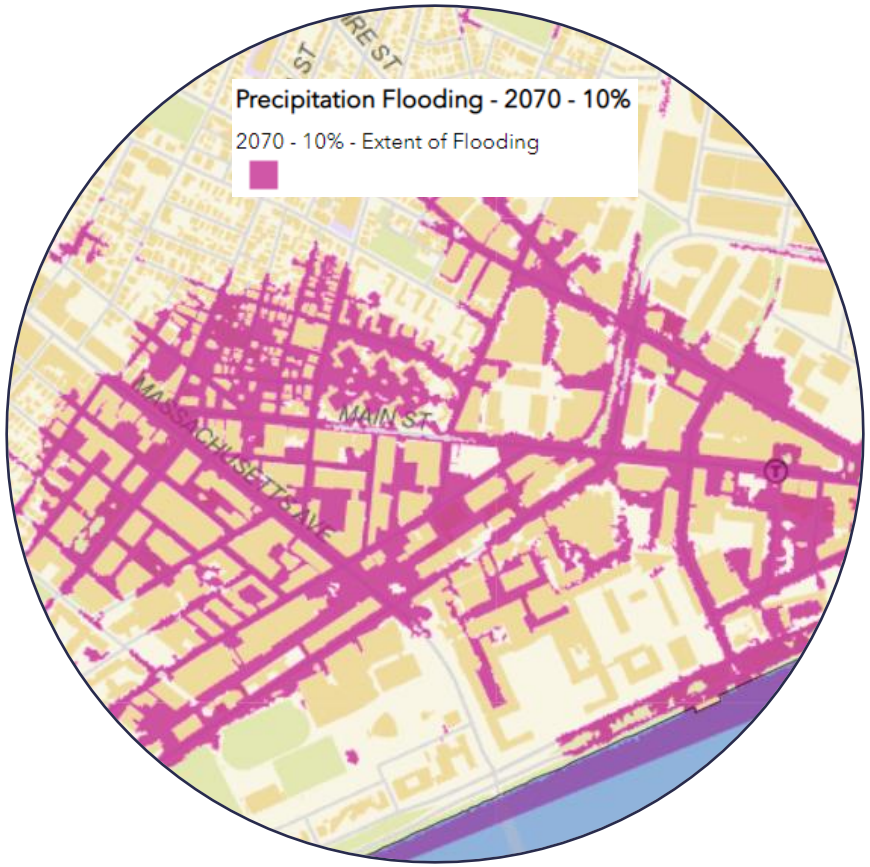
Chapter 3 Identifies the natural hazards that can affect the city:

Location: Areas of Cambridge that might be affected

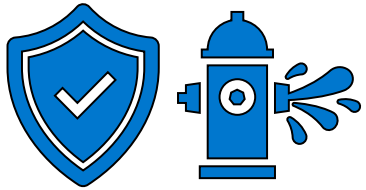
Level of Intensity: Potential size of natural hazard event

Previous Events: How often events have happened in the past?

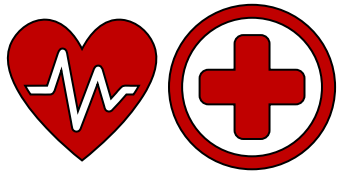
Future Probability: How likely they are to occur in the future?



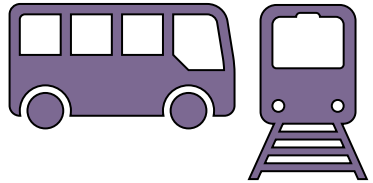
CH 4: ASSET INVENTORY



Safety & Security



Health & Medical

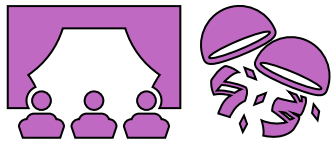


Transportation

Food, Water, Shelter

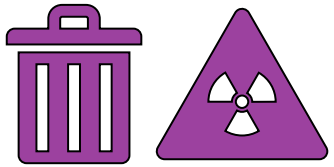
Parks & Greenspace

Communications



Cultural, Historic, & Events

Energy



Hazardous Material Management

CH 4: ASSET INVENTORY

Examples of assets in FEMA categories

***People*:**

- Populations, shelters, housing, schools, and food distribution

***Structures*:**

- Faith community buildings, grocery stores, medical facilities, transportation infrastructure, schools, and Fresh Pond Water Treatment Plant

Systems:

- Power grid, cell towers, transit routes, MWRA facilities, and water/sewer system

Resources:

- Parks, open spaces, community gardens, and arts and cultural facilities

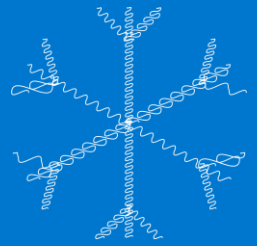
Activities:

- Festivals, events, community-building activities that strengthen social capital and resilience

CH 5: VULNERABILITY & IMPACT ASSESSMENT

VULNERABILITY =
ASSETS that could be impacted by HAZARDS

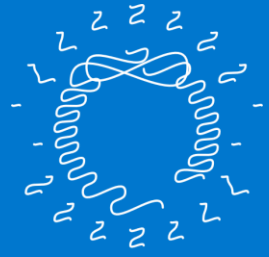
WHAT WE'VE HEARD FROM YOU...



Major blizzards have disrupted daily life and work, with power outages, mountains of snow to shovel, digging out the car, difficulty navigating on foot due to relentless ice that's never fully addressed by community.
- Survey Respondent

My basement has flooded twice when we had storms that dumped 7-8 inches in 48 hours.
- Survey Respondent

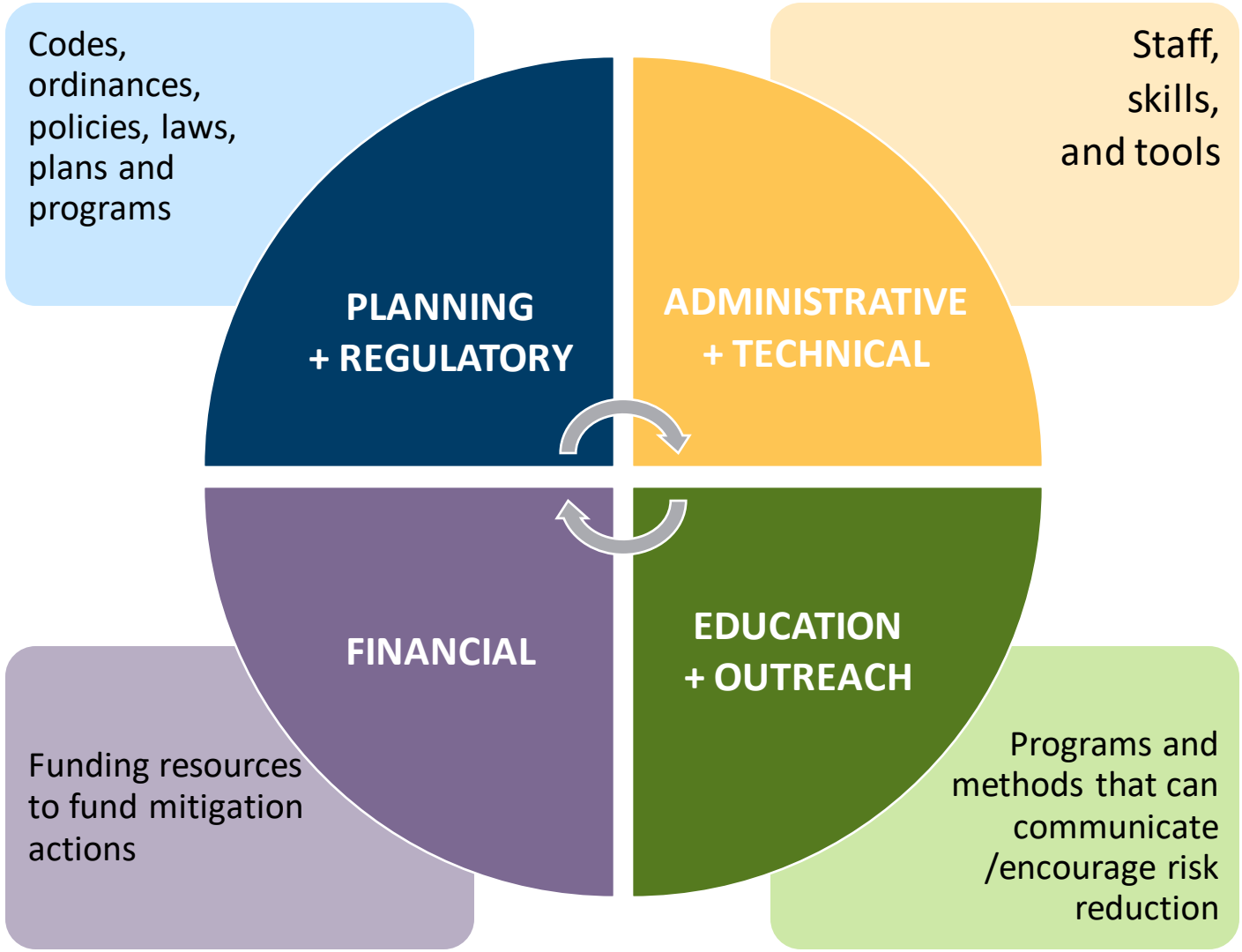
Recent wildfire smoke affected by health
- Survey Respondent



Extremes of heat and cold or heavy snow make it difficult and unpleasant for me to get around. I don't have a car, and I still have to walk to or from the bus stop or T station and wait for the bus in bad weather conditions.
-Survey Respondent

CH 6: CAPABILITIES ASSESSMENT

The City of Cambridge has a unique set of capabilities, in the form of laws, policies, programs, staff, funding and other resources, to carry out the HMP and increase resilience.



WHAT WE'VE HEARD FROM YOU...

Summary of Public Survey Results

What does the city <u>DO WELL</u> to prepare for natural hazards?

1. **Winter road treatment - salting and sanding (87%)**
2. **Public notification of upcoming extreme events (78%)**
3. **Snow removal/preparedness (75%)**
4. **Tree planting (63%)**
5. **Cooling stations (43%)**

What could the city <u>IMPROVE ON</u> to prepare for natural hazards?

1. **Flood protection and response (55%)**
2. **Climate resilience planning (50%)**
3. **Reliable public transportation (45%)**
4. **Tree planting (42%)**
5. **Renewable energy implementation (41%)**

CH 7: MITIGATION ACTIONS

Mitigation Actions are what that the whole plan has been building up to.

Mitigation Actions….

…fulfill the goals in Chapter 1.

Chapter 1 Introduction & Goals

…protect assets in Chapter 4…

Chapter 4 Asset Inventory

…that are vulnerable to natural hazards in Chapter 3…

Chapter 3 Natural Hazard Profiles

…in ways defined by Chapter 5.

Chapter 5 Vulnerability & Impacts Assessment

…have been confirmed or added to through engagement processes in Chapter 2.

Chapter 2 Planning Process

The City has or will create the capacity to undertake them as described in Chapter 6.

Chapter 6 Capabilities Assessment

A mitigation action is a measure, project, plan, or activity proposed to reduce current and future vulnerabilities.

These actions will create resilience for the City of Cambridge (ability to withstand and swiftly recover from an extreme event). These actions will support adaptation to climate change.

CH 7: MITIGATION ACTIONS

EXAMPLE ACTIONS

- Local Planning & Regulation
- Structure & Infrastructure
- Natural Systems Protection
- Education and Awareness Programs

CH 8: PLAN MAINTENANCE

MONITORING THE PLAN

The City will monitor the mitigation actions to ensure that they are going to plan.

EVALUATING THE PLAN

The City will meet regularly, and after major natural hazard events, to evaluate how well the plan is working.

UPDATING THE PLAN

The City will continue to update the Plan every 5 years.

INTEGRATING THE PLAN

The City will integrate data, information, and actions from the HMP into other City plans and initiatives.

PUBLIC PARTICIPATION THROUGHOUT PLAN MAINTENANCE

The City is committed to conducting equitable and impactful public participation. Public engagement activities will align with the evaluation, monitoring, and plan update meetings as well as with large natural hazard events.

NEXT STEPS

Hazard Mitigation Plan (HMP) Planning Process

Questions or
Comments?

MITIGATION ACTIONS

#	Action	Timeframe to Start	Associated Goal(s)	Hazards
1	Develop program for enhanced staffing for disaster recovery	1-2 years	#5 Monitor & Respond	All
2	Perform a study to evaluate the replacement of manually operated components with remote operated components, including the evaluation of cybersecurity vulnerability of the public water supply system	1-2 years	#5 Monitor & Respond	Loss of Water Supply
3	Integrate resiliency strategies and considerations into implementation of open space projects.	1-2 years	#1 Protect	Extreme Heat, Precipitation Flooding, Drought
4	Extend swimming pool operational hours and season	1-2 years	#1 Protect	Extreme Heat
5	Collaborate with Cambridge public housing authority and community centers to identify community rooms to use as cooling centers and shelters during storms	1-2 years	#1 Protect	All
6	Develop an operations plan for DPW and Police on how to respond to flooding	1-2 years	#1 Protect, #5 Monitor & Respond	Precipitation Flooding, Coastal Flooding
7	Create an emergency response higher education and city collaboration plan	1-2 years	#3 Coordinate & Collaborate, #5 Monitor & Respond	All
8	Perform a vulnerability assessment of vaults where hard copy records are kept	2-5 years	#3 Coordinate & Collaborate, #5 Monitor & Respond	Precipitation Flooding, Coastal Flooding
9	Conduct maintenance activities to monitor and reduce brushfire risks	1-2 years	#5 Monitor & Respond	Brushfire
10	Prepare a Tree Pest Vulnerability Matrix or similar pest and disease threat assessment and management options report utilizing the most recent tree inventory	2-5 years	4. Sustainably Invest, #5 Monitor & Respond	Invasive Species
11	Conduct study to identify how to engage with the disability community during an emergency.	1-2 years	#1 Protect	All

MITIGATION ACTIONS

#	Action	Timeframe to Start	Associated Goal(s)	Hazards
12	Develop an annual media campaign about signing up for code red notifications	1-2 years	#2 Communication	All
13	Provide a central location on the City's website to provide up-to-date notification and items such as extreme weather, air quality alerts, etc.	1-2 years	#2 Communication	All
14	Identify areas for green stormwater infrastructure and reducing impervious surfaces	in-progress/ongoing	#4 Sustainably Invest	Precipitation Flooding
15	Perform a study to identify how to best protect Fresh Pond reservoir from saltwater intrusion	2-5 years	#1 Protect, #3 Coordinate & Collaborate, #4 Sustainably Invest	Coastal Flooding
16	Prepare an Earthquake Emergency Plan	2-5 years	#1 Protect, # Monitor & Respond	Earthquake
17	Develop an enhanced communication plan and program related natural hazards in collaboration with community groups	2-5 years	#2 Communication	All
18	Purchase emergency radios for critical staff to utilize when an emergency event is expected where power and cell phone service may be compromised. Develop a plan for distribution and use.	1-2 years	#5 Monitor & Respond	All
19	Upgrade deicing / snow removal equipment, including smaller equipment that is able to accommodate bicycle facilities and pedestrian paths	in progress	#5 Monitor & Respond	Winter Storms
20	Install water fountains + cooling features locations at bus/bike routes	Ongoing	#1 Protect, #5 Monitor & Respond	Extreme Heat
21	Evaluate use of Microgrid(s) for critical facilities and implement recommendations	2-5 years	#5 Monitor & Respond	All

MITIGATION ACTIONS

#	Action	Timeframe to Start	Associated Goal(s)	Hazards
22	Undertake interventions as a regional collaboration at Charles River and Amelia Earhart Dam to reduce overtopping/flanking	in-progress	#3 Coordinate & Collaborate, #4 Sustainably Invest	Coastal Flooding
23	Improve collection and conveyance system in the Port Neighborhood	In progress	#1 Protect, #4 Sustainably Invest	Precipitation Flooding
24	Complete in-progress stormwater management program: Green, Franklin + Sidney Streets, School, Pine, Cherry and Windsor Streets	Less than 1 year	#1 Protect, #4 Sustainably Invest	Precipitation Flooding
25	Update and Improve City's HeatViewer with best available information	2-5 years	#2 Communication	Extreme Heat
26	Update and Improve Floodplain Mapping* (Cambridge Flood Viewer)	in progress	#2 Communication	Precipitation Flooding, Coastal Flooding
27	Develop and update materials to support homeowners in completing retrofits related to flooding & heat (e.g., trainings, & educational materials on funding assistance)	2-5 years	#1 Protect	Extreme Heat, Precipitation Flooding, Coastal Flooding
28	Develop an emergency community support reference guide which provides a list of health services which are operational during extreme events for community reference(i.e. dialysis centers)	1-2 years	#1 Protect, #2 Communications	All
29	Update the climate change vulnerability assessment to include up-to-date climate information and new facilities and identify recommendations for municipal facility improvements for resiliency, including an updated flood duration study using MC-FRM	2-5 years	#3 Coordinate & Collaborate	Extreme Heat, Precipitation Flooding, Coastal Flooding
30	Implement actions of Cambridge Urban Forest Master Plan	in progress/ongoing	#1 Protect, #4 Sustainably Invest	Extreme Heat, Precipitation Flooding, Drought

MITIGATION ACTIONS

#	Action	Timeframe to Start	Associated Goal(s)	Hazards
31	Complete study to evaluate shade needs (other than trees) referred to as "The Shade Study", and implement recommendations (e.g., adding shade structures)	in progress	#1 Protect	Extreme Heat
32	Encourage energy efficiency in buildings through zoning requirements and community engagement and support	Less than 1 year	#5 Monitor & Respond	Extreme Heat, Extreme Cold
33	Prioritize clean energy solutions for power such as solar, battery, geothermal, etc. where feasible	Less than 1 year	#5 Monitor & Respond	All
34	Coordinate with the MBTA their efforts to protect critical regional transit infrastructure in Cambridge	Less than 1 year	#3 Coordinate & Collaborate, #4 Sustainably Invest	All
35	Coordinate with adjacent communities for hazard preparation and response	1-2 years	#3 Coordinate & Collaborate	All
36	Continue to engage with the Charles River Climate Compact and Mystic River Watershed Association on regional collaboration	in-progress	#3 Coordinate & Collaborate	Precipitation Flooding, Coastal Flooding, Extreme Heat
37	Begin to develop a central emergency response plan and centralize emergency response within the city	Less than 1 year	#3 Coordinate & Collaborate	All
38	Design and construct updates to metering stations for Combined Sewers	in-progress	#5 Monitor & Respond	Precipitation Flooding
39	Collaborate with energy providers to protect critical community infrastructure	Less than 1 year	#3 Coordinate & Collaborate, #4 Sustainably Invest	All

Hazard Mitigation Plan Update 2023

Thank You!

CITY OF CAMBRIDGE

Weston & Sampson SM

HAZARD MITIGATION PLAN 2023 UPDATE
PUBLIC MEETINGS #2 AND #3
ATTENDANCE AND RECORDING

October 25, 2023

Attendees

City of Cambridge

- Leila Mekias, CDD
- Catherine Woodbury, DPW
- Deputy Chief Colin Walsh, Fire Dept.
- Jim Wilcox, DPW
- Julie Torelli-Greenwood, CWD
- Sam Lipson, CPHD
- Vedad Konjic, CPS Facilities
- Marlees Owayda
- Denise Garcia
- Peter Vellucci
- Rachel Tanenhaus, CCPD

Members of the Public

- Amelia Joselow
- Dawn Baxter
- Jennifer Letourneau
- John Nardone
- Julie Wood
- Latoya Weaver
- Mikayla Criger
- Pe Kutcher
- Qumrunnessa A Huda
- Rebecca Feuntes
- Salley Watermulder
- Steve Miller
- Cathie Zusy
- Jeanne Petropoulos
- Nahid Chowdhury
- Olivia Hallstein
- Sue Reinert
- Susan Pacheco

- Tom Rawson

Weston & Sampson

- Robin Seidel, Project Manager
- Jennie Moonan, HMP Technical Lead
- Emily Judson, Resiliency Planner

Recording

The recordings for public meetings two and three are available at the links below. Enter the passcode if prompted.

Public meeting 2:

- Presentation Recording
- Passcode: F77P#&TO

Public meeting 3:

- Presentation Recording
- Passcode: FX4ct#Z+

Natural Hazard Mitigation Plan Update 2023

City Council Committee
December 5, 2023

CITY OF CAMBRIDGE

Weston & Sampson SM

AGENDA

- Overview of Natural Hazard Mitigation Plan Development
- 2023 NHMP Contents Review
- Next Steps after Council
- Discussion

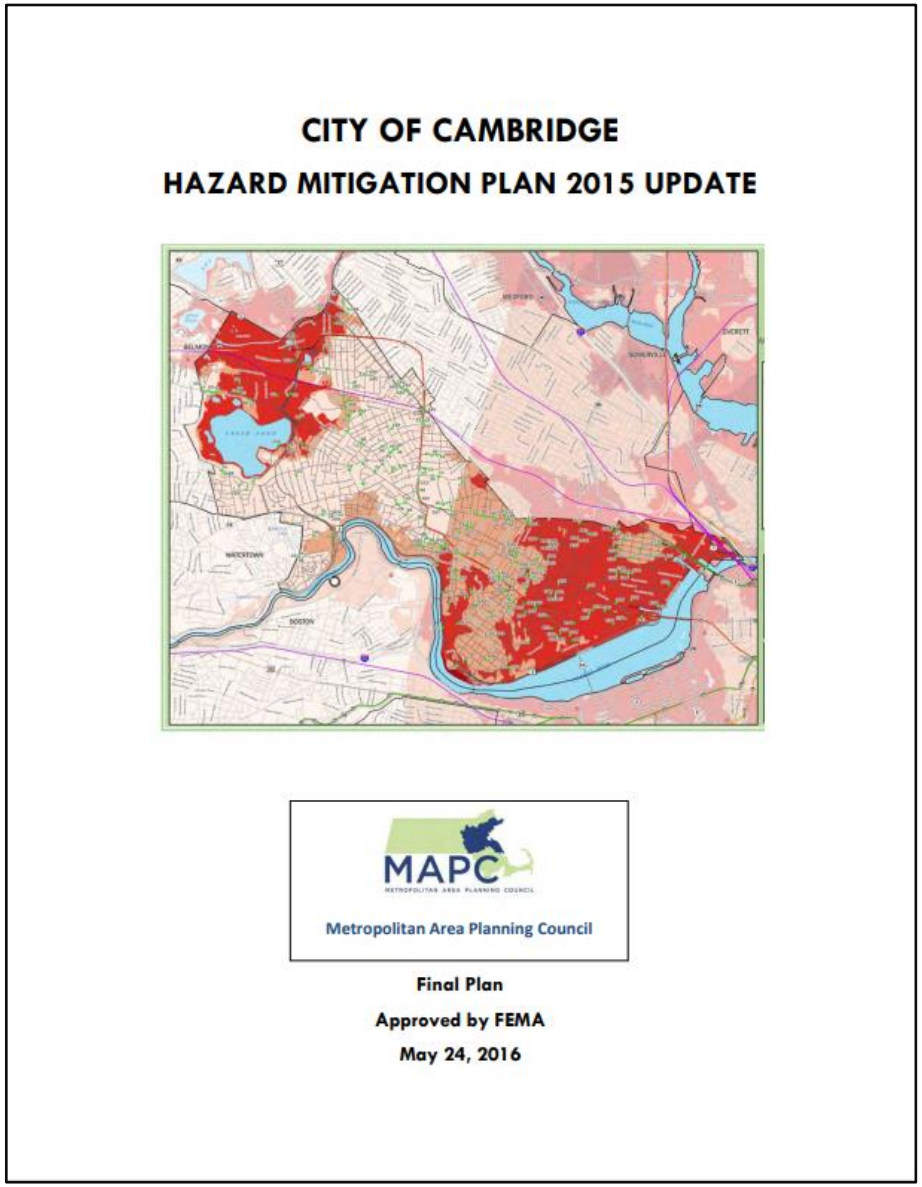
CITY'S PREVIOUS HMP

The work undertaken serves as an update to the previous Hazard Mitigation Plan

CITY OF CAMBRIDGE
HAZARD MITIGATION PLAN 2015 UPDATE
Prepared by MAPC

Adopted: 3/21/2016
Approved: 5/24/2016

24 Mitigation Actions for 2016-2021



https://www.cambridgema.gov/-/media/Files/firedepartment/emergencymanagement/cambridgehazardmitigationplan2015updatefemaapproved052415forweb.pdf

FEMA & MEMA REQUIREMENTS

"The Disaster Mitigation Act of 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (44 CFR Part 201), creating the framework for state, local, tribal and territorial governments to engage in hazard mitigation planning to receive certain types of non-emergency disaster assistance."

FEMA updated *Local Mitigation Planning Policies and Guidance* (released April 2022, effective April 2023)

FEMA updated *Location Mitigation Planning Handbook* (May 2023)

2022 Updates Include:

- ✓ Expanded list of participants required in planning process.
- ✓ Requires consideration of climate change.
- ✓ Recognizes the important role of adopting and enforcing building, land use, and development code.
- ✓ Facilitates stronger alignment with other FEMA mitigation programs.

VALUE OF HAZARD MITIGATION PLANNING

EVERY $1 SPENT ON MITIGATION

SAVES $6 ON DISASTER RECOVERY

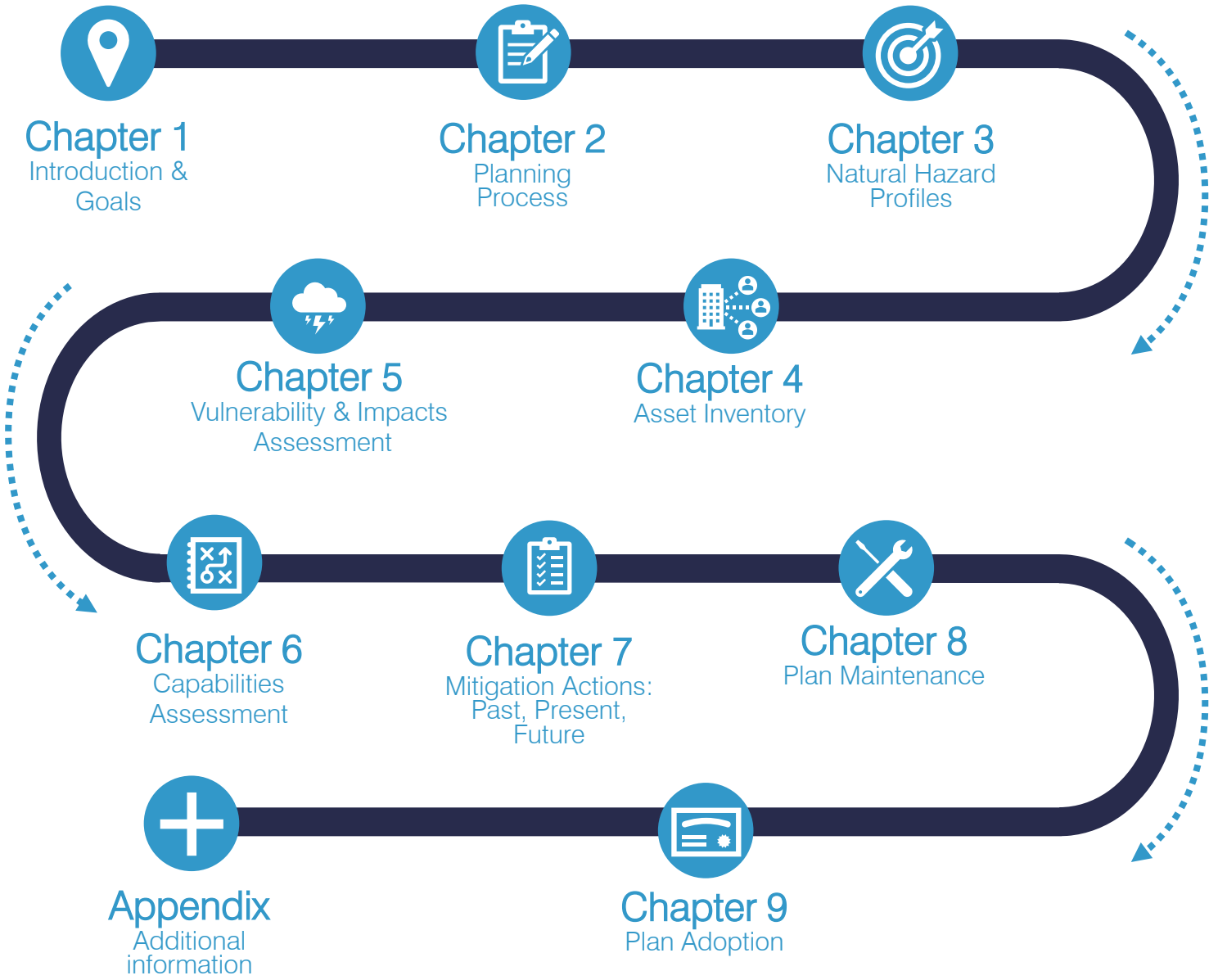
2023 CAMBRIDGE NHMP DEVELOPMENT

	Task	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1	Project Initiation										
2	Engagement										
3	Hazard Profiles										
4	Facility/Asset Inventory										
5	Vulnerability Assessment										
6	Mitigation Goals & Capabilities										
7	Develop Actions										
8	Plan Implementation										
9	Public Review										
10	Adoption										
	Meetings	K	S	S	S	P S H	H S H	S		P	

Legend:

K Kickoff Meeting **P** Public Meeting **S** STC Meeting **H** HMPT Workshop

2023 CAMBRIDGE NHMP OVERVIEW



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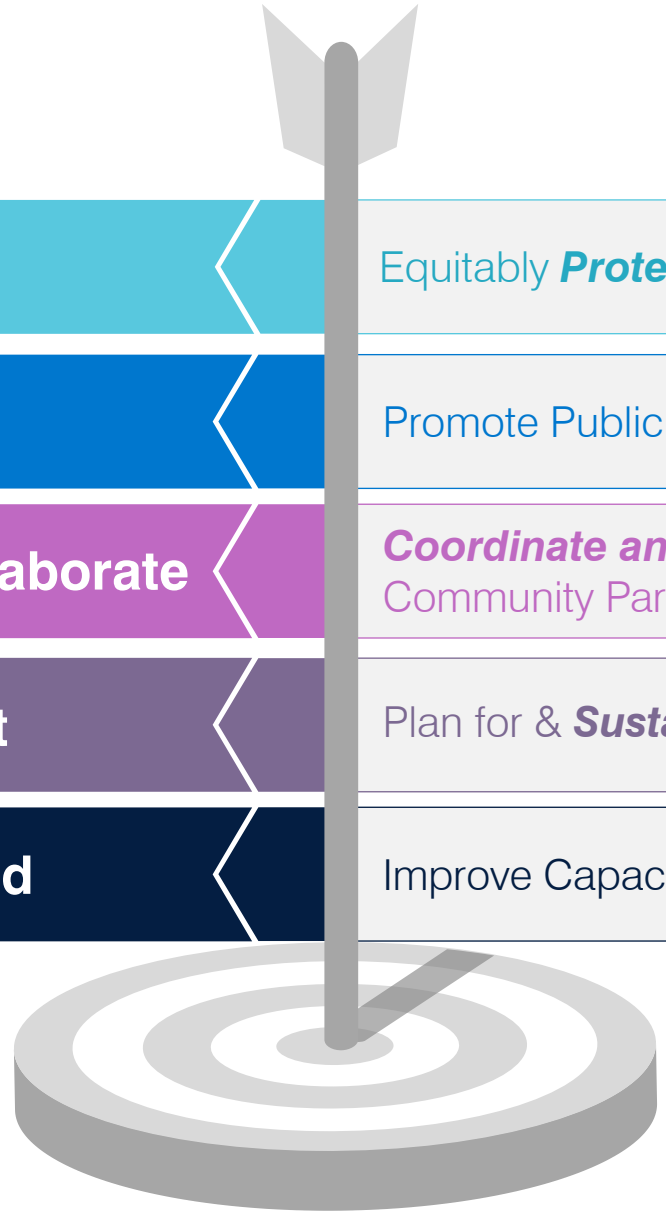

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Hazard Mitigation Planning Team (HMPT)

90 stakeholders

including advocates, residents, business-owners, state and local agency representatives, and people from various other organizations.

3 Workshops

Public

Public Engagement

Everyone

Results from public meetings and other feedback are integrated into the final report.

3 Public Meetings
150+ Survey Responses
9 Survey Responses on Mitigation Actions

CH 3: NATURAL HAZARD PROFILES

HURRICANES / TROPICAL STORMS

INLAND FLOODING

EXTREME TEMPERATURES

SEVERE WINTER WEATHER / NOR'EASTERS

COASTAL FLOODING

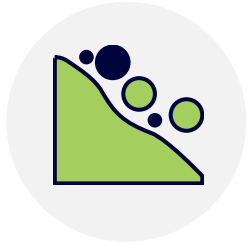
TSUNAMI

DROUGHT

WILDFIRE

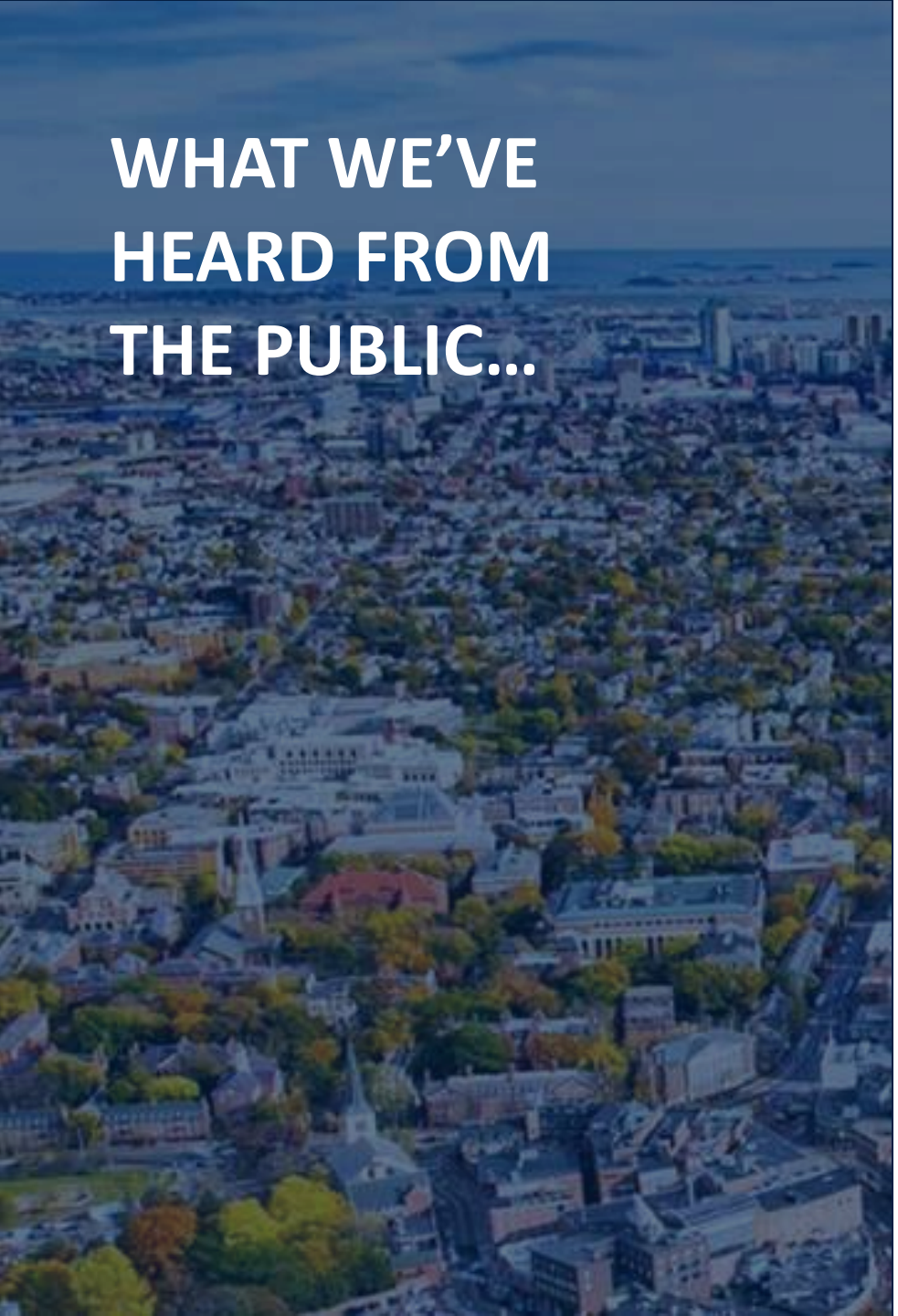
EARTHQUAKES

TORNADOES



LANDSLIDES

INVASIVE SPECIES



WHAT WE'VE HEARD FROM THE PUBLIC…

Summary of Public Survey Results

Most concerning natural hazards

1. Flooding
2. Extreme heat
3. Winter Storms / Nor'easters

Most concerning impact of natural hazards

1. Power outages (>75%)
2. Damage to the home (72%)
3. Contaminated drinking water (69%)
4. Limited access to food or supplies (>50%)

CH 4: ASSET INVENTORY

Examples of assets in FEMA categories

Critical Facilities:

- Facilities within Cambridge to which Eversource prioritizes providing electrical power.

People / Community:

- Populations, shelters, housing, schools, and food distribution

Structures:

- Faith community buildings, grocery stores, medical facilities, transportation infrastructure, schools, and Fresh Pond Water Treatment Plant

Systems:

- Power grid, cell towers, transit routes, MWRA facilities, and water/sewer system

Resources:

- Parks, open spaces, community gardens, and arts and cultural facilities

Activities:

- Festivals, events, community-building activities that strengthen social capital and resilience

People / Community
697

Structures
266

Natural, Cultural, and Historic Resources
919

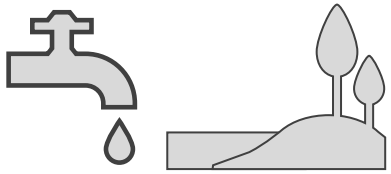
Systems
255

Activities
78

Assets that are Community Lifelines
35%

Critical Facilities
32

CH 5: VULNERABILITY & IMPACT ASSESSMENT

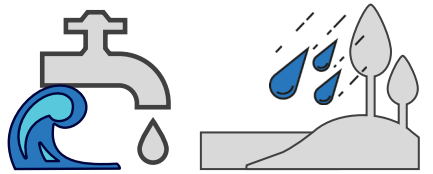


Drinking water at Fresh Pond…

…is vulnerable to…

…saltwater intrusion from coastal flood events…

…resulting in…



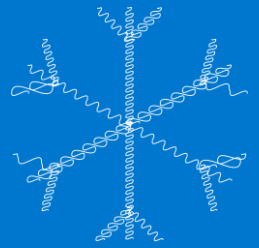
…detrimental impacts to ecosystem and drinking water quality.

ASSET

HAZARD

IMPACT

WHAT WE'VE HEARD FROM THE PUBLIC...



Major blizzards have disrupted daily life and work, with power outages, mountains of snow to shovel, digging out the car, difficulty navigating on foot due to relentless ice that's never fully addressed by community.
- Survey Respondent

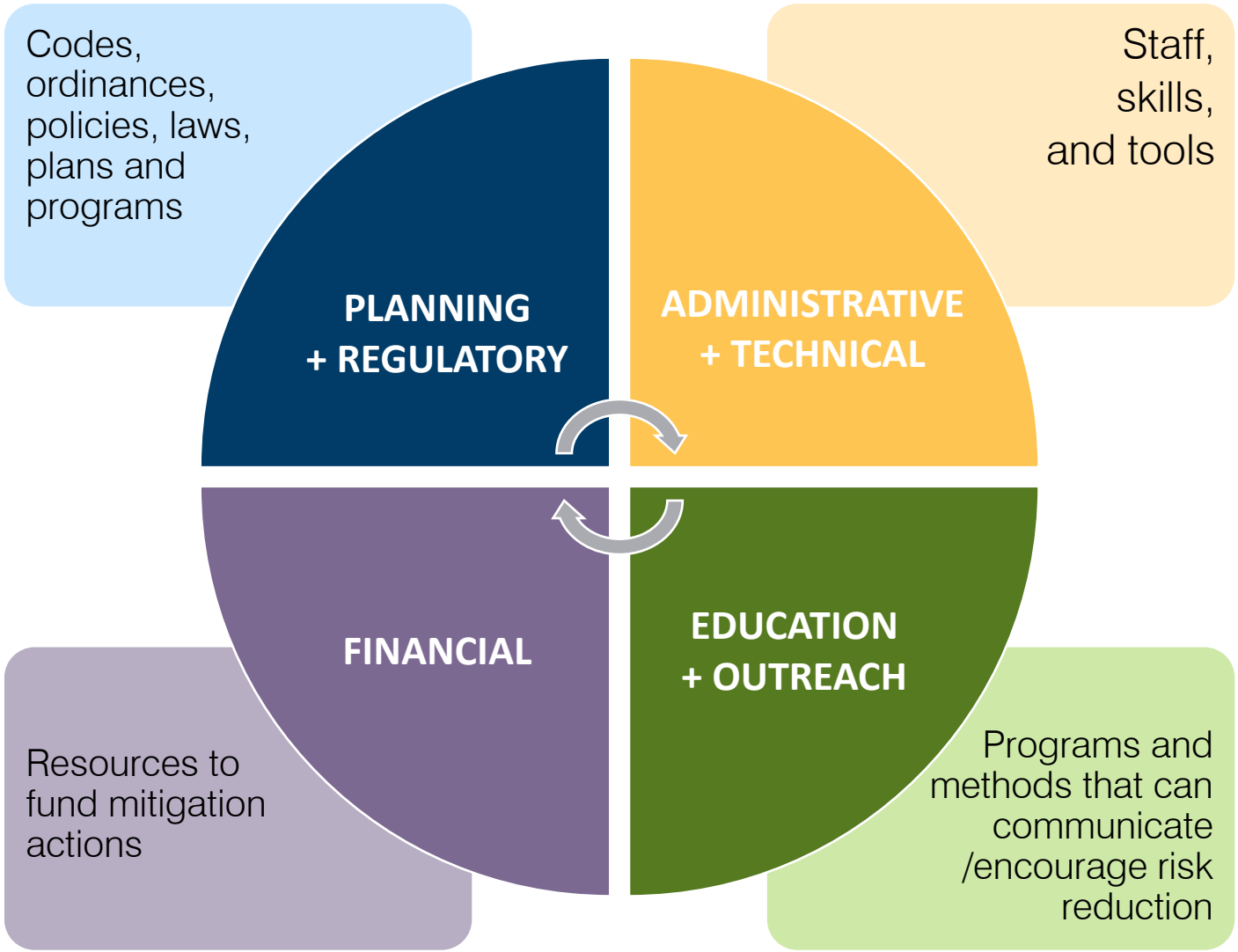
My basement has flooded twice when we had storms that dumped 7-8 inches in 48 hours.
- Survey Respondent

Recent wildfire smoke affected my health
- Survey Respondent

Extremes of heat and cold or heavy snow make it difficult and unpleasant for me to get around. I don't have a car, and I still have to walk to or from the bus stop or T station and wait for the bus in bad weather conditions.
-Survey Respondent

CH 6: CAPABILITIES ASSESSMENT

The City of Cambridge has a unique set of capabilities, in the form of laws, policies, programs, staff, funding and other resources, to carry out the HMP and increase resilience.



CH 7: MITIGATION ACTIONS

Mitigation Actions are what the whole plan has been building up to.

Mitigation Actions….

…fulfill the goals in Chapter 1.

Chapter 1 Introduction & Goals

…protect assets in Chapter 4…

Chapter 4 Asset Inventory

…that are vulnerable to natural hazards in Chapter 3…

Chapter 3 Natural Hazard Profiles

…in ways defined by Chapter 5.

Chapter 5 Vulnerability & Impacts Assessment

…have been confirmed or added to through engagement processes in Chapter 2.

Chapter 2 Planning Process

The City has or will create the capacity to undertake them as described in Chapter 6.

Chapter 6 Capabilities Assessment

A mitigation action is a measure, project, plan, or activity proposed to reduce current and future vulnerabilities.

These actions will create resilience for the City of Cambridge (ability to withstand and swiftly recover from an extreme event). These actions will support adaptation to climate change.

CH 7: PRIORITIZATION CRITERIA

Does this action contribute to **regional resilience?**

Is the action **part of other city plans?**

Does the action **positively impact residents** of Low to Moderate Income (LMI) or Environmental Justice (EJ) census block groups (based on EEA's viewer)?

Is this action a **nature-based solution?**

Would the action **mitigate economic loss/damage?**

Will the action **reduce risk to life/safety?**

Does the action **address future climate change projections?**

Does the action **leverage innovation/technology?**

CH 7: MITIGATION ACTIONS

#	Action	Timeframe to Start In Progress Less than 1 year 1-2 years 2-5 years	Hazards	Enhances Inclusion and Equity / Co-Benefits Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students Enhances Community Education Equitable Implementation	Priority	Cost High = $1M Medium = Over $100k up to $1M Low = Up to $100k
1	Improve collection and conveyance system in the Port Neighborhood.	In progress	Precipitation Flooding	Equitable Implementation	High	High
2	Design and construct updates to metering stations for Combined Sewers	In progress	Precipitation Flooding		Medium	Medium
3	Identify areas for green stormwater infrastructure and reducing impervious surfaces	In progress	Precipitation Flooding		High	Medium
4	Undertake interventions as a regional collaboration at Charles River and Amelia Earhart Dam to reduce overtopping/flanking	In progress	Coastal Flooding	Positive Impact on Priority Populations	High	High
5	Upgrade deicing / snow removal equipment, including smaller equipment that is able to accommodate bicycle facilities and pedestrian paths	In progress	Winter Storms	Positive impact on students, positive impact on Priority Populations	High	Medium
6	Complete study to evaluate shade needs (other than trees) referred to as "The Shade Study", and implement recommendations (e.g., adding shade structures)	In progress	Extreme Heat	Positive impact on Priority Populations, Equitable implementation	High	Low
7	Install water fountains and cooling features locations along bus/bike routes	In progress	Extreme Heat	Positive Impact on Priority Populations Positive Impact on Students	High	Medium
8	Update and Improve Floodplain Mapping (Cambridge Flood Viewer)	In progress	Precipitation Flooding, Coastal Flooding	Enhances Community Education, Equitable Implementation	High	Low
9	Encourage energy efficiency in buildings through zoning requirements and community engagement and support	In progress	Extreme Heat, Extreme Cold	Positive impact on renters	Low	Low

CH 7: MITIGATION ACTIONS

#	Action	Timeframe to Start In Progress Less than 1 year 1-2 years 2-5 years	Hazards	Enhances Inclusion and Equity / Co-Benefits Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students Enhances Community Education Equitable Implementation	Priority	Cost High = $1M Medium = Over $100k up to $1M Low = Up to $100k
10	Identify recommendations for municipal facility improvements for resiliency, including an updated flood duration study using MC-FRM	In progress	Extreme Heat, Precipitation Flooding, Coastal Flooding		Medium	Low
11	Implement actions of Cambridge Urban Forest Master Plan	In progress	Extreme Heat, Precipitation Flooding, Drought	Positive impact on Priority Populations	High	Low
12	Continue to engage with the Charles River Climate Compact and Mystic River Watershed Association on regional collaboration	In progress	Precipitation Flooding, Coastal Flooding, Extreme Heat		Medium	Low
13	Prioritize clean energy solutions for power such as solar, battery, geothermal, etc. where feasible	In progress	All		Low	Low
14	Begin to develop a central emergency response plan and centralize emergency response within the city	Less than 1 year	All	Positive Impact on Priority Populations, Equitable implementation	Medium	Low
15	Coordinate with the MBTA their efforts to protect critical regional transit infrastructure in Cambridge	Less than 1 year	All		High	Low
16	Collaborate with energy providers to protect critical community infrastructure	Less than 1 year	All	Positive impact on Priority Populations, equitable implementation	High	Medium

CH 7: MITIGATION ACTIONS

#	Action	Timeframe to Start In Progress Less than 1 year 1-2 years 2-5 years	Hazards	Enhances Inclusion and Equity / Co-Benefits Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students Enhances Community Education Equitable Implementation	Priority	Cost High = $1M Medium = Over $100k up to $1M Low = Up to $100k
17	Extend swimming pool operational hours and season	1-2 years	Extreme Heat	Positive impact on Priority Populations, Equitable implementation	Low	Low
18	Perform a study to evaluate the replacement of manually operated components with remote operated components, including the evaluation of cybersecurity vulnerability of the public water supply system	1-2 years	Loss of Water Supply		Medium	High
19	Conduct maintenance activities to monitor and reduce brushfire risks	1-2 years	Brushfire		Low	Low
20	Update the climate change vulnerability assessment to include up-to-date climate information	1-2 years	Extreme Heat, Precipitation Flooding, Coastal Flooding		Medium	Low
21	Integrate resiliency strategies and considerations into implementation of open space projects.	1-2 years	Extreme Heat, Precipitation Flooding, Drought	Positive impact on Priority Populations	Medium	Low
22	Develop an operations plan for DPW and Police on how to respond to flooding in the roadway	1-2 years	Precipitation Flooding, Coastal Flooding	Equitable implementation	Medium	Low
23	Succession planning should be integrated into the City's Continuity of Operations Plan (COOP) and revisited on a yearly basis by June 30 of every year and updated to reflect staff changes and required trainings for staff identified as part of the planning process	1-2 years	All		Medium	Low

CH 7: MITIGATION ACTIONS

#	Action	Timeframe to Start In Progress Less than 1 year 1-2 years 2-5 years	Hazards	Enhances Inclusion and Equity / Co-Benefits Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students Enhances Community Education Equitable Implementation	Priority	Cost High = $1M Medium = Over $100k up to $1M Low = Up to $100k
24	Develop an emergency community support reference guide which provides a list of health services which are operational during extreme events for community reference(i.e. dialysis centers)	1-2 years	All	Enhances community education	Low	Low
25	Collaborate with Cambridge public housing authority and community centers to identify community rooms to use as cooling centers and shelters during storms	1-2 years	All	Positive impact on Priority Populations, Positive impact on renters, Equitable implementation	Low	Low
26	Coordinating with adjacent communities for hazard preparation and response	1-2 years	All		Medium	Low
27	Create an emergency response higher education and city collaboration plan	1-2 years	All	Positive impact on Priority Populations, Positive impact on students, equitable implementation	Low	Low
28	Conduct study to identify how to engage with the disability community during an emergency.	1-2 years	All	Positive Impact on Priority Populations, Enhances Community Education	Low	Low
29	Develop an annual media campaign about signing up for code red notifications	1-2 years	All	Enhances Community Education, Equitable implementation	Medium	Low
30	Provide a central location on the City's website to provide up-to-date notification and items such as extreme weather, air quality alerts, etc.	1-2 years	All	Enhances Community Education	Medium	Low

CH 7: MITIGATION ACTIONS

#	Action	Timeframe to Start In Progress Less than 1 year 1-2 years 2-5 years	Hazards	Enhances Inclusion and Equity / Co-Benefits Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students Enhances Community Education Equitable Implementation	Priority	Cost High = $1M Medium = Over $100k up to $1M Low = Up to $100k
31	Purchase emergency radios for critical staff to utilize when an emergency event is expected where power and cell phone service may be compromised. Develop a plan for distribution and use.	1-2 years	All		Medium	Medium
32	Each department shall ensure identified staff have been trained in ICS and NIMS and continuing education and training shall be determined by each department head or training division	1-2 years	All		High	Low
33	Design and construct sewer separation work for the Baldwin neighborhood	2-5 years	Precipitation Flooding		Low	Medium
34	Update and improve the City's HeatViewer with best available information	2-5 years	Extreme Heat	Enhances Community Education, Equitable Implementation	Medium	Low
35	Perform a study to identify how to best protect Fresh Pond reservoir from saltwater intrusion	2-5 years	Coastal Flooding	Equitable Implementation	Low	Low
36	Prepare an Earthquake Emergency Plan	2-5 years	Earthquake	Positive Impact on Renters, Positive Impact on Students, Equitable Implementation	Low	Low
37	Prepare a Pest Vulnerability Matrix using the most recent tree inventory and develop a management options report	2-5 years	Invasive Species		Low	Low

CH 7: MITIGATION ACTIONS

#	Action	Timeframe to Start In Progress Less than 1 year 1-2 years 2-5 years	Hazards	Enhances Inclusion and Equity / Co-Benefits Positive Impact on Priority Populations Positive Impact on Renters Positive Impact on Students Enhances Community Education Equitable Implementation	Priority	Cost High = $1M Medium = Over $100k up to $1M Low = Up to $100k
38	Create a program that offers support to property owners located in the 2070 10% flood area, as determined by the City's flood viewer, to help them make improvements that increase the resiliency of their properties against flooding.	2-5 years	Precipitation Flooding, Coastal Flooding	Positive impact on Priority Populations, positive impact on renters	Low	Medium
39	Perform a vulnerability assessment of vaults where hard copy records are kept	2-5 years	Precipitation Flooding, Coastal Flooding		Low	Low
40	Develop flood protection and operations planning for historic and critical facilities.	2-5 years	Precipitation Flooding, Coastal Flooding, Extreme Heat		Medium	Low
41	Develop and update materials to support homeowners in completing retrofits related to flooding & heat (e.g., trainings, & educational materials on funding assistance)	2-5 years	Extreme Heat, Precipitation Flooding, Coastal Flooding	Positive impact on Priority Populations, Equitable implementation	Low	Low
42	Evaluate use of Microgrid(s) for critical facilities and implement recommendations	2-5 years	All		Medium	Medium
43	Develop an enhanced communication plan and program related to natural hazards in collaboration with community groups	2-5 years	All	Positive Impact on Priority Populations, Enhances Community Education, Equitable implementation	Low	Low

CH 8: PLAN MAINTENANCE

MONITORING THE PLAN

The City will monitor the mitigation actions to ensure that they are going according to plan.

EVALUATING THE PLAN

The City will meet regularly, and after major natural hazard events, to evaluate how well the plan is working.

UPDATING THE PLAN

The City will continue to update the Plan every 5 years.

INTEGRATING THE PLAN

The City will integrate data, information, and actions from the HMP into other City plans and initiatives.

PUBLIC PARTICIPATION THROUGHOUT PLAN MAINTENANCE

The City is committed to conducting equitable and impactful public participation. Public engagement activities will align with the evaluation, monitoring, and plan update meetings as well as with large natural hazard events.

CH 9: PLAN ADOPTION

City of Cambridge

IN CITY COUNCIL
_____, 2023

CITY OF CAMBRIDGE, MASSACHUSETTS
RESOLUTION NO. _____

A RESOLUTION OF THE CITY OF CAMBRIDGE ADOPTING THE 2023 HAZARD MITIGATION PLAN UPDATE

MAYOR SIDDIQUI

WHEREAS the City Council recognizes the threat that natural hazards pose to people and property within the City of Cambridge; and

WHEREAS the City of Cambridge has prepared a multi-hazard mitigation plan, hereby known as the City of Cambridge 2023 Hazard Mitigation Plan Update, in accordance with federal laws, including the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended; the National Flood Insurance Act of 1968, as amended; and the National Dam Safety Program Act, as amended; and

WHEREAS the City of Cambridge 2023 Hazard Mitigation Plan Update identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the City of Cambridge from the impacts of future hazards and disasters; and

WHEREAS duly-noticed public meetings on the 2023 Hazard Mitigation Plan Update were held by the City on June 13, 2023 and two on September 13, 2023; and

WHEREAS the City Council authorizes Departments to executive their responsibilities demonstrated in the 2023 Hazard Mitigation Plan Update; and

WHEREAS adoption by the City Council demonstrates its commitment to hazard mitigation and achieving the goals outlined in the City of Cambridge 2023 Hazard Mitigation Plan Update; now therefore be it

Resolved: That in accordance with M.G.L. 40 §4 or the charter and ordinances of the City of Cambridge, the City Council adopts the City of Cambridge 2023 Hazard Mitigation Plan Update. While content related to the City of Cambridge may require revisions to meet the plan approval requirements, changes occurring after adoption will not require the City of Cambridge to re-adopt any further iterations of the plan. Subsequent plan updates following the approval period for this plan will require separate adoption resolutions.

Step 1

City approves NHMP, allowing for potential updates due to MEMA/FEMA Review. Resolution language leaves room for any required NHMP revisions that occur after adoption is approved

Step 2

Submit plan to MEMA following state guidance (issued in Feb. 2023).

NEXT STEPS AFTER SUBMITTAL TO MEMA

Step 1

MEMA provides review and comments, if any (likely some)

Step 2

If comments (likely some), City responds to comments and updates plan, and sends revised documents to MEMA.

Address comments from MEMA and restart process

Step 3

MEMA reviews and sends to FEMA

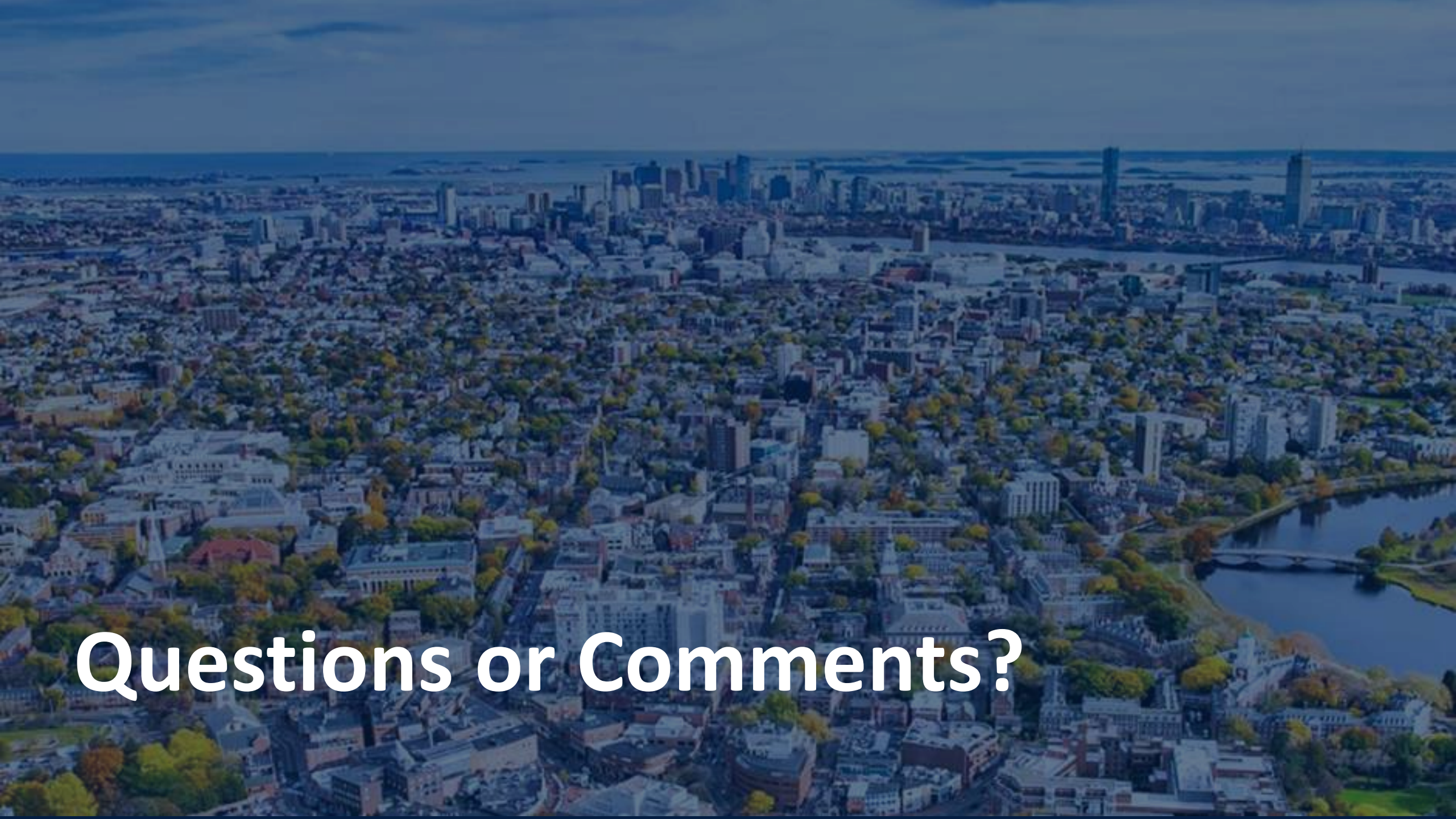
Step 4

If comments, City responds and provides updated final HMP.

Address comments from FEMA and restart process

Step 5

FEMA confirms and provides final approval.



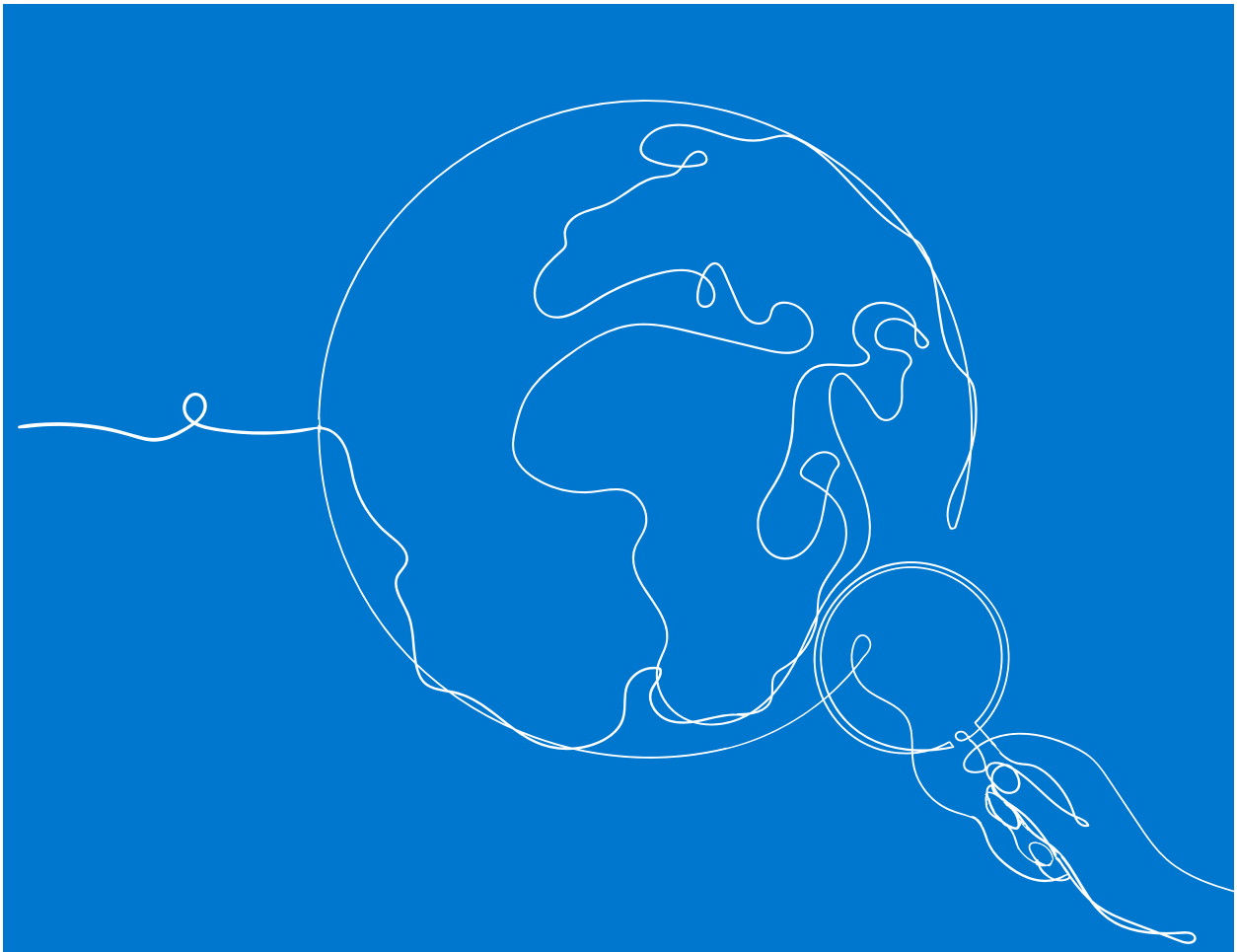
Questions or Comments?

Natural Hazard Mitigation Plan Update 2023

Thank You!

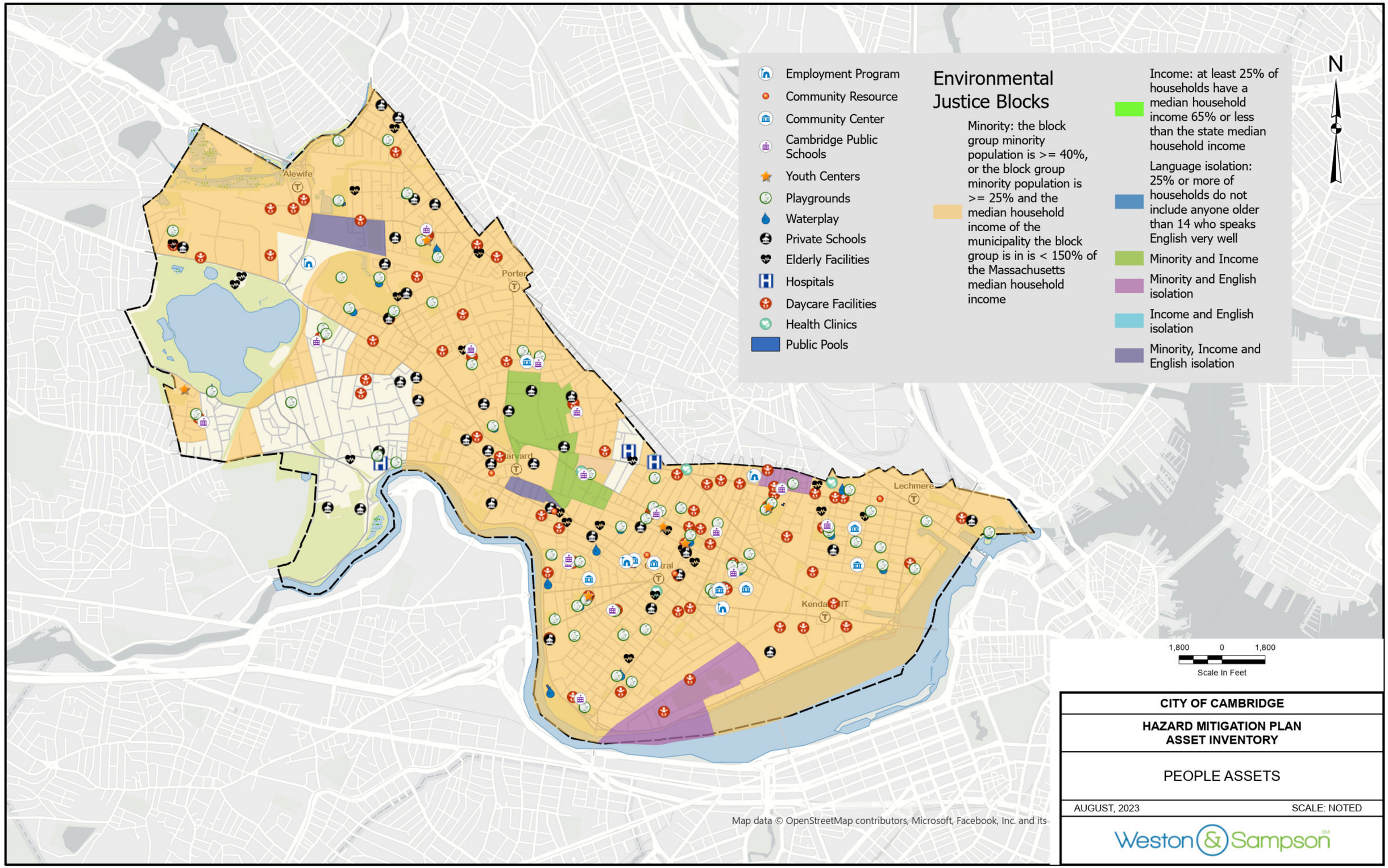
CITY OF CAMBRIDGE

Weston & Sampson SM



Appendix E

Asset Maps



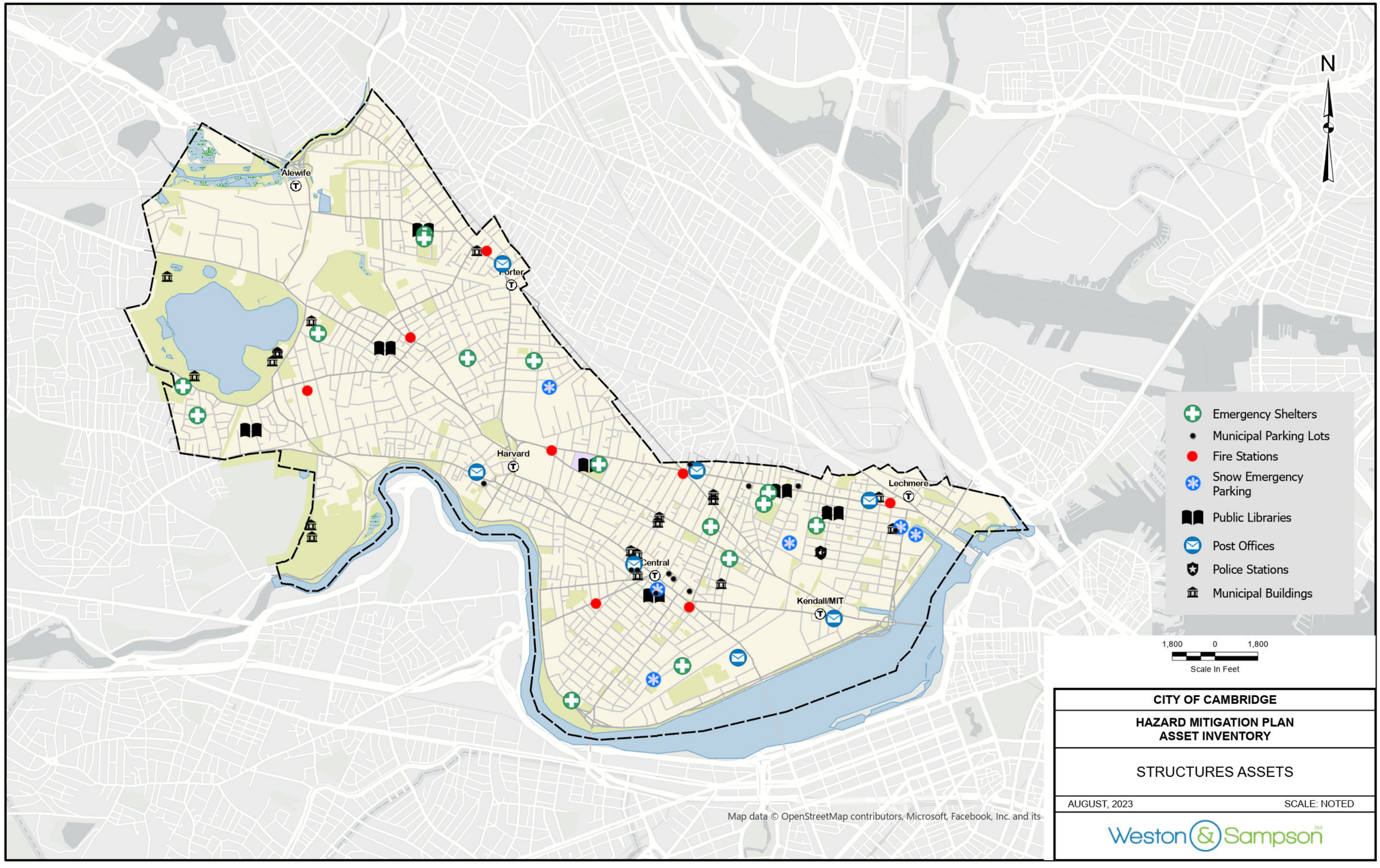
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

PEOPLE ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



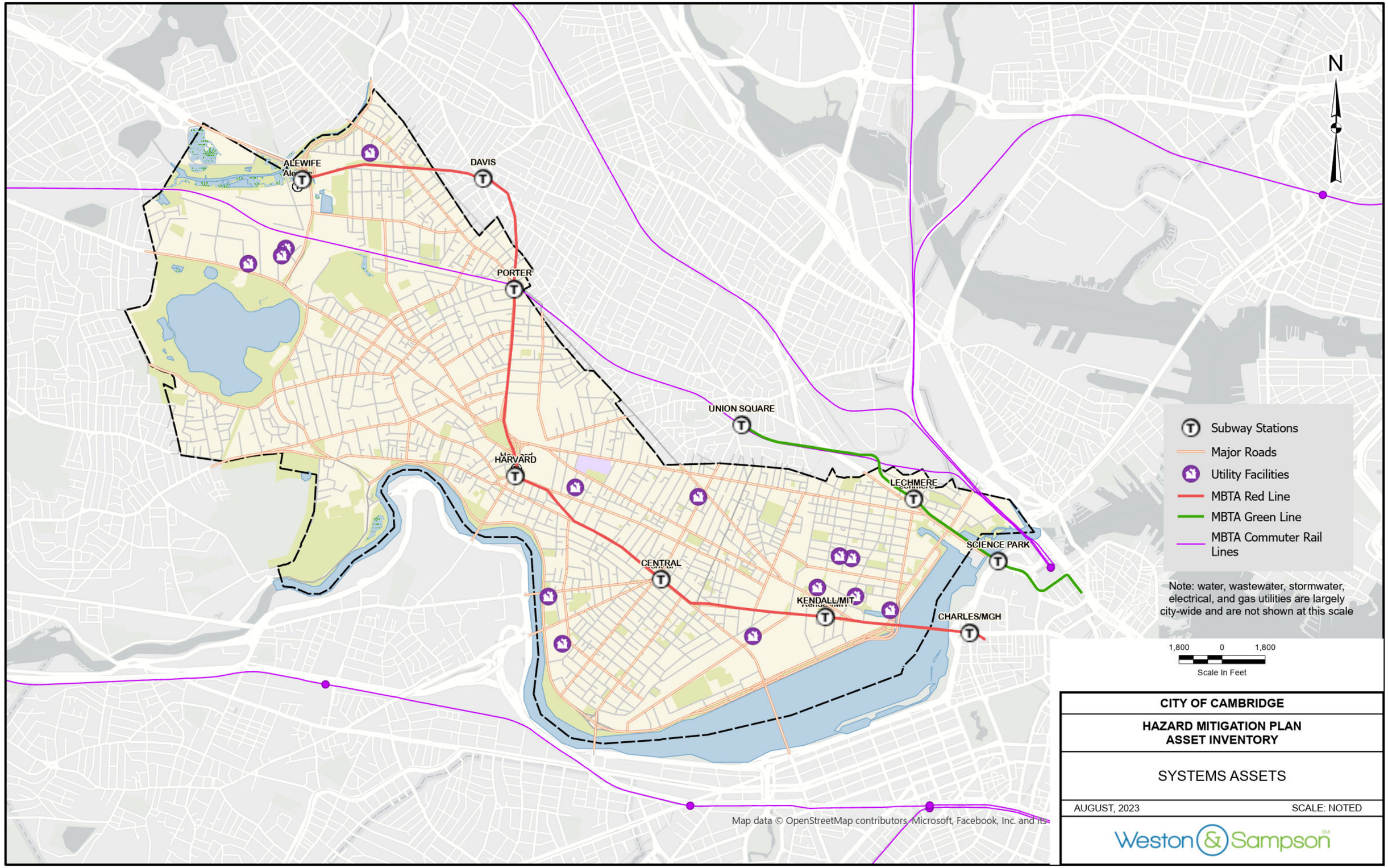
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

STRUCTURES ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

SYSTEMS ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson

N

Porter

Harvard

Central

Lechmere

Kendall/MIT

- Community Gardens
- Arts & Culture
- Places of Worship
- Historical Markers
- Public Art
- Historic Landmarks and Easements
- Open Space
- Historic Districts
- National Register of Historic Places

1,800 0 1,800

Scale In Feet

Map data © OpenStreetMap contributors, Microsoft, Facebook, Inc. and its

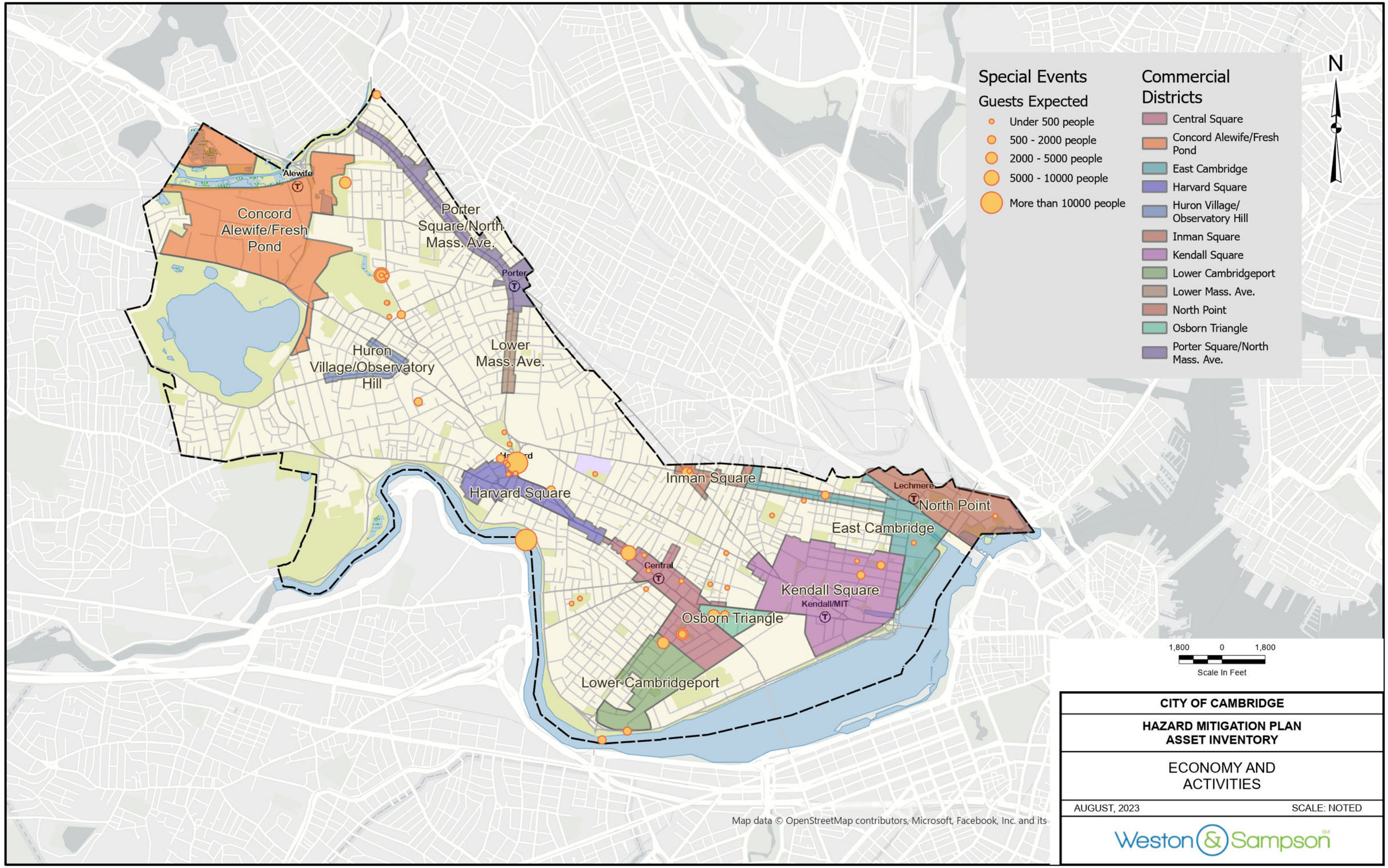
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

NATURAL HISTORIC &
CULTURAL RESOURCES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

ECONOMY AND ACTIVITIES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson

Appendix A

Critical Assets and Community Resources Maps

Climate Change Vulnerability Assessment

City of Cambridge, Massachusetts

November 2015

Maps - Critical Assets and Community Resources

The Built Environment

Energy

E.1: Buildings by Heating Fuel Type, City of Cambridge
E.2: Energy Infrastructures Systems, City of Cambridge

Transportation

Tr.1: MBTA Transit Ridership, City of Cambridge
Tr.2: MBTA support infrastructure
Tr.3: Road System and Traffic Count, City of Cambridge
Tr.4: Bridges, Tunnels and Underpasses, City of Cambridge
Tr.5: Parking Garages, City of Cambridge
Tr. 6: Bicycle Infrastructures
Tr. 7: Bicycle Critical Assets

Water

W.1: Location of surface water bodies, wetlands and dams in Cambridge
W.2: Surface water supply source area, City of Cambridge
W.3: Water distribution system, City of Cambridge
W.4: Stormwater collection system, City of Cambridge
W.5: Combined sewer collection system, City of Cambridge
W.6 Impervious surfaces, City of Cambridge

Telecommunications

Te.1: Telecommunication critical assets, City of Cambridge

Critical Services

CS.1: Critical Services, City of Cambridge

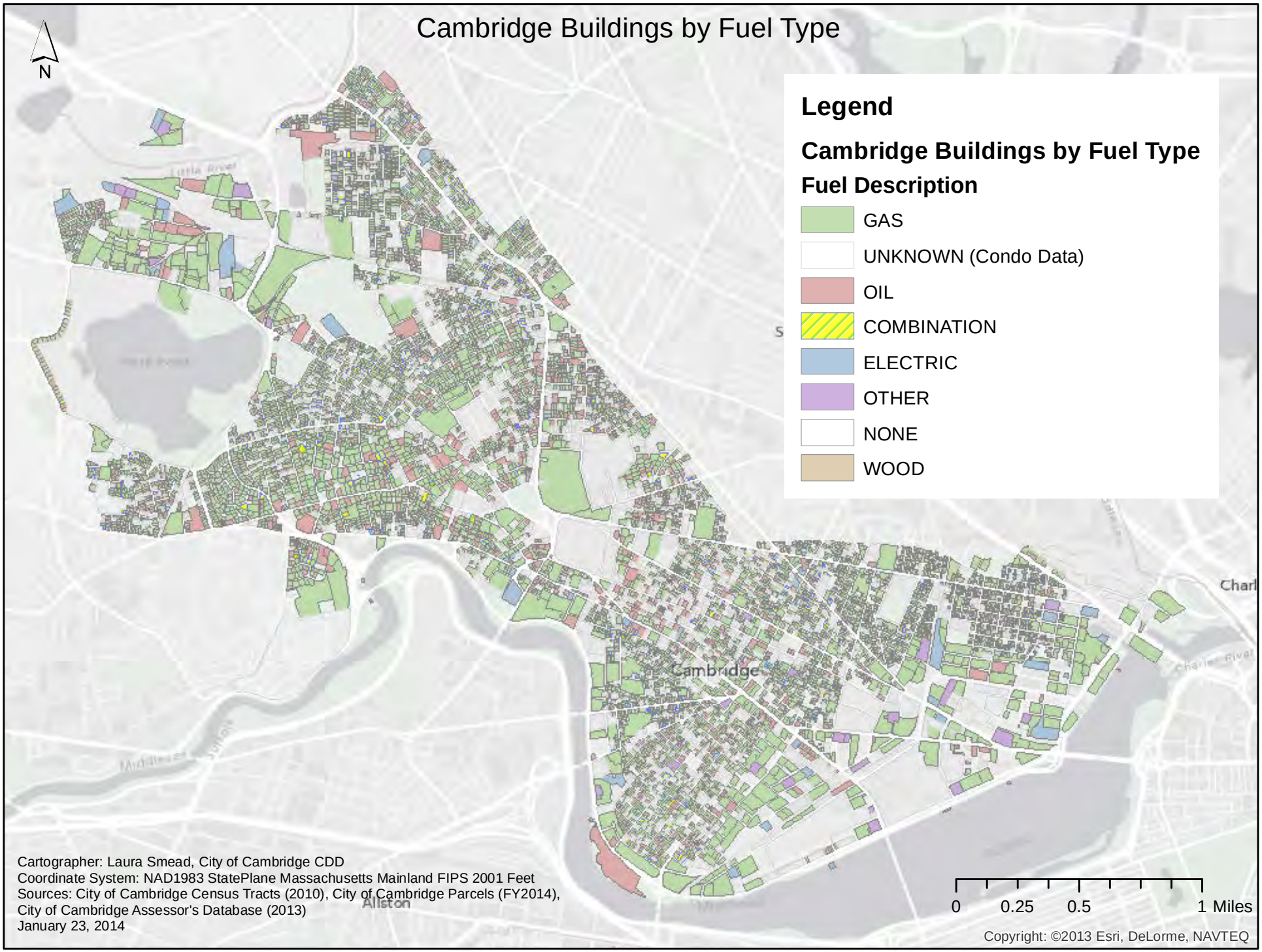
The Urban Forests

UF.1: Percentage of tree canopy in Cambridge
UF.2: Cooling impact of trees in Cambridge

The Social Environment

CR.1: K-12 Schools and Day Care Facilities in Cambridge
CR.2: Affordable Housing, City of Cambridge
CR.3: Pharmacies & Food Assistance, City of Cambridge
CR.4: Municipal Resources, City of Cambridge
CR.5: Community-Based Organizations and Services, City of Cambridge
CR.6: Hazardous Material Sites, City of Cambridge

Cambridge Buildings by Fuel Type



Cartographer: Laura Smead, City of Cambridge CDD
Coordinate System: NAD1983 StatePlane Massachusetts Mainland FIPS 2001 Feet
Sources: City of Cambridge Census Tracts (2010), City of Cambridge Parcels (FY2014), City of Cambridge Assessor's Database (2013)
January 23, 2014

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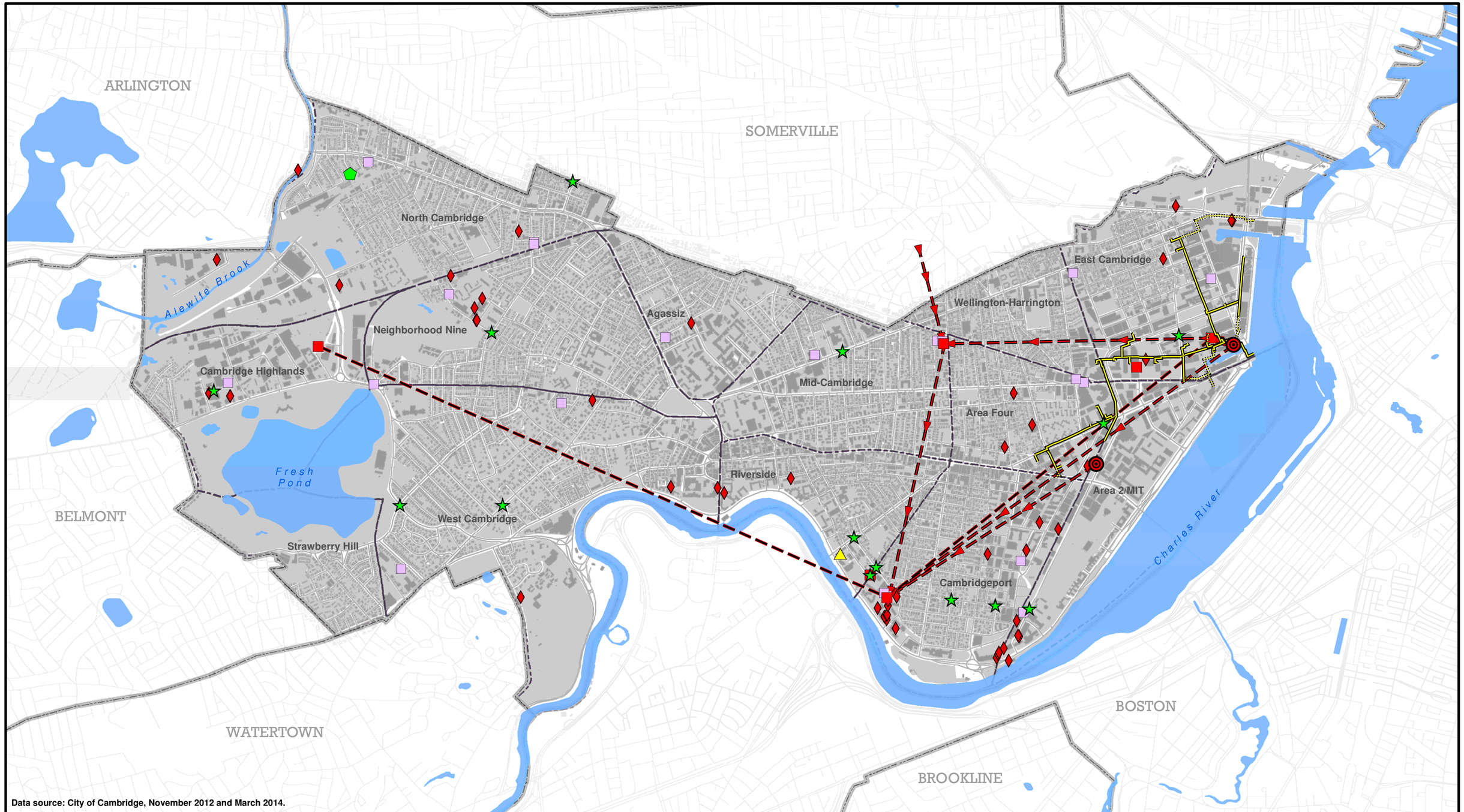


Data source: City of Cambridge, November 2012 and March 2014.

LEGEND

- Power Plant (10 MW or more)
- Gas Distribution System Regulator Station
- Natural Gas Gate Station
- Steam Generating Facility
- Steam Distribution Line
  - Active
  - Inactive
- NSTAR Electrical Substation
- Minor Substation
- Backup Electrical Generator
- Transmission Line (Schematic)
  - 13.8 kV (unidirectional)
  - 115 kV (bi-directional)

0 1,000 2,000
Feet
Locations are approximate

THIS MAP HAS BEEN PREPARED FOR THE CITY OF CAMBRIDGE CLIMATE CHANGE VULNERABILITY ASSESSMENT. IT IS BASED ON GIS DATA PROVIDED BY THE CITY (11/6/2012) AND FROM MASSGIS. USERS OF THIS MAP SHOULD CONSULT PRIMARY SOURCES FOR VERIFICATION OF THE INFORMATION CONTAINED ON THIS MAP. THE CITY OF CAMBRIDGE AND ITS MAPPING CONTRACTORS ASSUME NO LIABILITY FOR THE INFORMATION CONTAINED HEREIN.

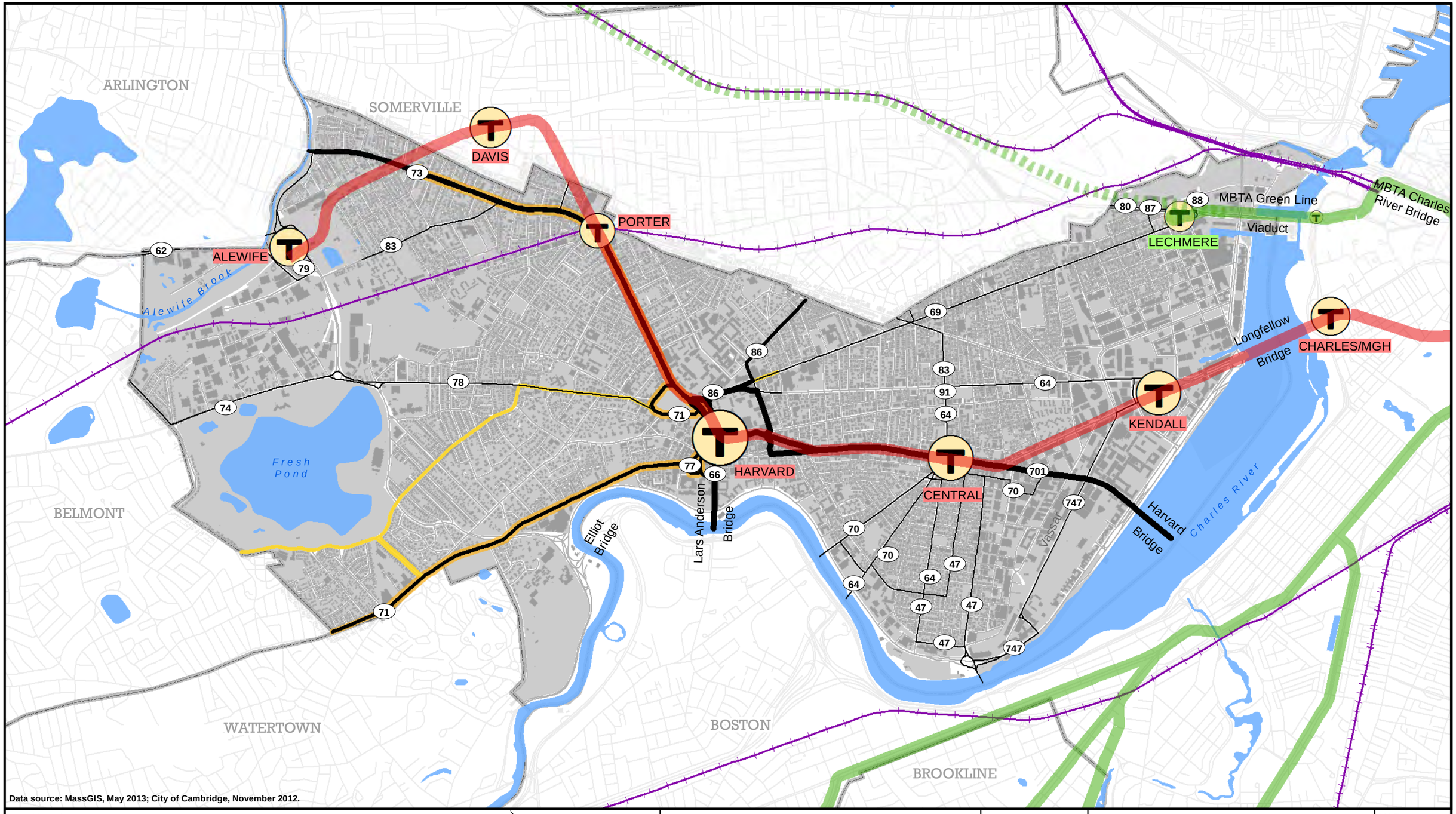
KLEINFELDER
www.kleinfelder.com

PROJECT NO.	20100259
DRAWN:	10/1/2014
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	E.2-Infrastructure.mxd

ENERGY INFRASTRUCTURE SYSTEMS

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
E.2



Data source: MassGIS, May 2013; City of Cambridge, November 2012.

LEGEND

- Green Line
- Red Line
- Green Line Extension (schematic)
- Trackless Trolley
- Fitchburg Commuter Rail

Weekday Entries
- 1,000
- 5,000
- 10,000

MBTA Bus Weekday Boarding
- > 1,000
- > 5,000
- > 10,000

0 1,000 2,000
Feet
Locations are approximate

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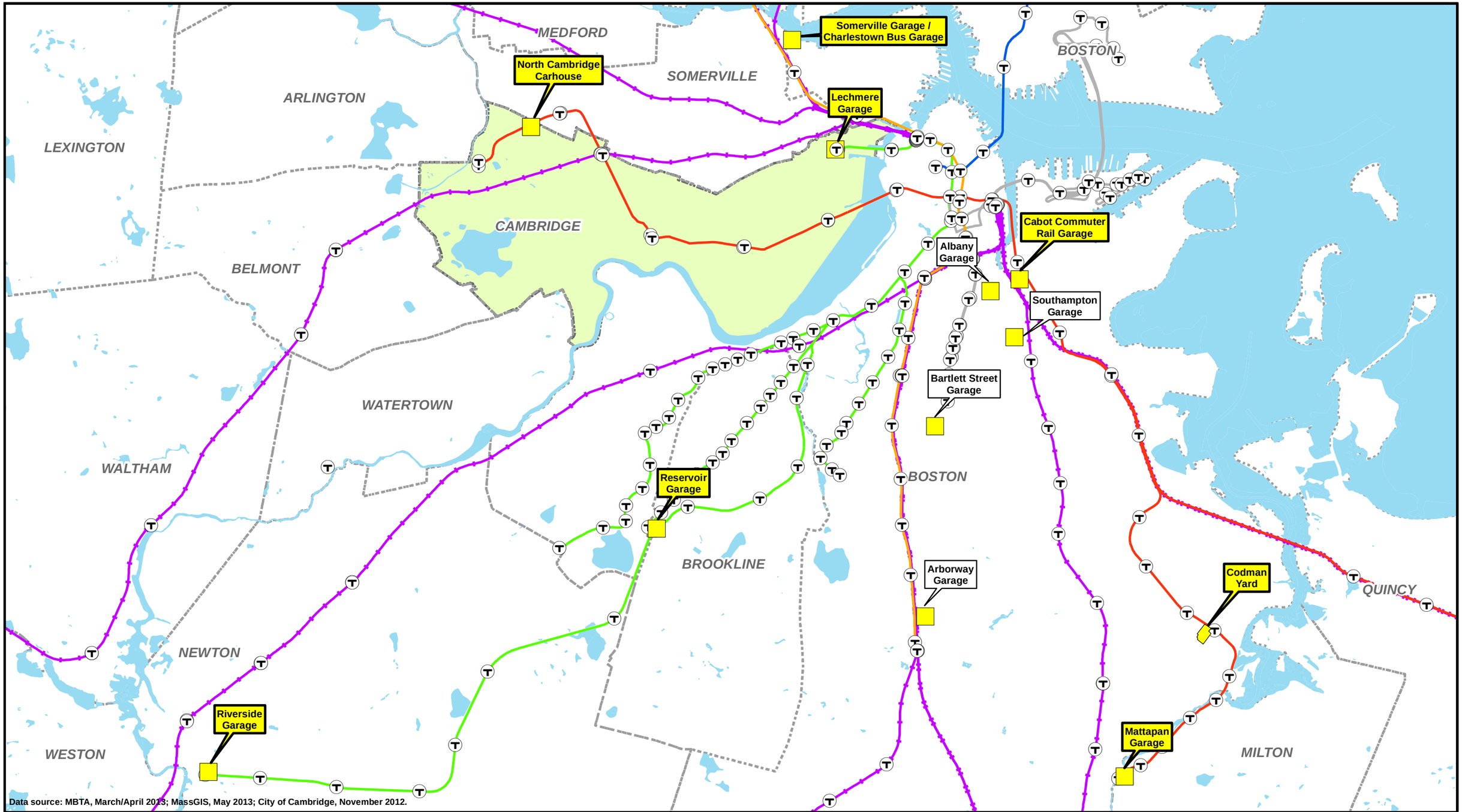
KLEINFELDER
www.kleinfelder.com

PROJECT NO.	20100259
DRAWN:	04/07/2015
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	Tr.1-Transit.mxd

MBTA TRANSIT RIDERSHIP

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
Tr.1



Data source: MBTA, March/April 2013; MassGIS, May 2013; City of Cambridge, November 2012.

LEGEND

- Arborway Garage — MBTA Garage
- Riverside Garage — Support Infrastructure Impacting Green and Red Lines
- Commuter Rail
- MBTA Blue Line
- MBTA Green Line
- MBTA Orange Line
- MBTA Red Line
- MBTA Silver Line
- Town Boundary

0 2,500 5,000
Feet
Locations are approximate

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KLEINFELDER
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PROJECT NO.	20100259
DRAWN:	04/07/2015
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	Tr.2-RegionalMBTA.mxd

MBTA SUPPORT INFRASTRUCTURE

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
Tr.2

SOMERVILLE
ARLINGTON
BELMONT
WATERTOWN
BOSTON
BROOKLINE
Alewife Brook
Fresh Pond
Elliot Bridge
Lars Anderson Bridge
MBTA Charles River Bridge
MBTA Green Line Viaduct
Longfellow Bridge
Harvard Bridge
BU Bridge
Charles River

Data source: City of Cambridge, November 2012 and January 2014; MassGIS October 2009.

LEGEND

Roads by Jurisdiction
- Interstate
- US Highway
- State Route

Roads by Traffic Count (Average Daily Traffic)
- < 10,000
- 10,000 - 20,000
- 20,001 - 30,000
- > 30,000

Critical Node
Convergence of two or more vehicular access routes with total traffic count exceeding 30,000.

0 1,000 2,000
Feet
Locations are approximate

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KLEINFELDER
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PROJECT NO.	20100259
DRAWN:	04/07/2015
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	Tr.3-TrafficCounts.mxd

ROAD SYSTEM AND TRAFFIC COUNT

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
Tr.3

ARLINGTON

SOMERVILLE

North Cambridge

Alewife Brook

Neighborhood Nine

Agassiz

Wellington-Harrington

East Cambridge

MBTA Charles River Bridge

MBTA Green Line Viaduct

Longfellow Bridge

Mid-Cambridge

Cambridge St Underpass

MBTA Underpass

Area Four

Cambridge Highlands

Fresh Pond

MBTA Underpass

West Cambridge

Riverside

Area 2/MIT

Charles River

Harvard Bridge

BELMONT

Strawberry Hill

Elliot Bridge

Lars Anderson Bridge

Western Ave Bridge

Cambridgeport

Cambridge St Bridge

BU Bridge

BOSTON

WATERTOWN

BROOKLINE

Data source: MBTA, April 2013; City of Cambridge, November 2012.

LEGEND

MBTA Ownership | Bridge or Overpass | Tunnel or Underpass

0 1,000 2,000

Feet

Locations are approximate

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KLEINFELDER

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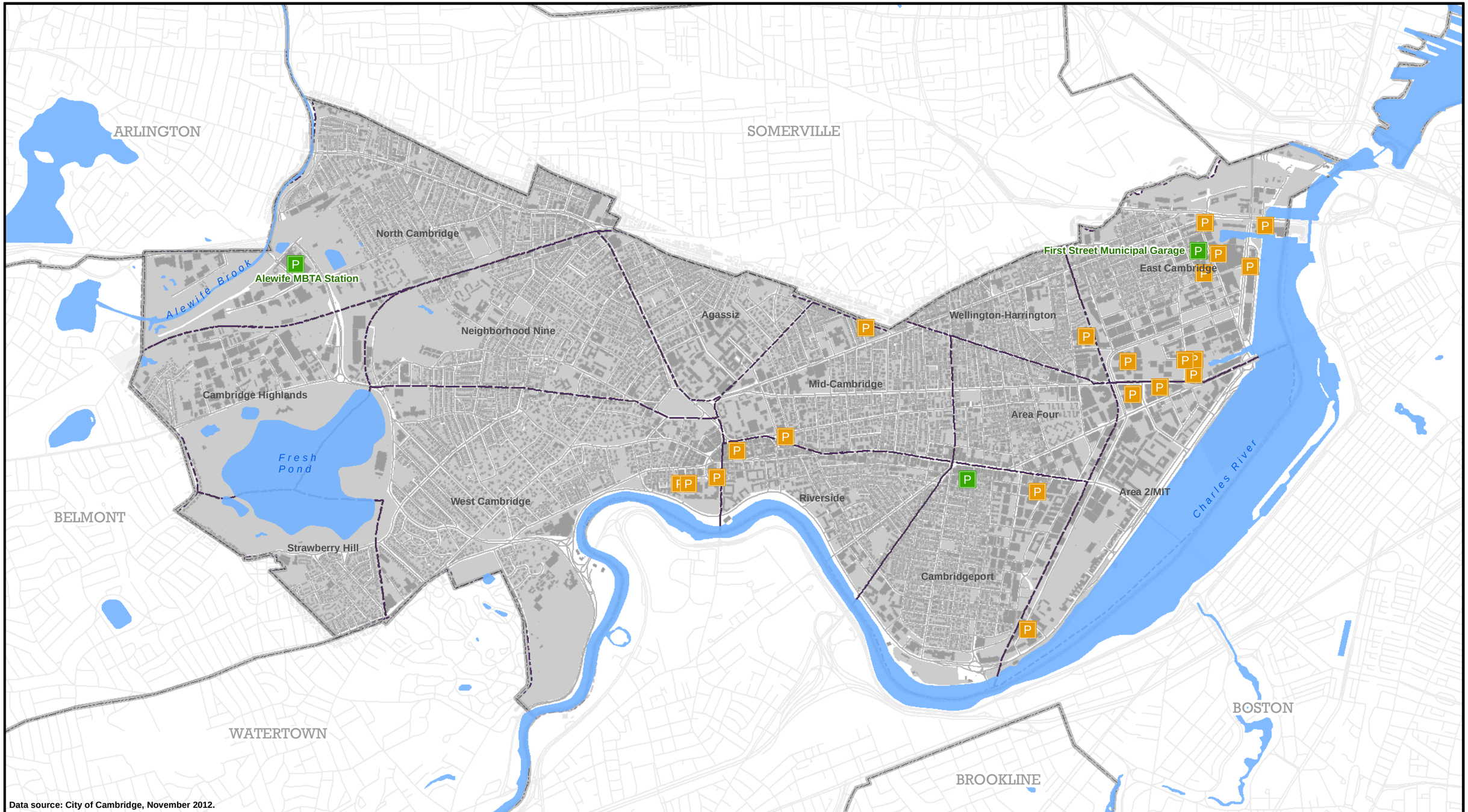
PROJECT NO.	20100259
DRAWN:	04/07/2015
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	Tr.4-Bridges.mxd

BRIDGES, TUNNELS AND UNDERPASSES

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP

Tr.4



Data source: City of Cambridge, November 2012.

LEGEND

- Municipal Parking Garage
- Private Parking Garage
- Neighborhood Boundary

0 1,000 2,000
Feet
Locations are approximate

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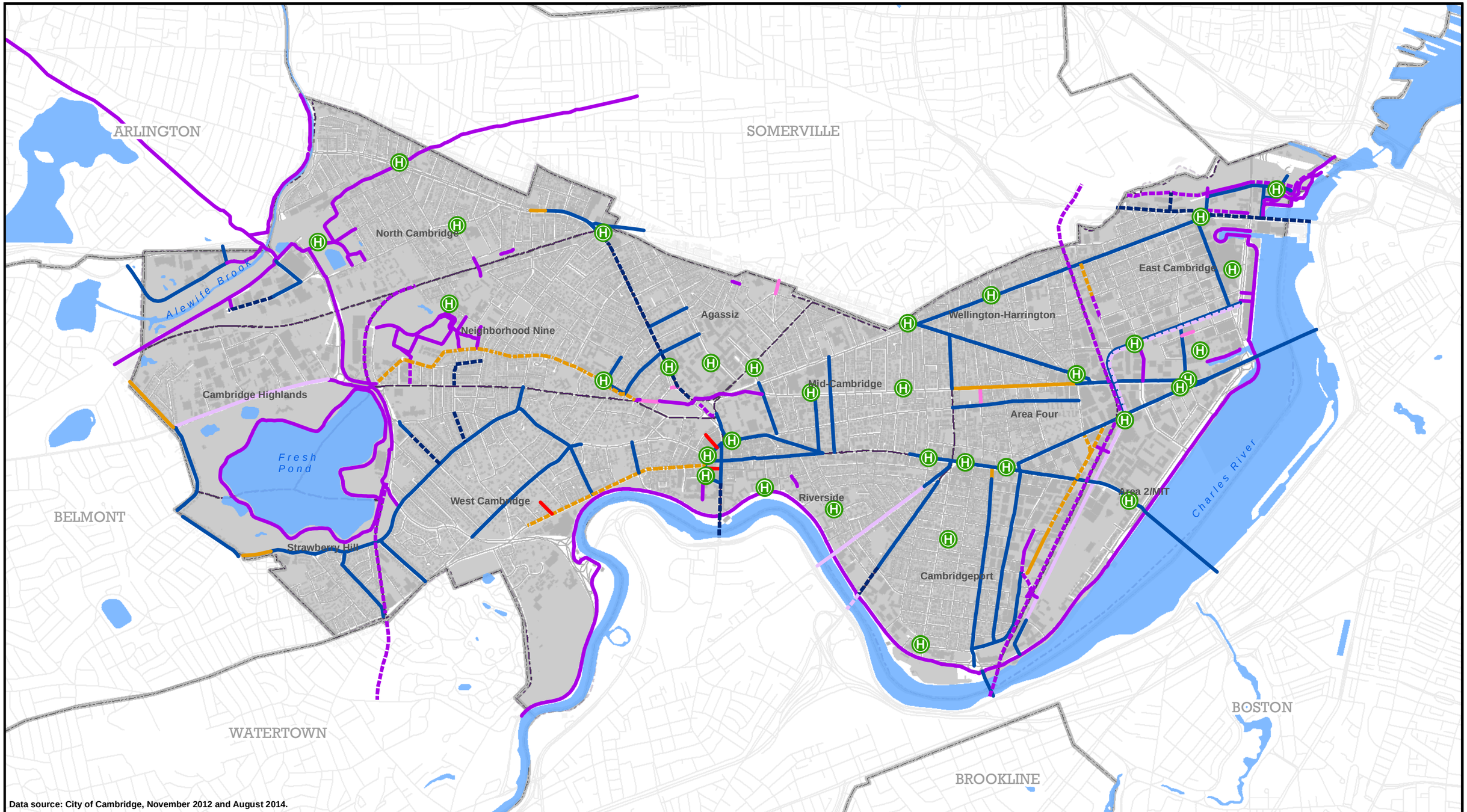
PROJECT NO.	20100259
DRAWN:	04/07/2015
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	Tr.5-Garages.mxd

PARKING GARAGES

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
Tr.5



Data source: City of Cambridge, November 2012 and August 2014.

LEGEND

Bike Paths and Road Markings

- Bike Path/Multi-Use Path
- Planned Bike Path/Multi-Use Path
- Bike Lane
- Planned Bike Lane
- Contra-flow
- Cycle Track
- Planned Cycle Track
- Shared Lane Pavement Marking
- Planned Shared Lane Pavement Marking
- Edge Line
- Planned Edge Line
- Shared Street
- Planned Shared Street
- Hubway Stations

0 1,000 2,000

Feet

Locations are approximate

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KLEINFELDER
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PROJECT NO.	20100259
DRAWN:	04/07/2015
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	Tr.6-BikeFacilities.mxd

BICYCLING INFRASTRUCTURE

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP

Tr.6

ARLINGTON

SOMERVILLE

North Cambridge

Alewife Brook

Neighborhood Nine

Agassiz

Wellington-Harrington

East Cambridge

Mid-Cambridge

Area Four

Cambridge Highlands

Fresh Pond

West Cambridge

Riverside

Area ZMIT

Charles River

BELMONT

Strawberry Hill

Cambridgeport

BOSTON

WATERTOWN

BROOKLINE

Number of Cyclists (AM)

397 - 400
401 - 500
501 - 550
551 - 600
601 - 610

Number of Cyclists (AM)

444 - 450
451 - 486
487 - 550
551 - 600
601 - 637

Data source: City of Cambridge, November 2012, August 2014

LEGEND

Main Bicycle Corridors

0 1,000 2,000
Feet
Locations are approximate

THIS MAP HAS BEEN PREPARED FOR THE CITY OF CAMBRIDGE CLIMATE CHANGE VULNERABILITY ASSESSMENT. IT IS BASED ON GIS DATA PROVIDED BY THE CITY (11/6/2012) AND FROM MASSGIS. USERS OF THIS MAP SHOULD CONSULT PRIMARY SOURCES FOR VERIFICATION OF THE INFORMATION CONTAINED ON THIS MAP. THE CITY OF CAMBRIDGE AND ITS MAPPING CONTRACTORS ASSUME NO LIABILITY FOR THE INFORMATION CONTAINED HEREIN.

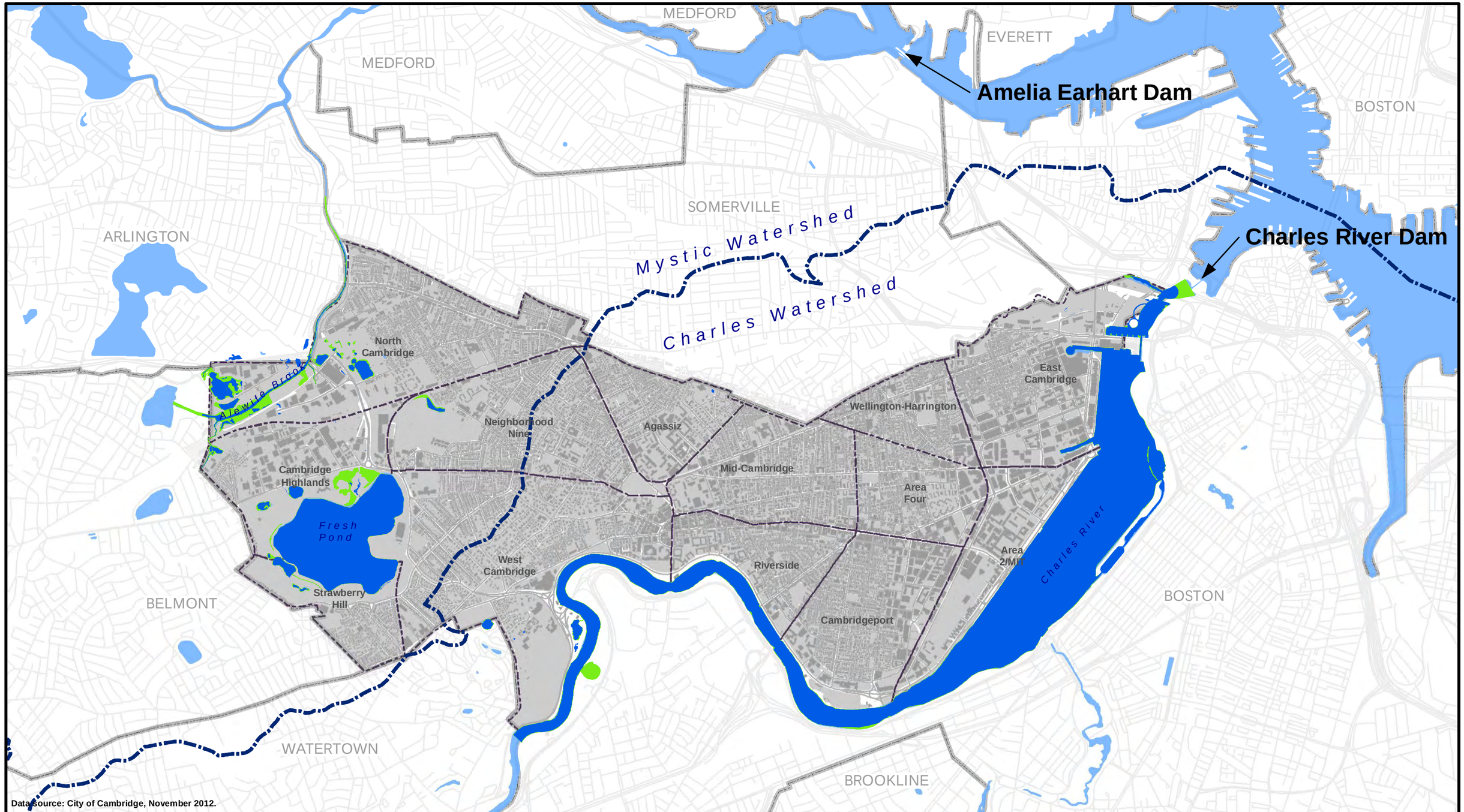
KLEINFELDER
www.kleinfelder.com

PROJECT NO.	20100259
DRAWN:	04/07/2015
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	Tr.7.BikeCriticalAssets.mxd

BICYCLE CRITICAL ASSETS

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
Tr. 7



Data Source: City of Cambridge, November 2012.

LEGEND

- Surface Water Body
- Wetland
- Watershed Boundary
- Neighborhood Boundary

0 1,250 2,500
Feet
Locations are approximate

THIS MAP HAS BEEN PREPARED FOR THE CITY OF CAMBRIDGE CLIMATE CHANGE VULNERABILITY ASSESSMENT. IT IS BASED ON GIS DATA PROVIDED BY THE CITY (11/6/2012) AND FROM MASSGIS. USERS OF THIS MAP SHOULD CONSULT PRIMARY SOURCES FOR VERIFICATION OF THE INFORMATION CONTAINED ON THIS MAP. THE CITY OF CAMBRIDGE AND ITS MAPPING CONTRACTORS ASSUME NO LIABILITY FOR THE INFORMATION CONTAINED HEREIN.

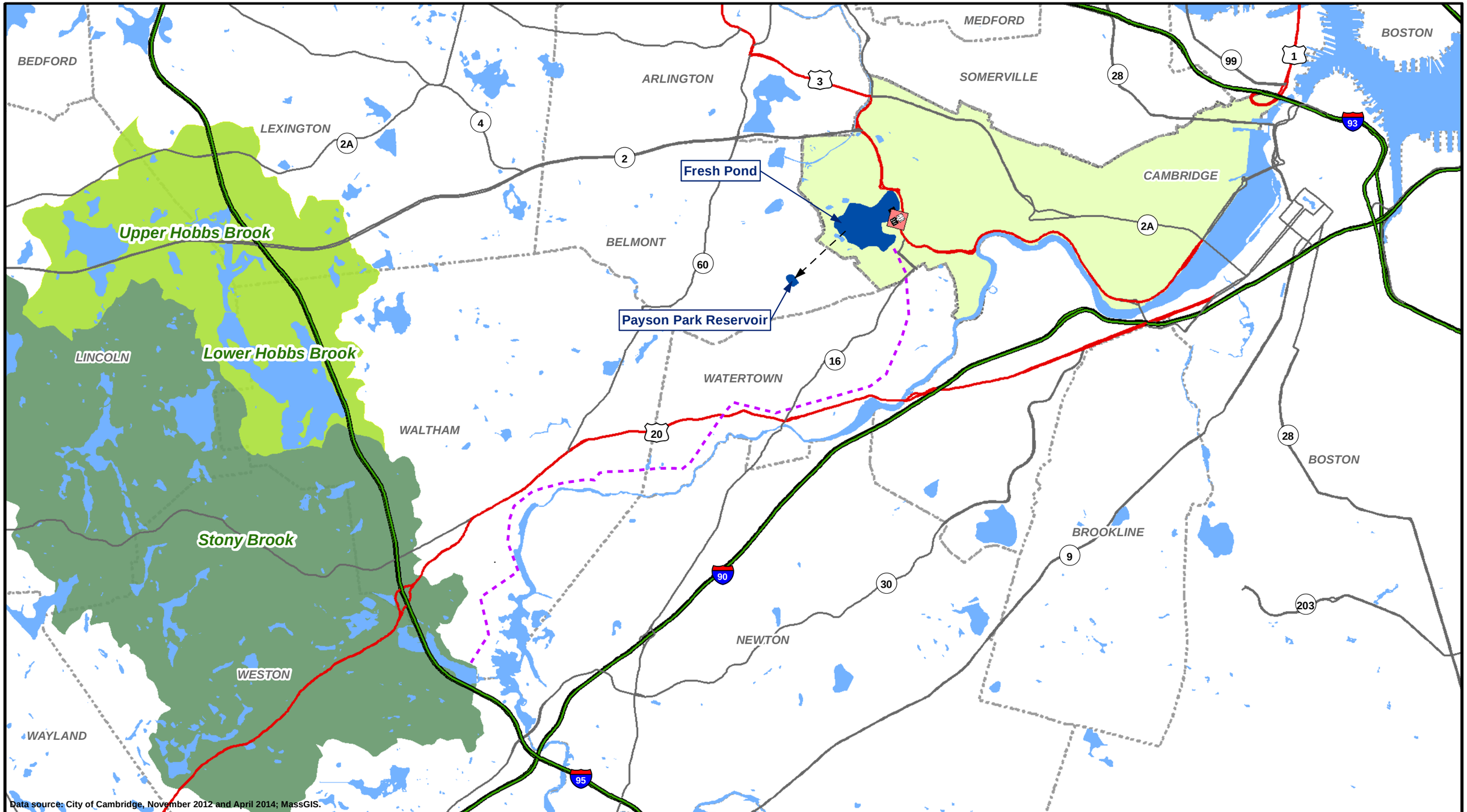
KLEINFELDER
www.kleinfelder.com

PROJECT NO.	20100259
DRAWN:	4/28/2014
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	W.1-SurfaceWater.mxd

SURFACE WATER BODIES, WETLANDS AND DAMS

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
W.1



Data source: City of Cambridge, November 2012 and April 2014; MassGIS.

LEGEND

- Hobbs Brook Watershed
- Stony Brook Watershed
- Surface Water Body Used for Storage
- Surface Water Body
- Aqueduct to Fresh Pond
- J Walter Sullivan Water Treatment Plant
- Interstate
- U.S. Highway
- State Route

0 2,500 5,000
Feet
Locations are approximate

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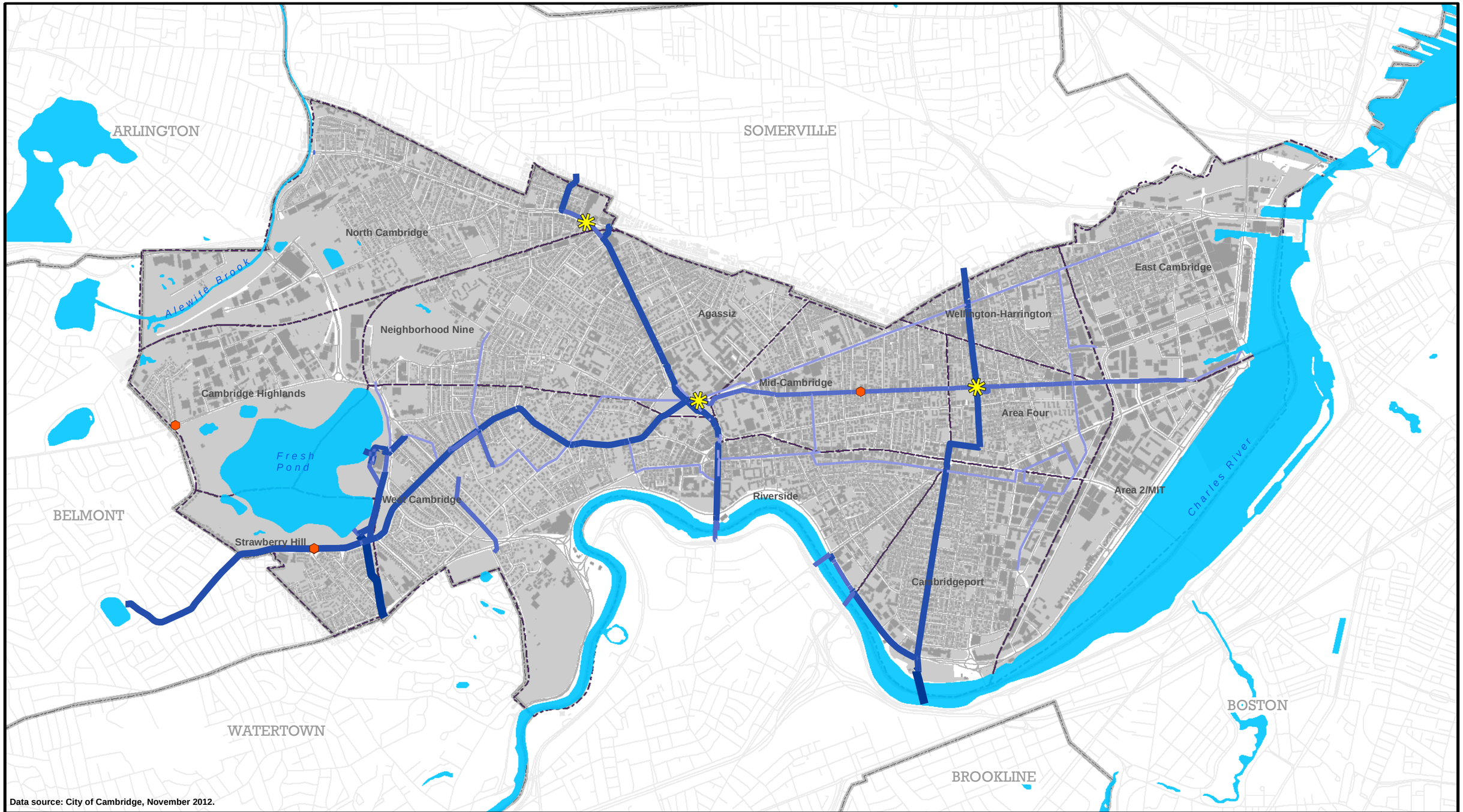
PROJECT NO.	20100259
DRAWN:	4/28/2014
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	W.2-WaterSupply.mxd

SURFACE WATER SUPPLY SOURCE AREAS

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
W.2



Data source: City of Cambridge, November 2012.

LEGEND

Water Main (diameter)

- >= 16 inches
- >= 24 inches
- >= 36 inches
- >= 48 inches

- Air Relief Valve
- MWRA connections
- Neighborhood Boundary

0 1,000 2,000

Feet

Locations are approximate

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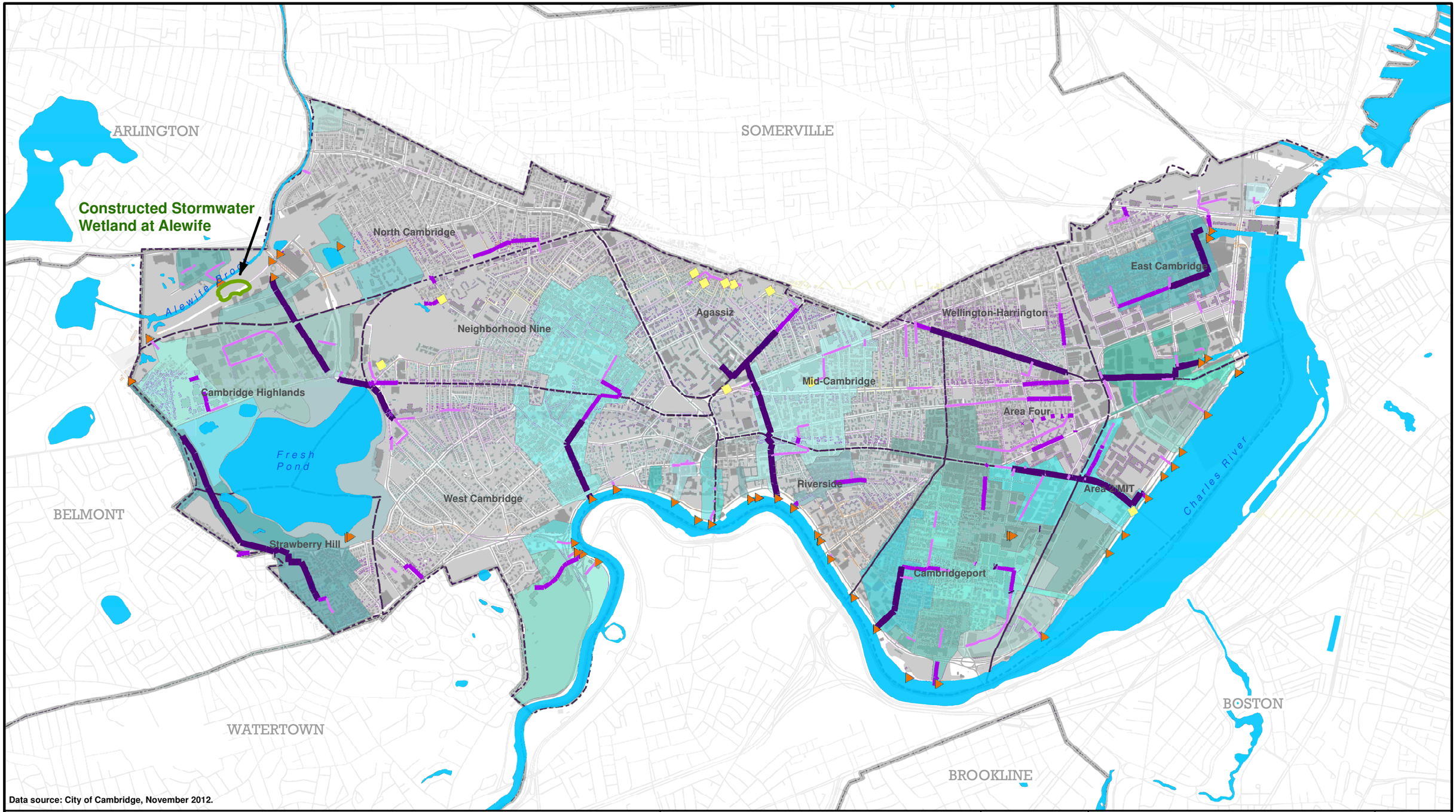
PROJECT NO.	20100259
DRAWN:	4/28/2014
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	W.3-Distribution.mxd

WATER DISTRIBUTION SYSTEM

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP

W.3



Data source: City of Cambridge, November 2012.

LEGEND

Stormwater Main (diameter)
- >= 24 inches
- >= 36 inches
- >=48 inches

- Pump Stations for Flood Control
- Stormwater Outfalls (>24 inches)
- Stormwater Catchment Area
- Neighborhood Boundary

0 1,000 2,000
Feet
Locations are approximate

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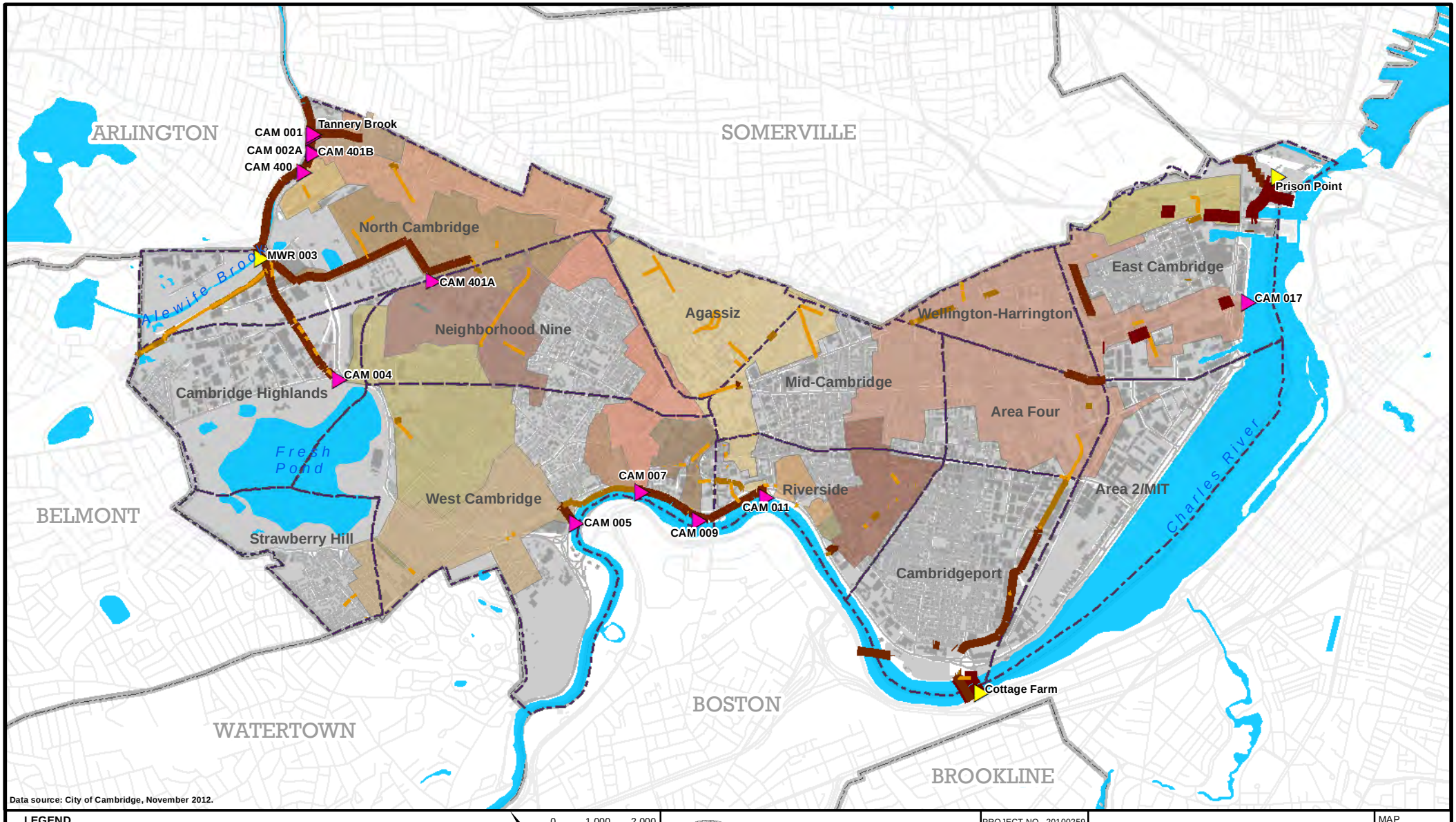
PROJECT NO.	20100259
DRAWN:	4/28/2014
DRAWN BY:	VK
CHECKED BY:	NB
FILE NAME:	W.4-Stormwater.mxd

STORMWATER COLLECTION SYSTEM

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
W.4



LEGEND

Combined Mains (diameter)
- >= 18 inches
- >= 36 inches
- >= 48 inches
- >= 72 inches

- CSO Locations - MWRA
- CSO Locations - CDPW
- Combined Catchment Area
- Neighborhood Boundary

0 1,000 2,000
Feet
Locations are approximate

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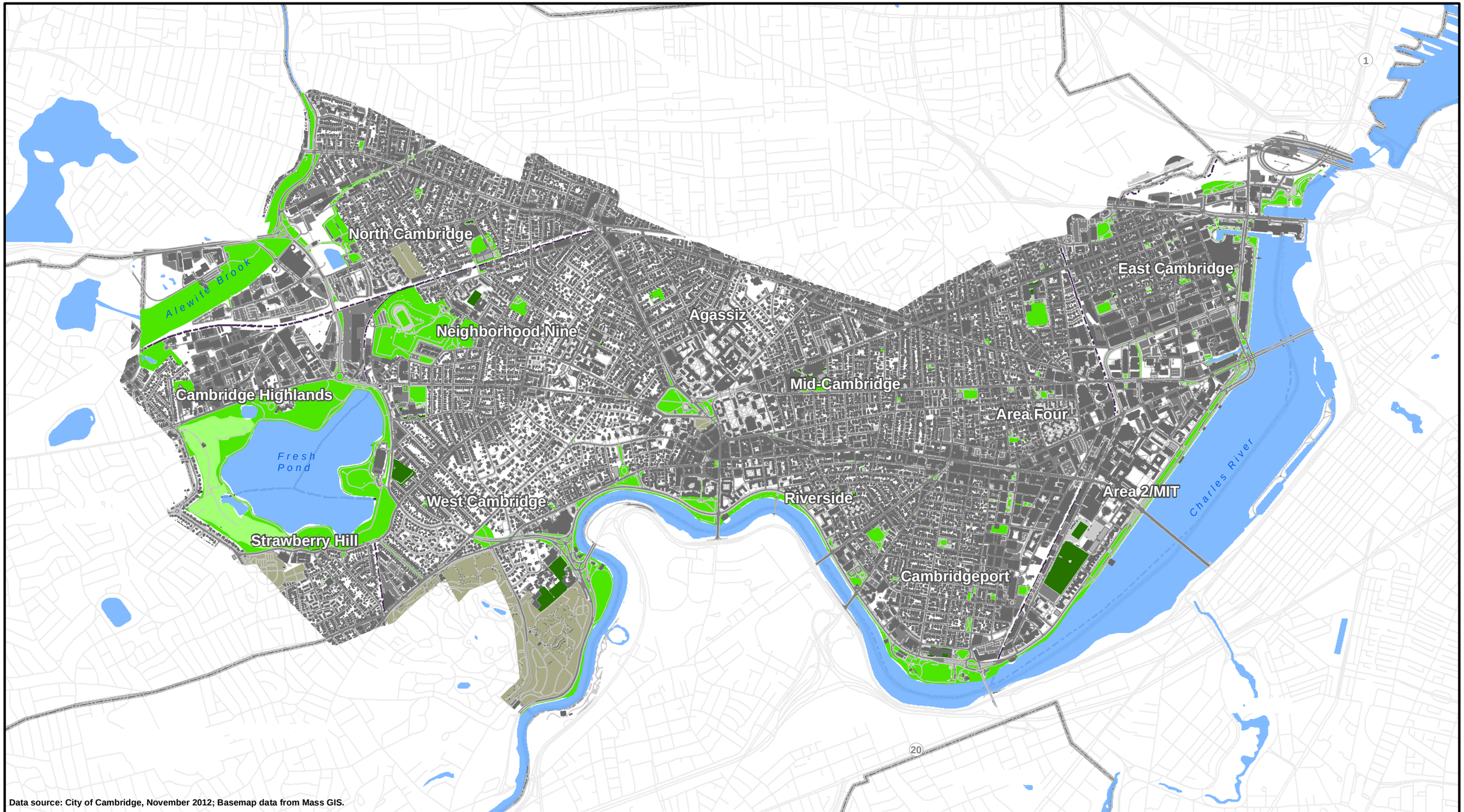
PROJECT NO.	20100259
DRAWN:	4/28/2014
DRAWN BY:	VK
CHECKED BY:	NB
FILE NAME:	W.5-CombinedCollection.mxd

COMBINED STORMWATER AND SEWER COLLECTION SYSTEM

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
W.5



Data source: City of Cambridge, November 2012; Basemap data from Mass GIS.

LEGEND

Impervious Surface
- Structure
- Paved Surface
- Surface
- Other

- Athletic Field
- Rooftop Park
- Park
- Golf Course
- Cemetery

Neighborhood Boundary

0 1,000 2,000
Feet
Locations are approximate

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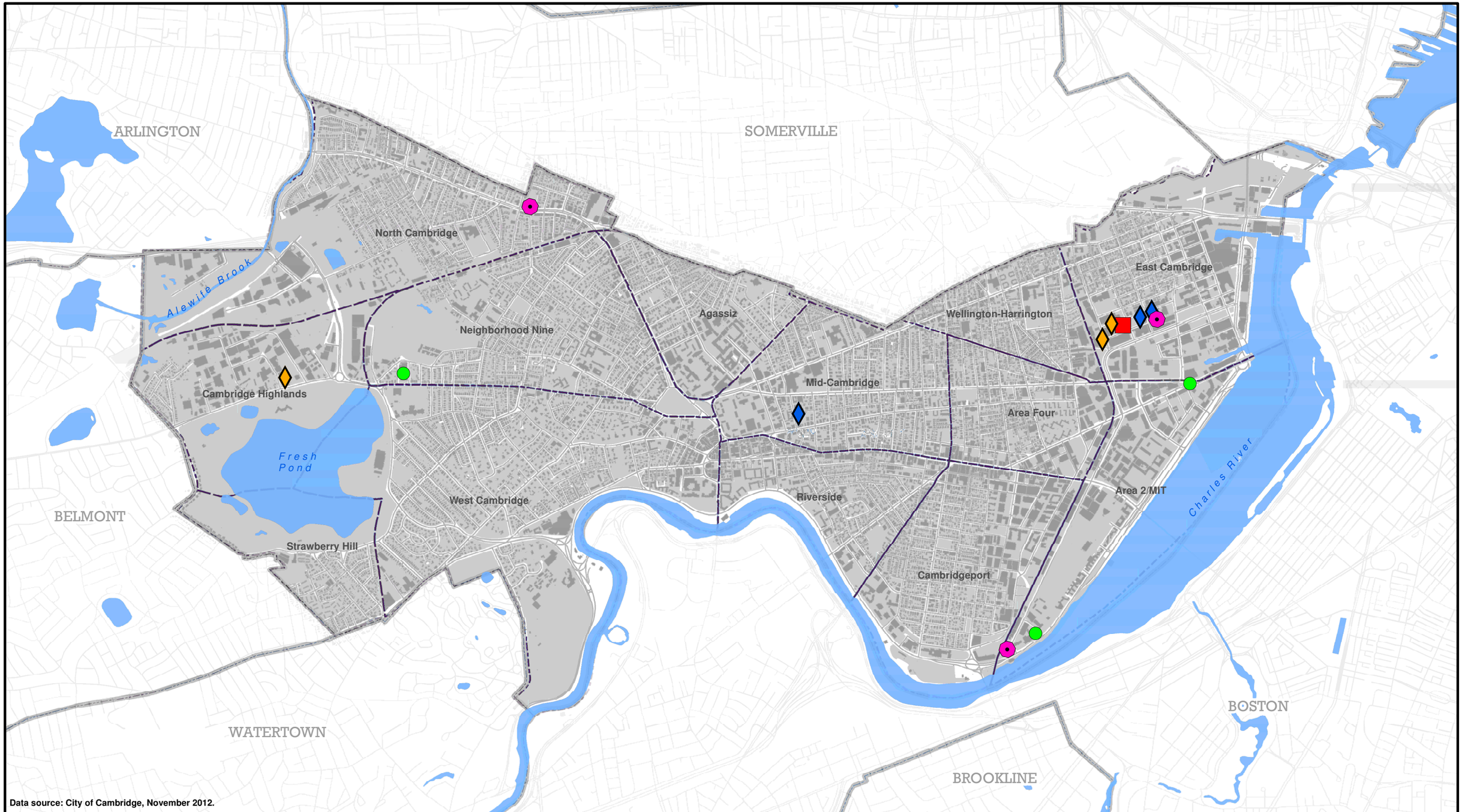
PROJECT NO.	20100259
DRAWN:	4/28/2014
DRAWN BY:	VK
CHECKED BY:	NB
FILE NAME:	W.6-ImperviousSurface.mxd

IMPERVIOUS SURFACE

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
W.6



Data source: City of Cambridge, November 2012.

LEGEND

- Antenna Towers (publicly sourced)
- Cell Towers
- Telephone Office/Switch
- Major Data Hub and Colocation Centers
- Emergency Communications Center
- Neighborhood Boundary

0 1,000 2,000
Feet
Locations are approximate

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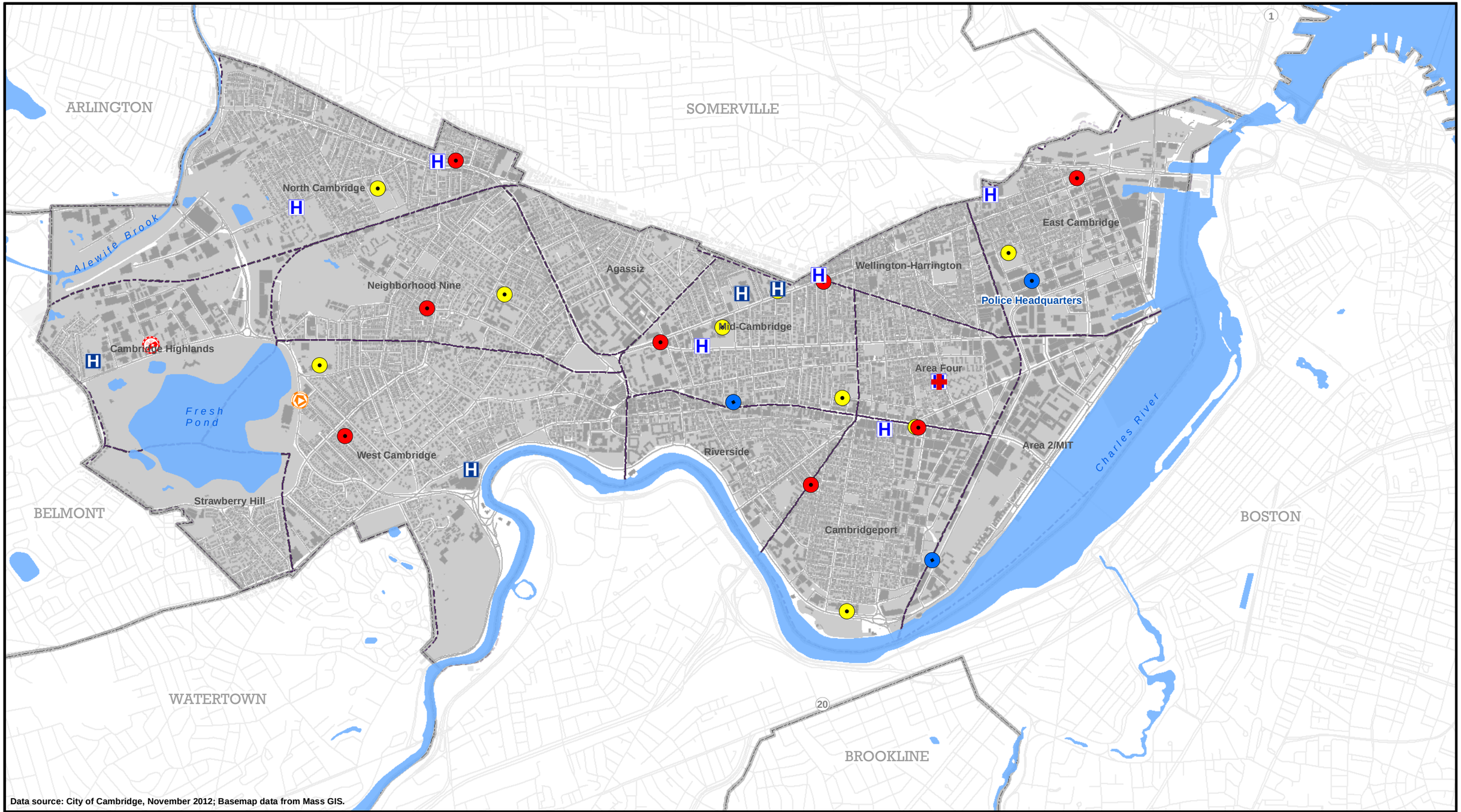
KLEINFELDER
www.kleinfelder.com

PROJECT NO.	20100259
DRAWN:	4/28/2014
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	Te.1-Telecommunications.mxd

TELECOMMUNICATIONS SYSTEM

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
Te.1



Data source: City of Cambridge, November 2012; Basemap data from Mass GIS.

LEGEND

- Public Health Office
- Hospital
- Health Clinic
- Police Station
- Fire Station
- Emergency Shelter
- Emergency Operations Center
- Professional Ambulance Service
- Neighborhood Boundary

0 1,000 2,000
Feet
Locations are approximate

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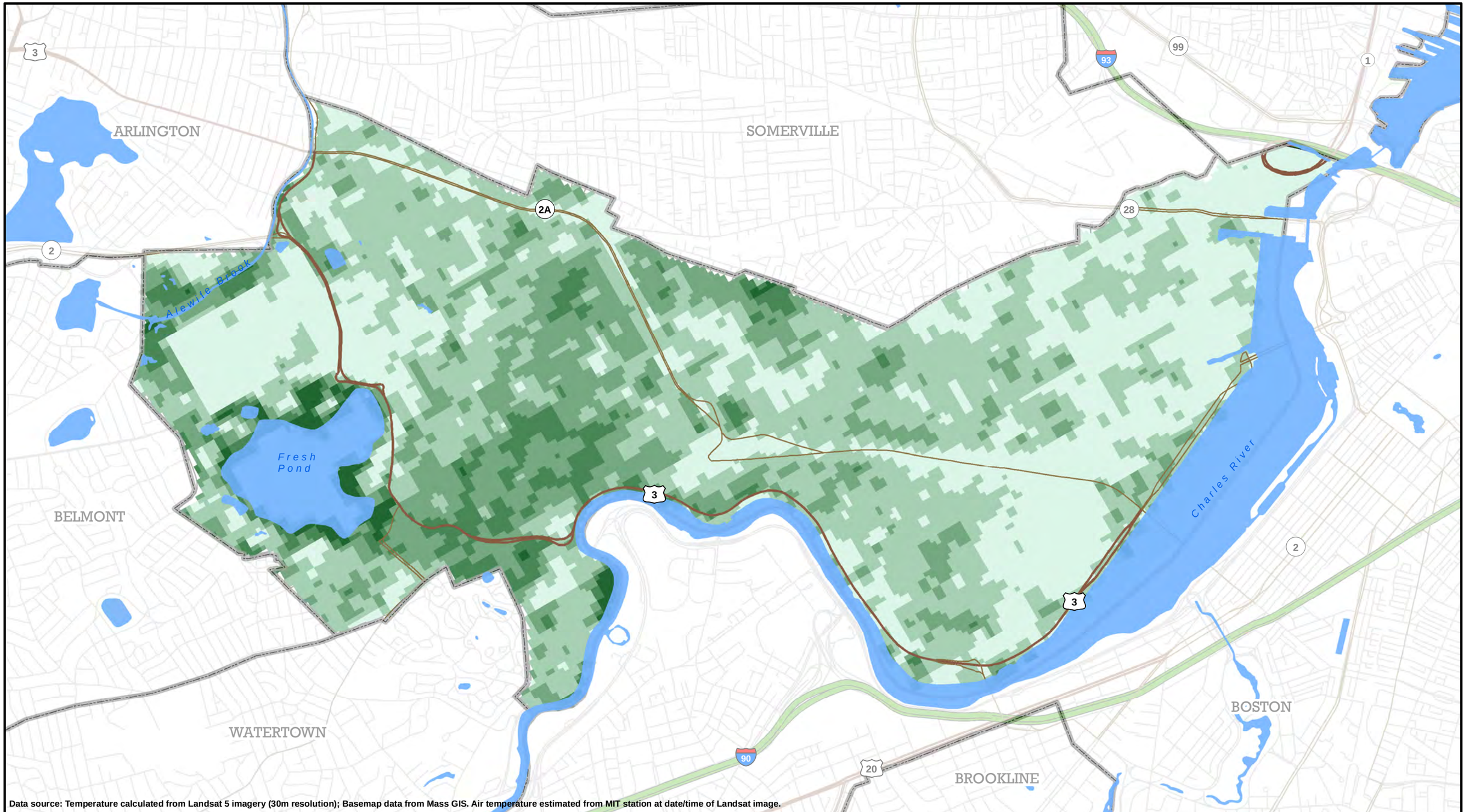
PROJECT NO.	20100259
DRAWN:	04/07/2015
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	CS.1-CriticalServices.mxd

CRITICAL SERVICES

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
CS.1



Data source: Temperature calculated from Landsat 5 imagery (30m resolution); Basemap data from Mass GIS. Air temperature estimated from MIT station at date/time of Landsat image.

LEGEND

Existing Tree Canopy (%)

- 0 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100

0 1,000 2,000

Feet

Locations are approximate

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KLEINFELDER
www.kleinfelder.com

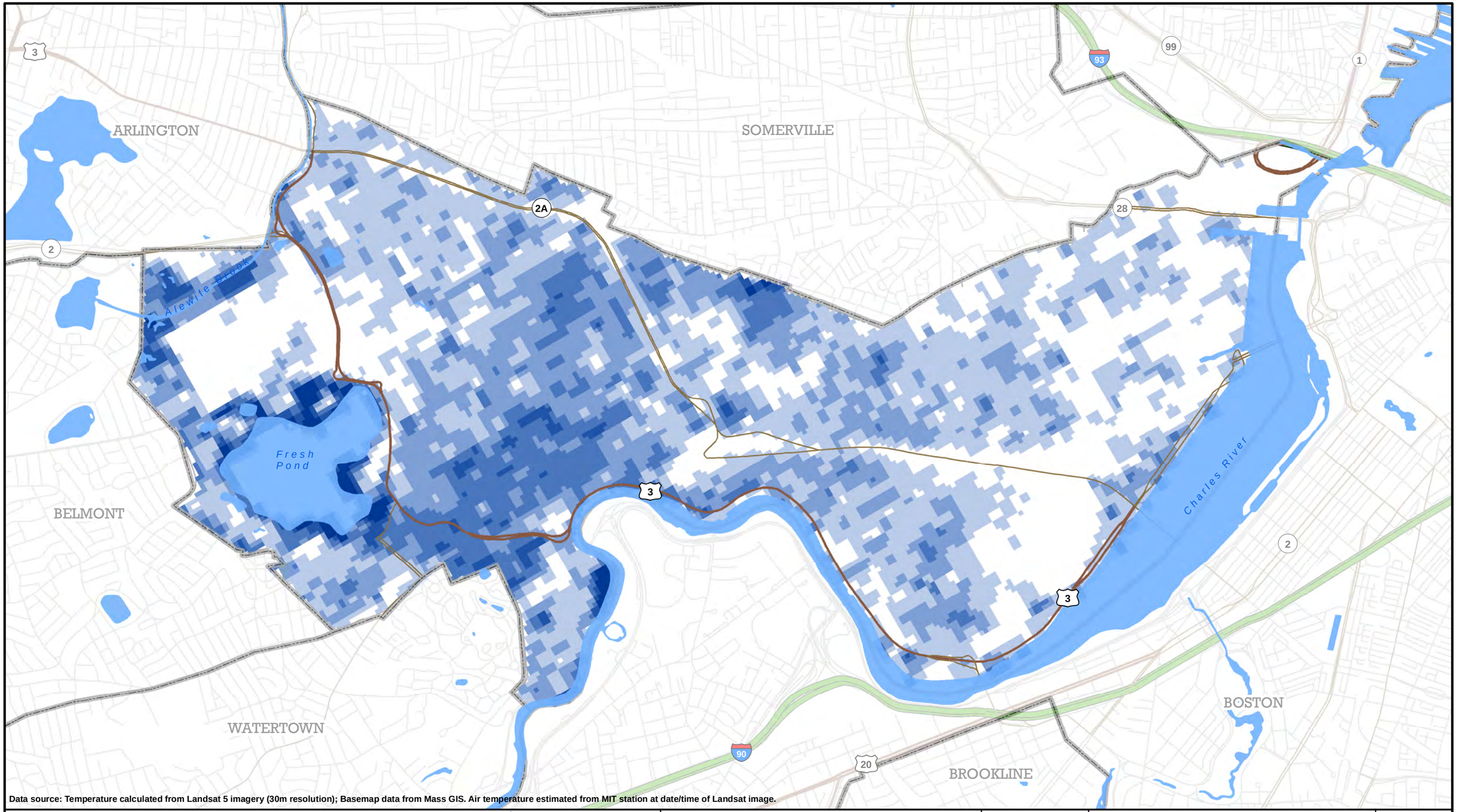
PROJECT NO.	20100259
DRAWN:	4/08/2015
DRAWN BY:	AW
CHECKED BY:	NB
FILE NAME:	PresentConditions_TreeCanopy_2015.mxd

PERCENTAGE OF TREE CANOPY IN CAMBRIDGE

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP

UF.1



Data source: Temperature calculated from Landsat 5 imagery (30m resolution); Basemap data from Mass GIS. Air temperature estimated from MIT station at date/time of Landsat image.

LEGEND

Estimated Cooling Impact of Tree Canopy (°F)

0 - 2	4 - 6	8 - 10
2 - 4	6 - 8	10 - 12

0 1,000 2,000

Feet

Locations are approximate

THIS MAP HAS BEEN PREPARED FOR THE CITY OF CAMBRIDGE CLIMATE CHANGE VULNERABILITY ASSESSMENT. IT IS BASED ON GIS DATA PROVIDED BY THE CITY (11/6/2012) AND FROM MASSGIS. USERS OF THIS MAP SHOULD CONSULT PRIMARY SOURCES FOR VERIFICATION OF THE INFORMATION CONTAINED ON THIS MAP. THE CITY OF CAMBRIDGE AND ITS MAPPING CONTRACTORS ASSUME NO LIABILITY FOR THE INFORMATION CONTAINED HEREIN.

KLEINFELDER

www.kleinfelder.com

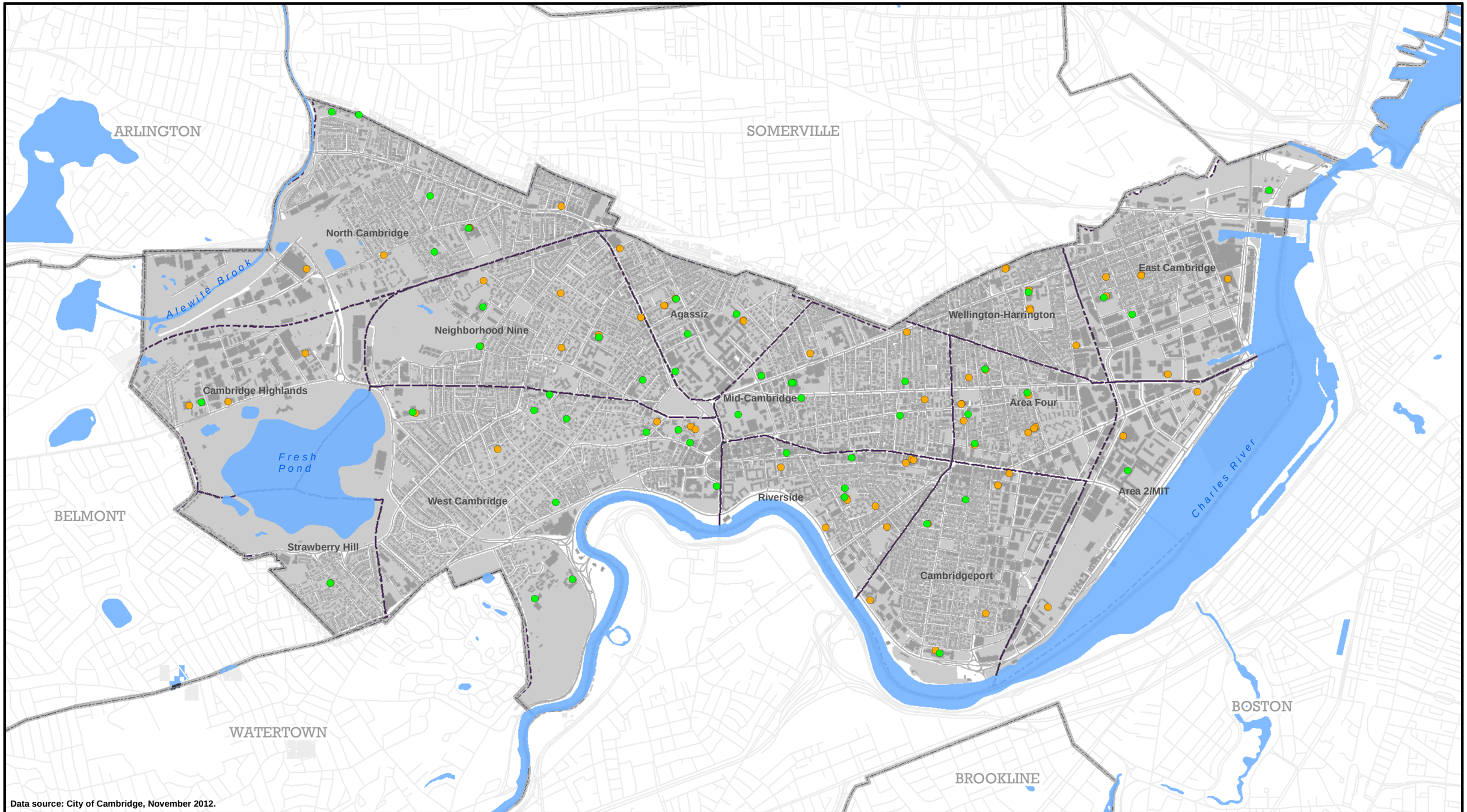
PROJECT NO.	20100259
DRAWN:	4/9/2015
DRAWN BY:	AW
CHECKED BY:	NB
FILE NAME:	PresentConditions_CoolingImpactTreeCanopy_2015.mxd

COOLING IMPACT OF TREES IN CAMBRIDGE

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP

UF.2



Data source: City of Cambridge, November 2012.

LEGEND

- School - K-12 Public or Private
- Daycare Facility
- Neighborhood Boundary

0 1,000 2,000
Feet
Locations are approximate

THIS MAP HAS BEEN PREPARED FOR THE CITY OF CAMBRIDGE CLIMATE CHANGE VULNERABILITY ASSESSMENT. IT IS BASED ON GIS DATA PROVIDED BY THE CITY (11/6/2012) AND FROM MASSGIS. USERS OF THIS MAP SHOULD CONSULT PRIMARY SOURCES FOR VERIFICATION OF THE INFORMATION CONTAINED ON THIS MAP. THE CITY OF CAMBRIDGE AND ITS MAPPING CONTRACTORS ASSUME NO LIABILITY FOR THE INFORMATION CONTAINED HEREIN.

KLEINFELDER
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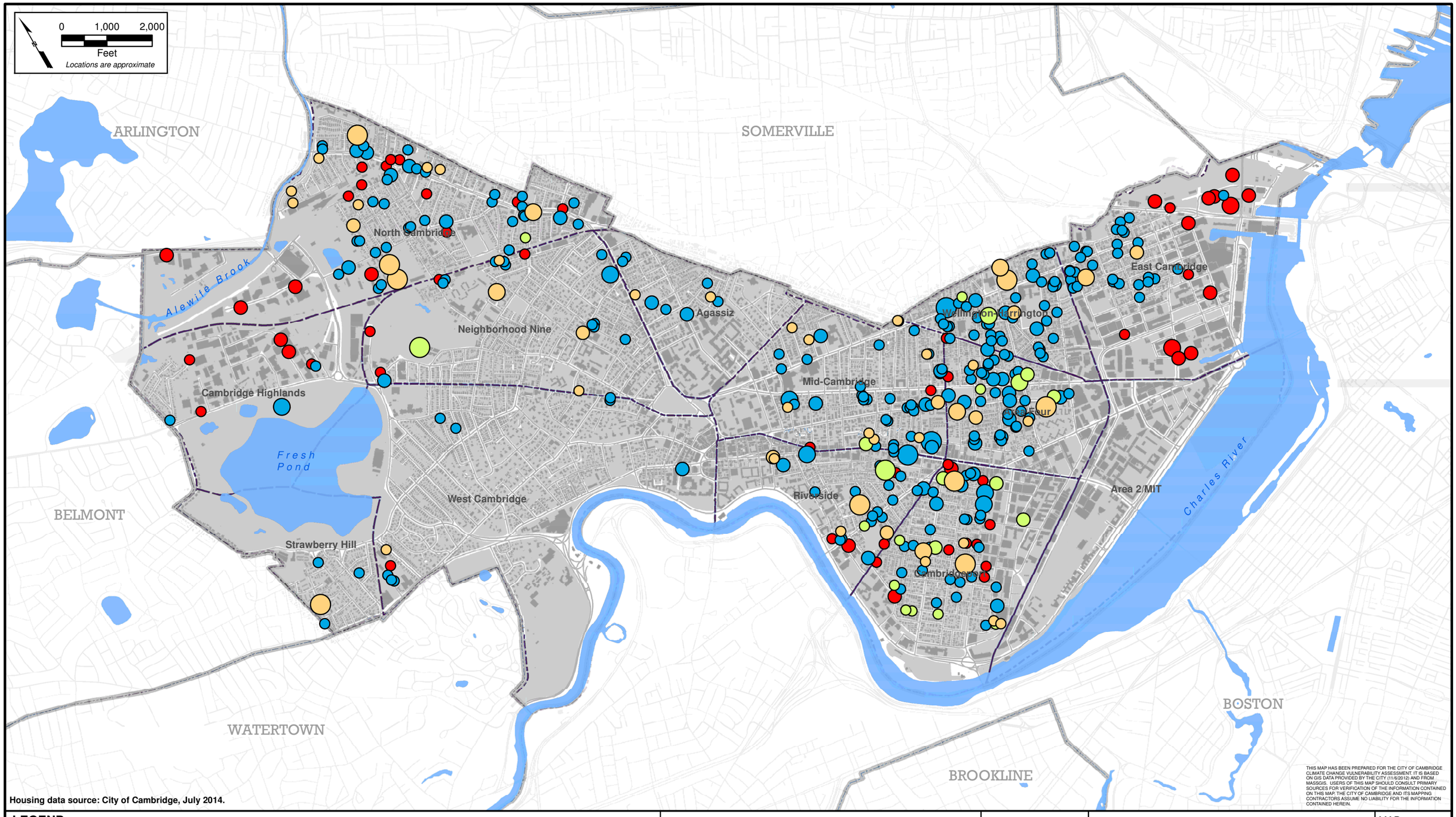
PROJECT NO.	20100259
DRAWN:	04/07/2015
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	CR.1-Schools.mxd

K-12 SCHOOLS AND DAY CARE FACILITIES

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
CR.1



Housing data source: City of Cambridge, July 2014.

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LEGEND

Public Housing	Private	Non-profit/Scattered site H/O	Inclusionary
Less than 10 units	Less than 10 units	Less than 10 units	Less than 10 units
10 to 49 units	10 to 49 units	10 to 49 units	10 to 49 units
50 to 99 units	50 to 99 units	50 to 99 units	50 to 99 units
More than 100 units	More than 100 units	More than 100 units	More than 100 units

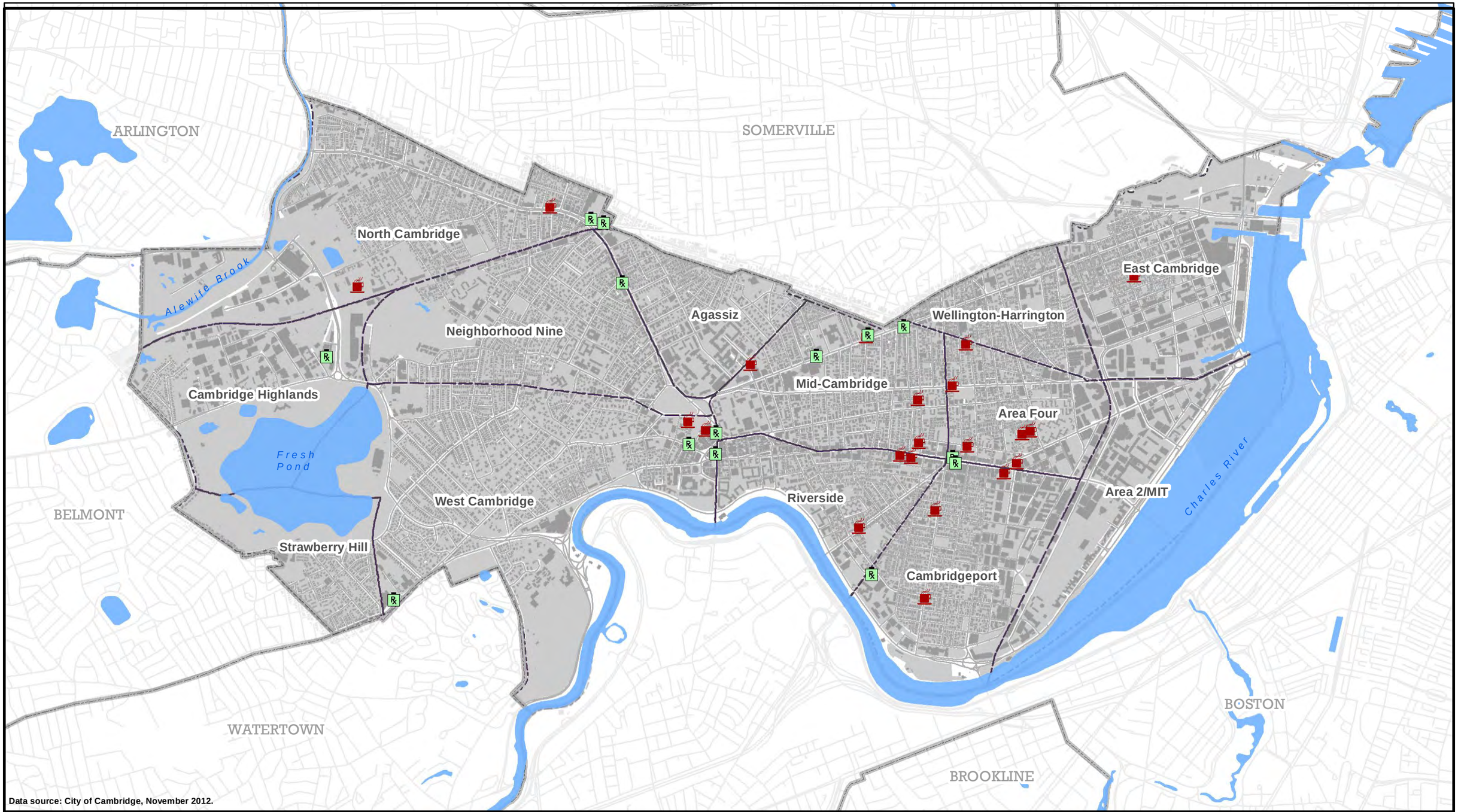
KLEINFELDER
www.kleinfelder.com

PROJECT NO.	20100259
DRAWN:	8/21/2014
DRAWN BY:	VK
CHECKED BY:	NB
FILE NAME:	CR.2-Housing082114.mxd

AFFORDABLE HOUSING

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
CR.2



Data source: City of Cambridge, November 2012.

LEGEND

- Community Food Program
- Neighborhood Boundary
- Pharmacy

0 1,000 2,000
Feet
Locations are approximate

THIS MAP HAS BEEN PREPARED FOR THE CITY OF CAMBRIDGE CLIMATE CHANGE VULNERABILITY ASSESSMENT. IT IS BASED ON GIS DATA PROVIDED BY THE CITY (11/6/2012) AND FROM MASSGIS. USERS OF THIS MAP SHOULD CONSULT PRIMARY SOURCES FOR VERIFICATION OF THE INFORMATION CONTAINED ON THIS MAP. THE CITY OF CAMBRIDGE AND ITS MAPPING CONTRACTORS ASSUME NO LIABILITY FOR THE INFORMATION CONTAINED HEREIN.

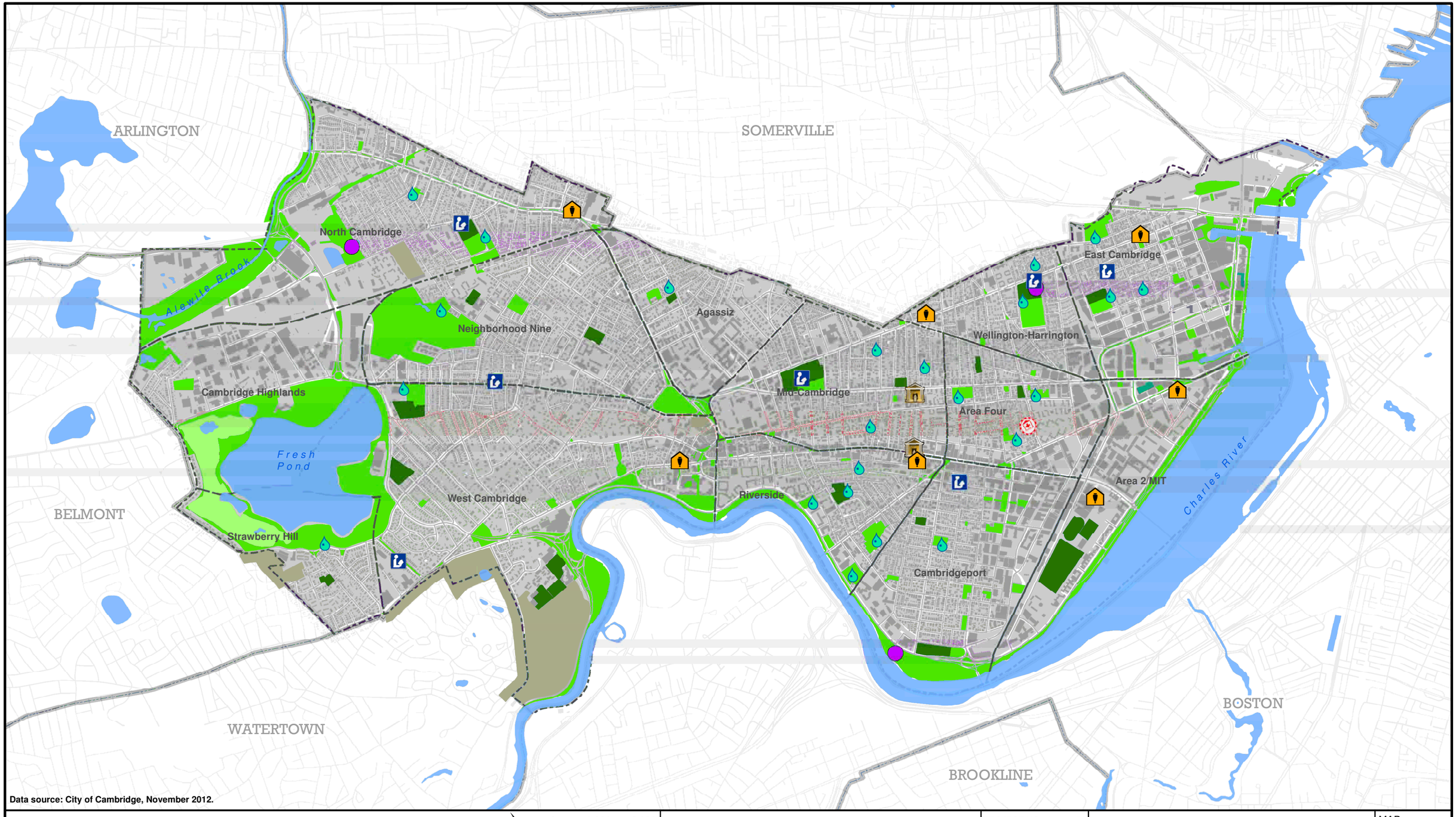
KLEINFELDER
www.kleinfelder.com

PROJECT NO.	20100259
DRAWN:	14/15/2014
DRAWN BY:	VK
CHECKED BY:	NB
FILE NAME:	CR.3-FoodPharma.mxd

FOOD AND PHARMACIES

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
CR.3



Data source: City of Cambridge, November 2012.

LEGEND

- City Hall; City Hall Annex
- Public Libraries
- Post Offices
- Public Health Dept.
- Waterplay Areas
- Public Pools
- Neighborhood Boundary
- Park
- Rooftop Park
- Golf Course
- Athletic Field
- Cemetery

0 1,000 2,000
Feet
Locations are approximate

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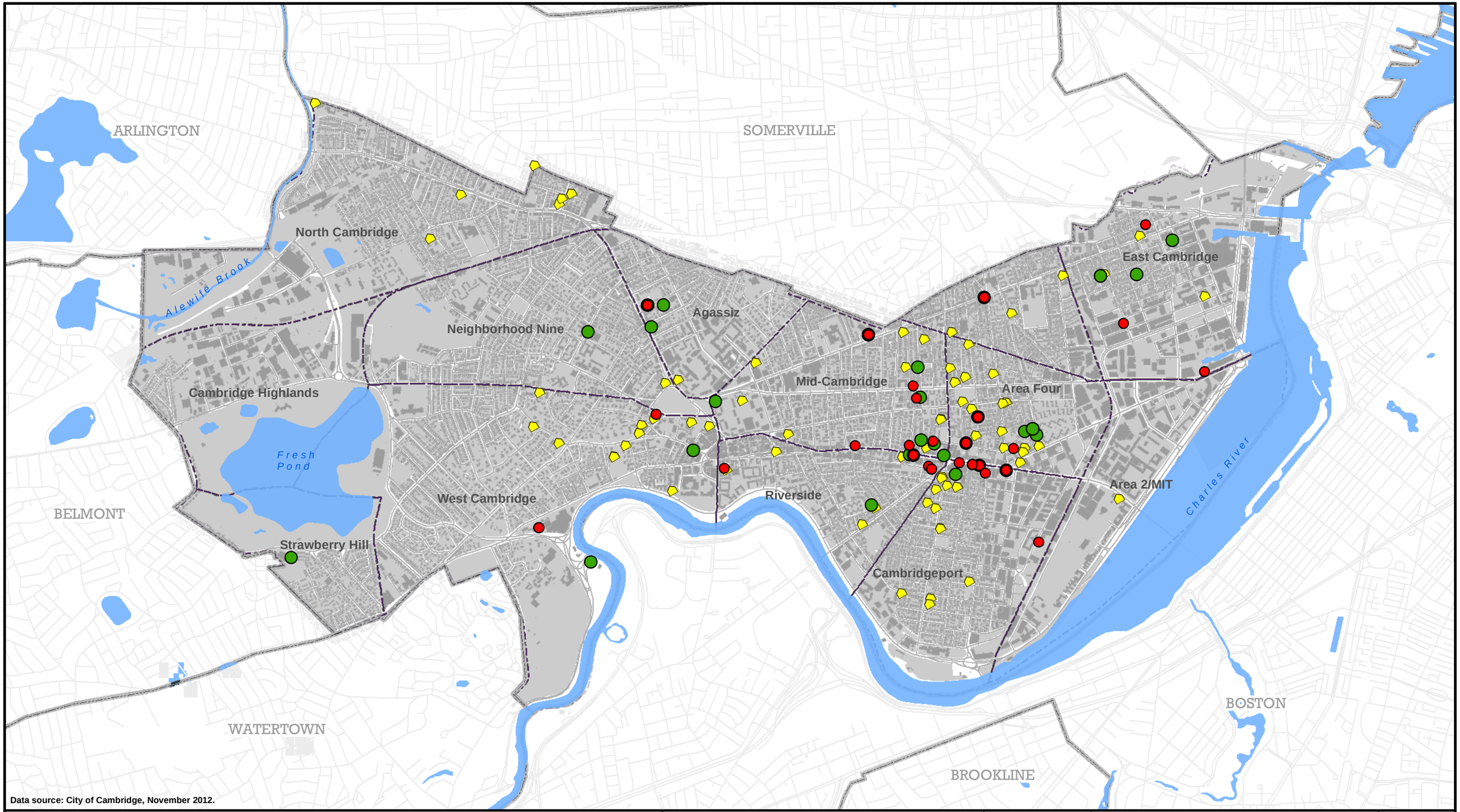
KLEINFELDER
www.kleinfelder.com

PROJECT NO.	20100259
DRAWN:	4/28/2014
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	CR.4-MuniResources.mxd

MUNICIPAL RESOURCES

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
CR.4



Data source: City of Cambridge, November 2012.

LEGEND

- Community-based service
- Vulnerable population support
- Faith-Based Organizations
- Neighborhood Boundary

0 1,000 2,000
Feet
Locations are approximate

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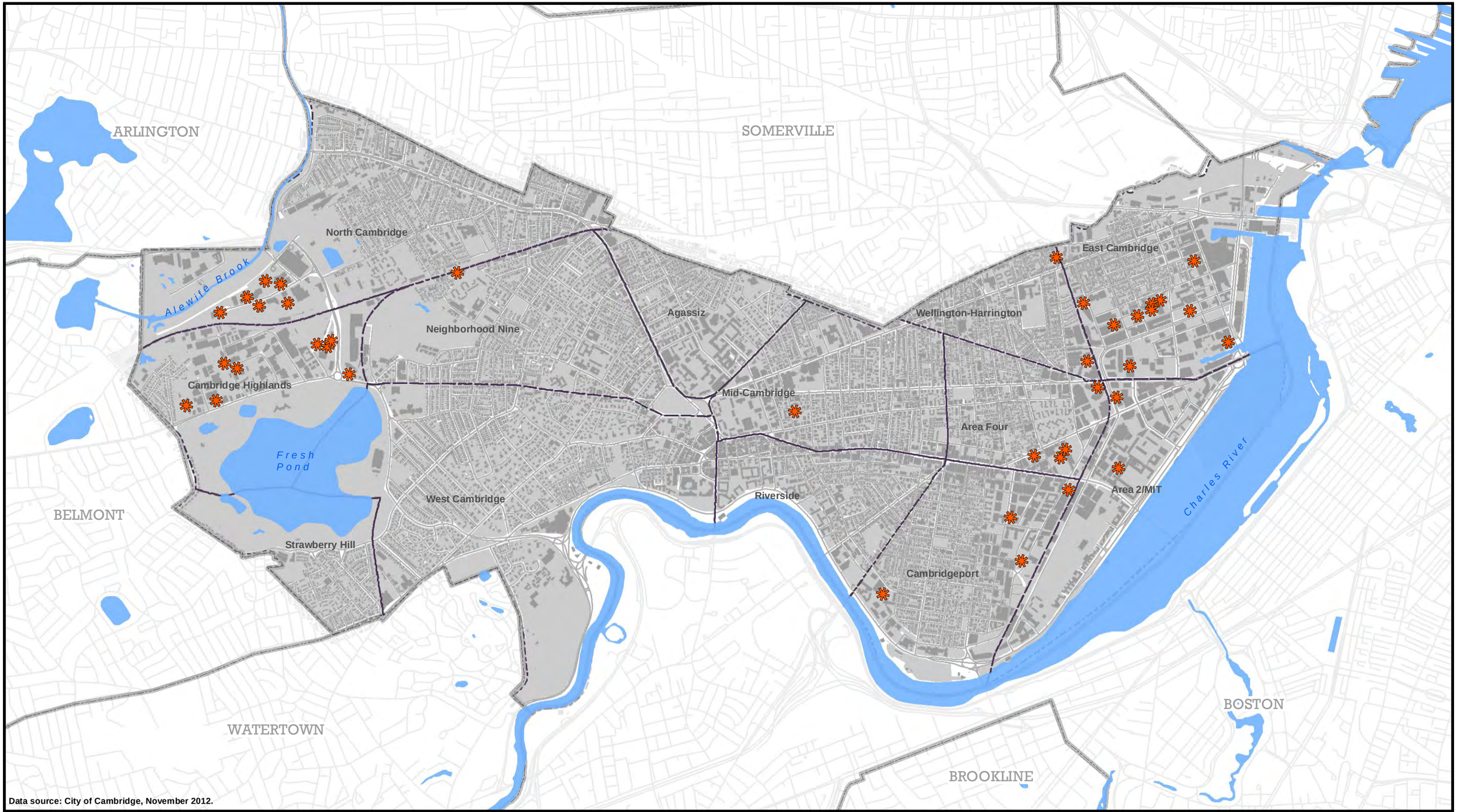
KLEINFELDER
www.kleinfelder.com

PROJECT NO.	20100259
DRAWN:	04/07/2015
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	CR.5-CommResources.mxd

COMMUNITY RESOURCES

Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP
CR.5



Data source: City of Cambridge, November 2012.

LEGEND

Hazardous Materials Site

Neighborhood Boundary

0 1,000 2,000

Feet

Locations are approximate

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KLEINFELDER

www.kleinfelder.com

PROJECT NO.	20100259
DRAWN:	04/07/2015
DRAWN BY:	KFH
CHECKED BY:	NB
FILE NAME:	CR.6-HazMat.mxd

HAZARDOUS MATERIALS SITES

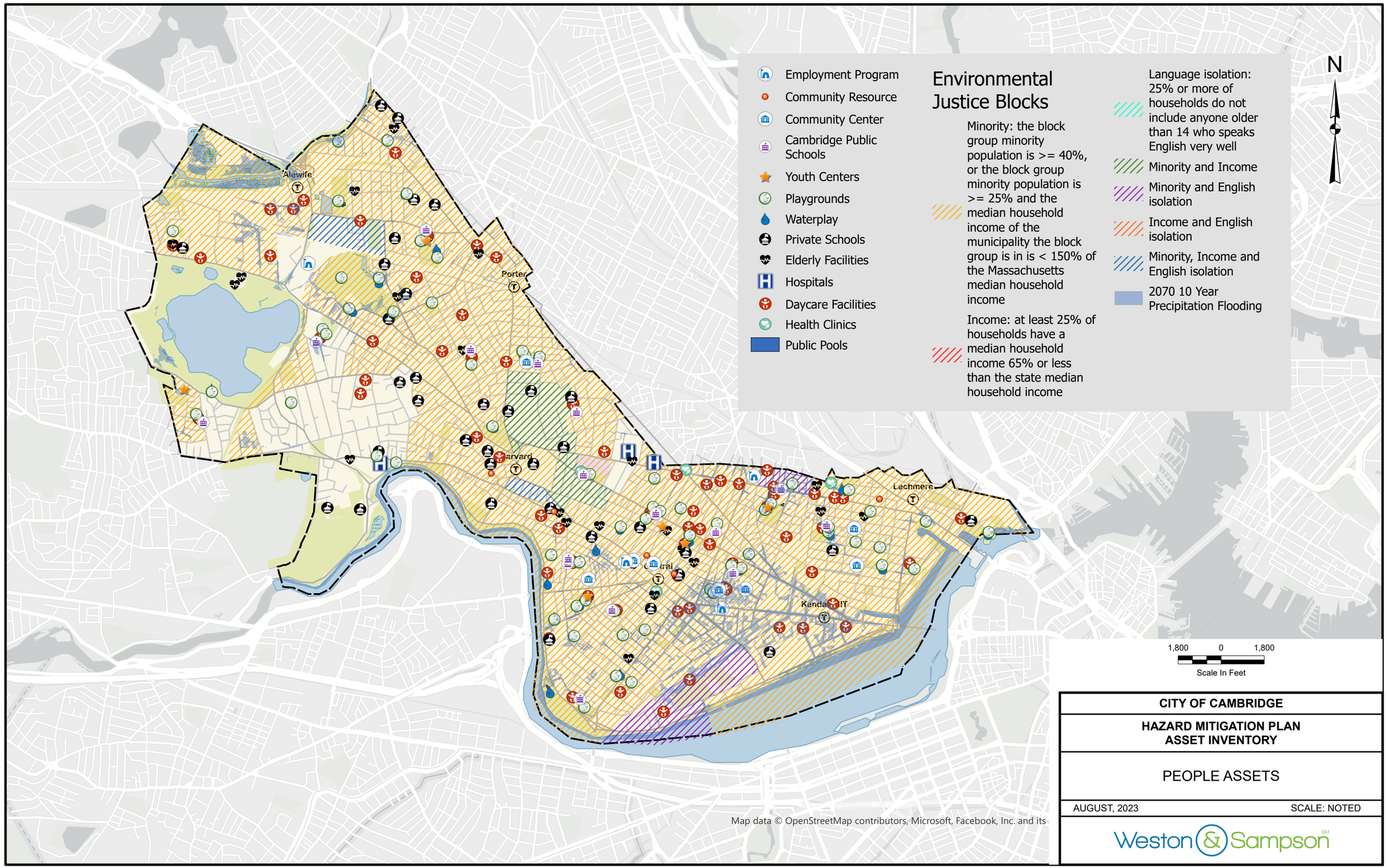
Climate Change Vulnerability Assessment
Cambridge, Massachusetts

MAP

CR.6

Appendix F

Vulnerability Maps



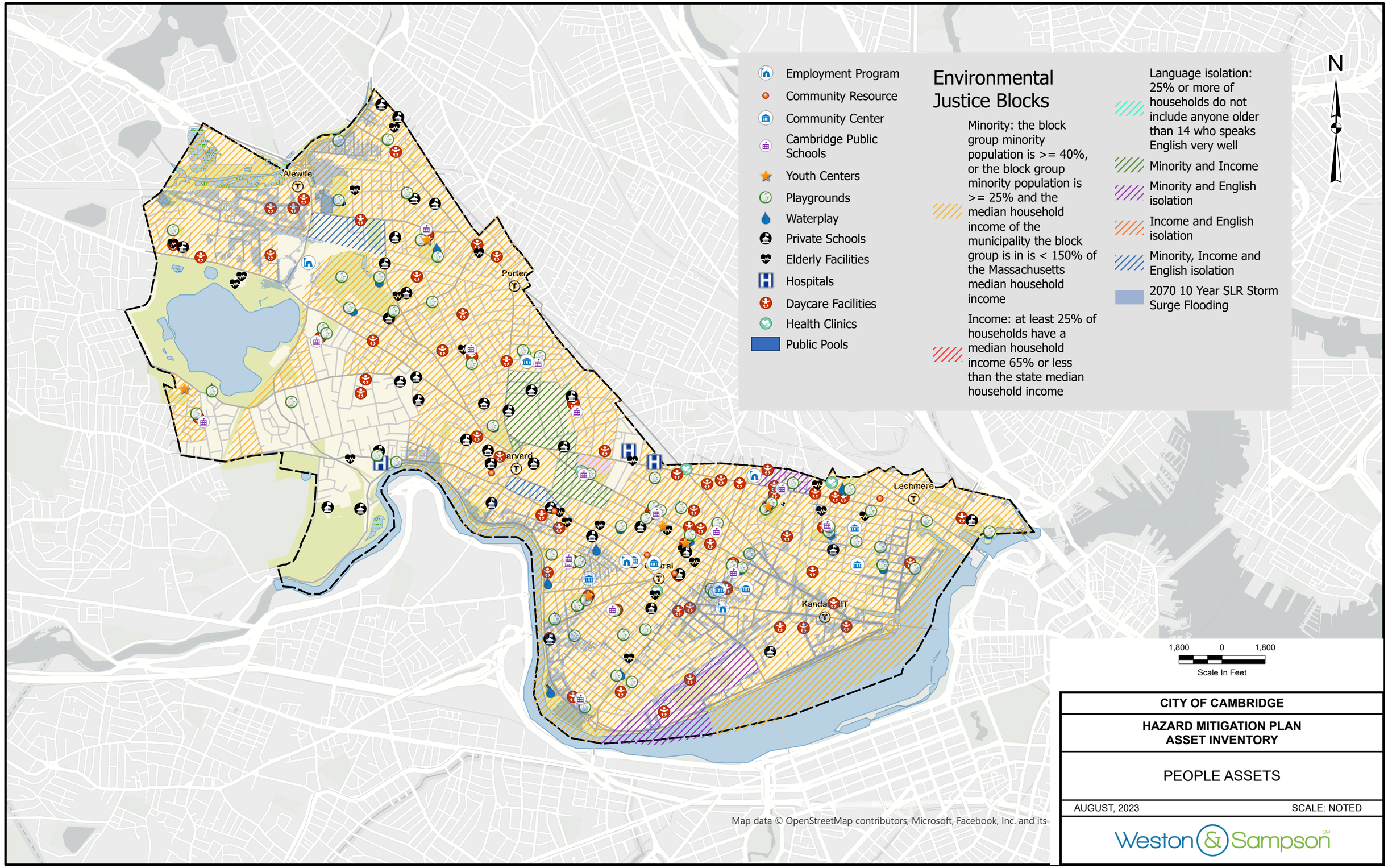
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

PEOPLE ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson℠



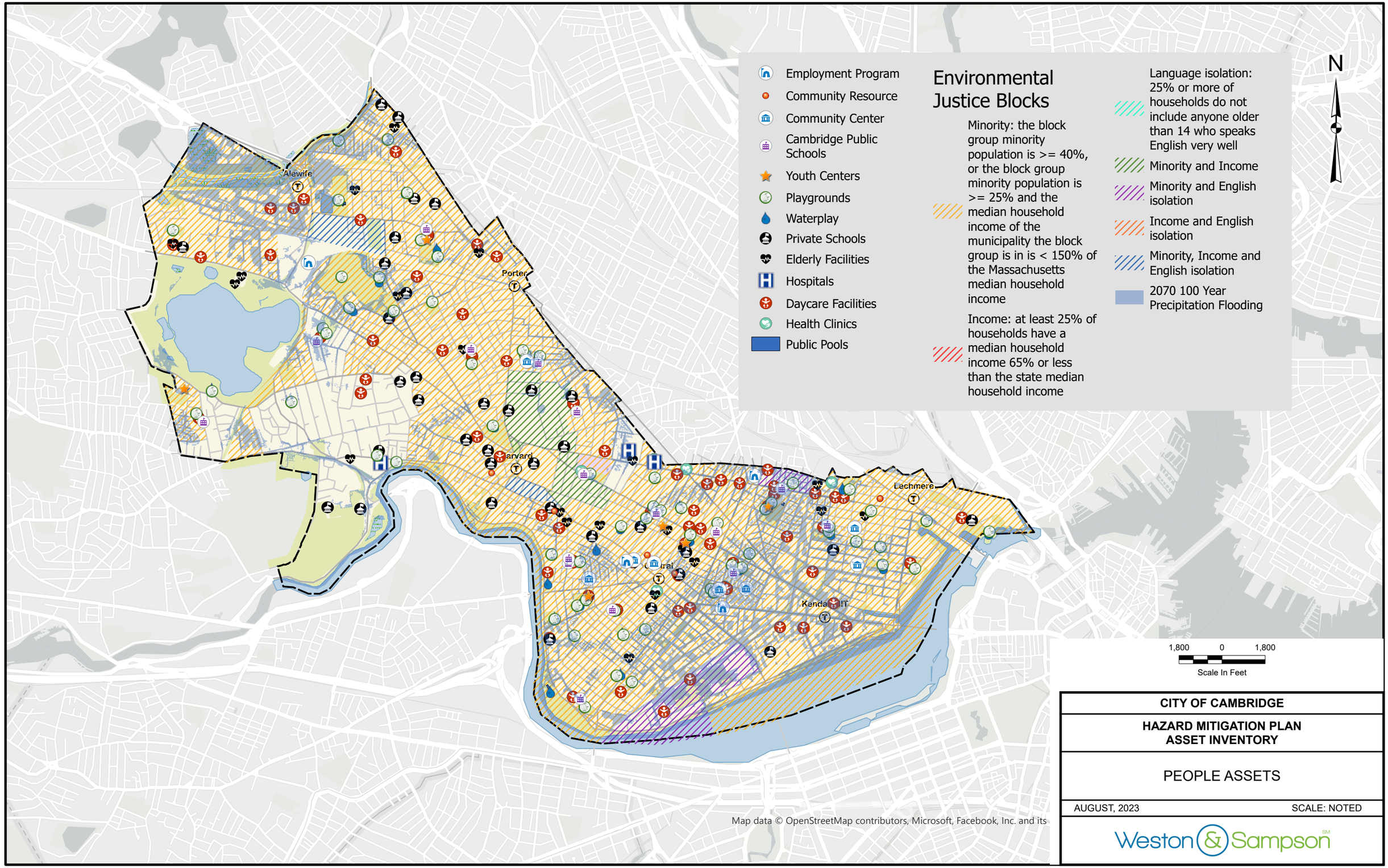
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

PEOPLE ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson℠



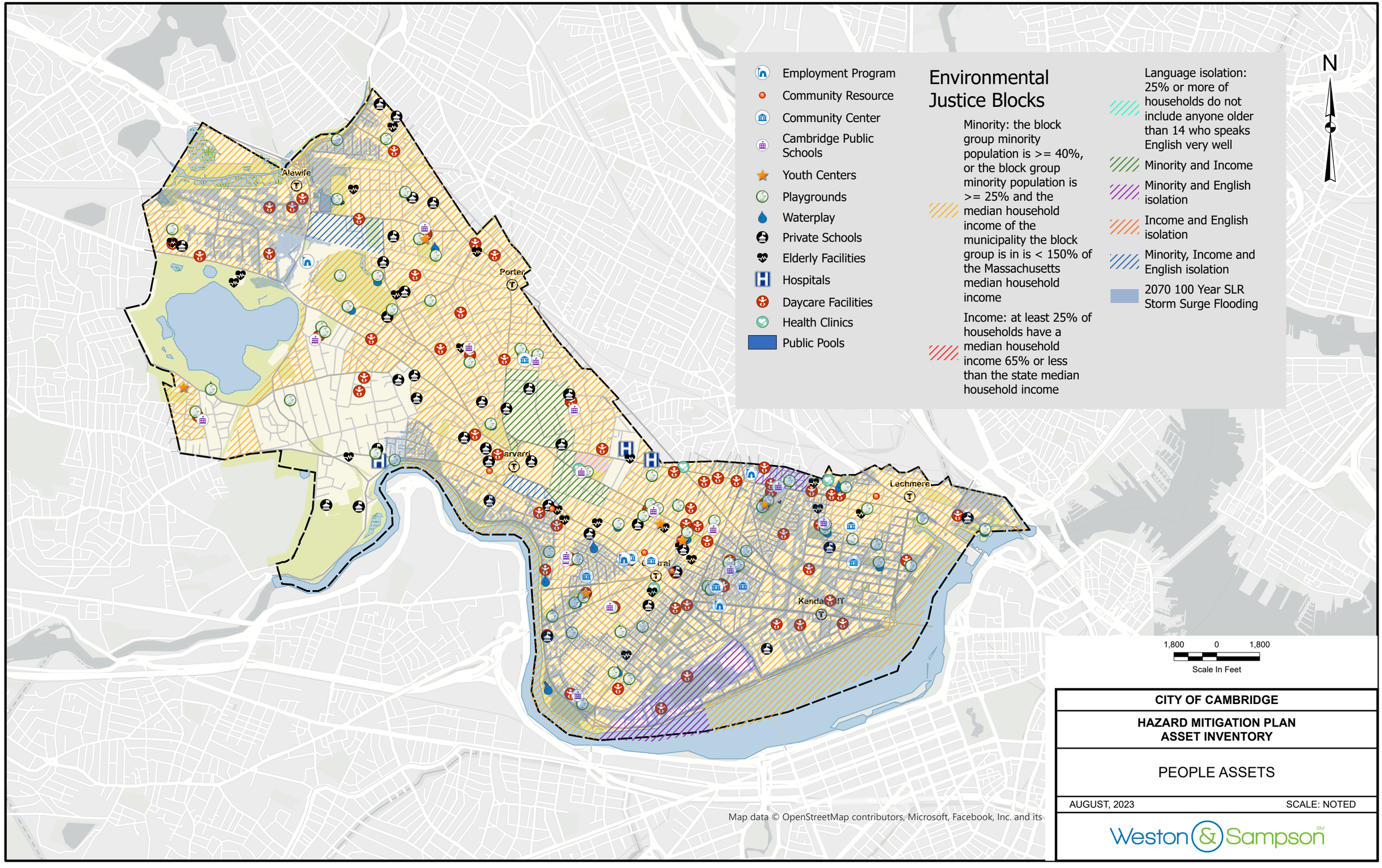
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

PEOPLE ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



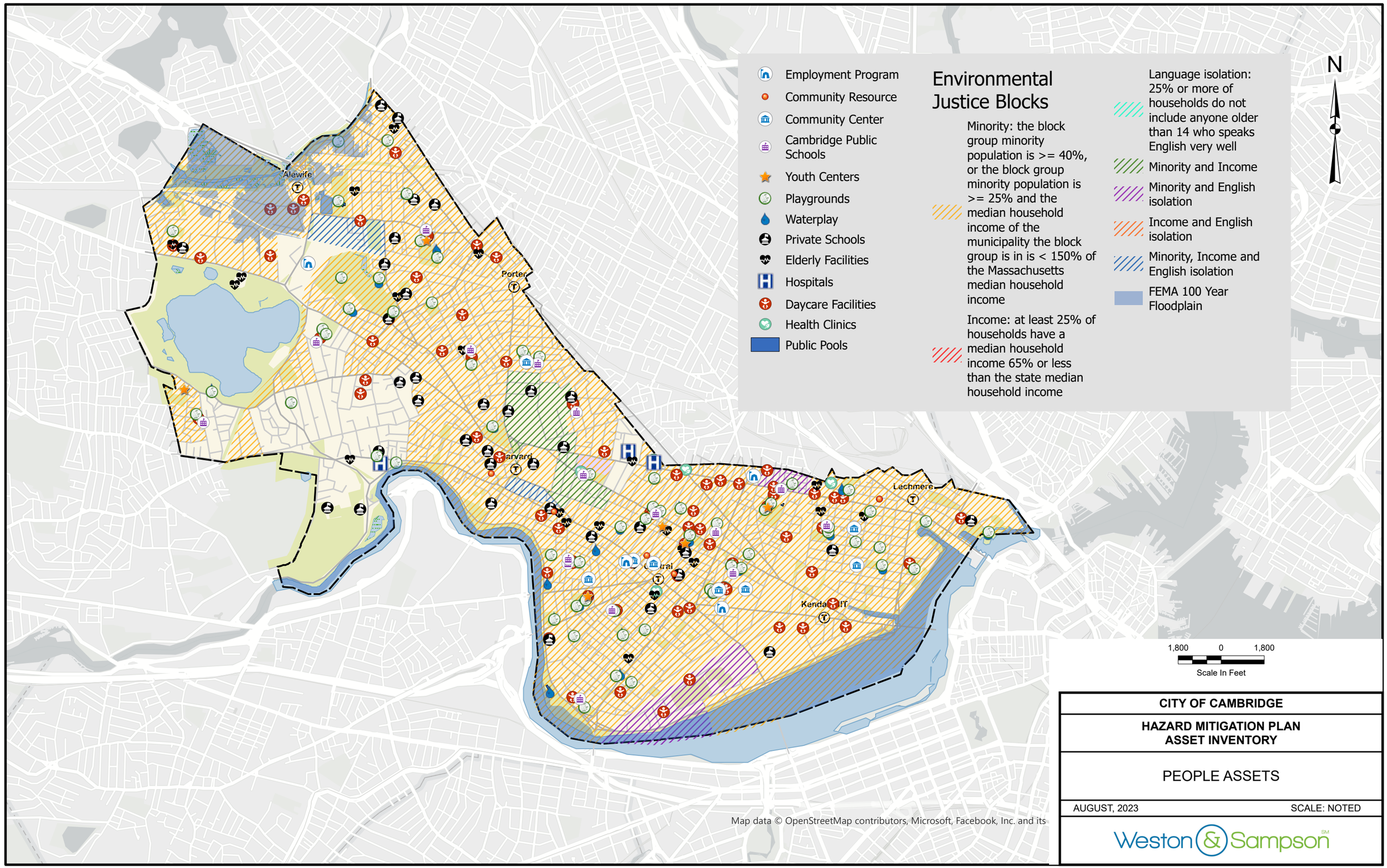
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

PEOPLE ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



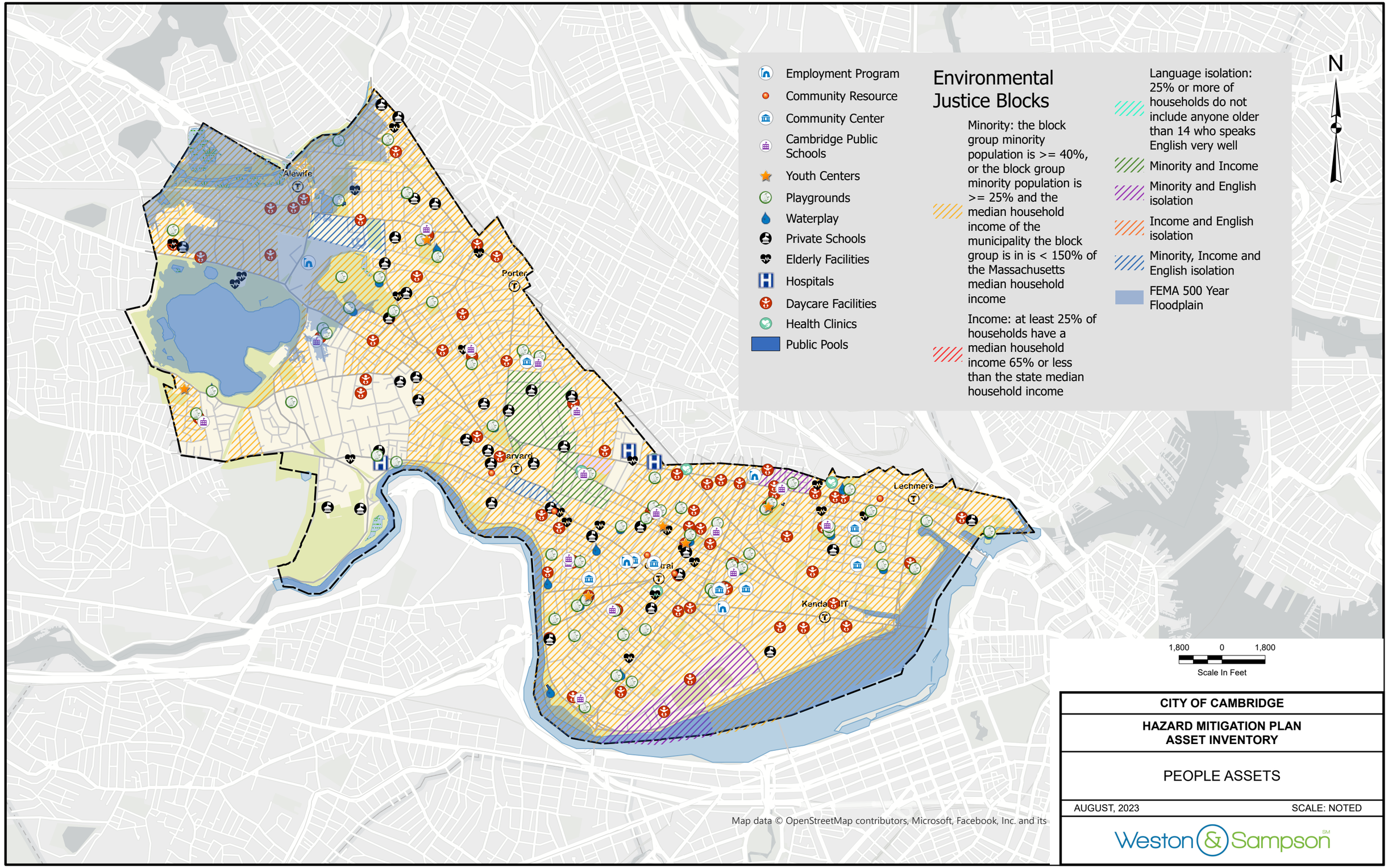
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

PEOPLE ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson℠



CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

PEOPLE ASSETS

AUGUST, 2023 SCALE: NOTED

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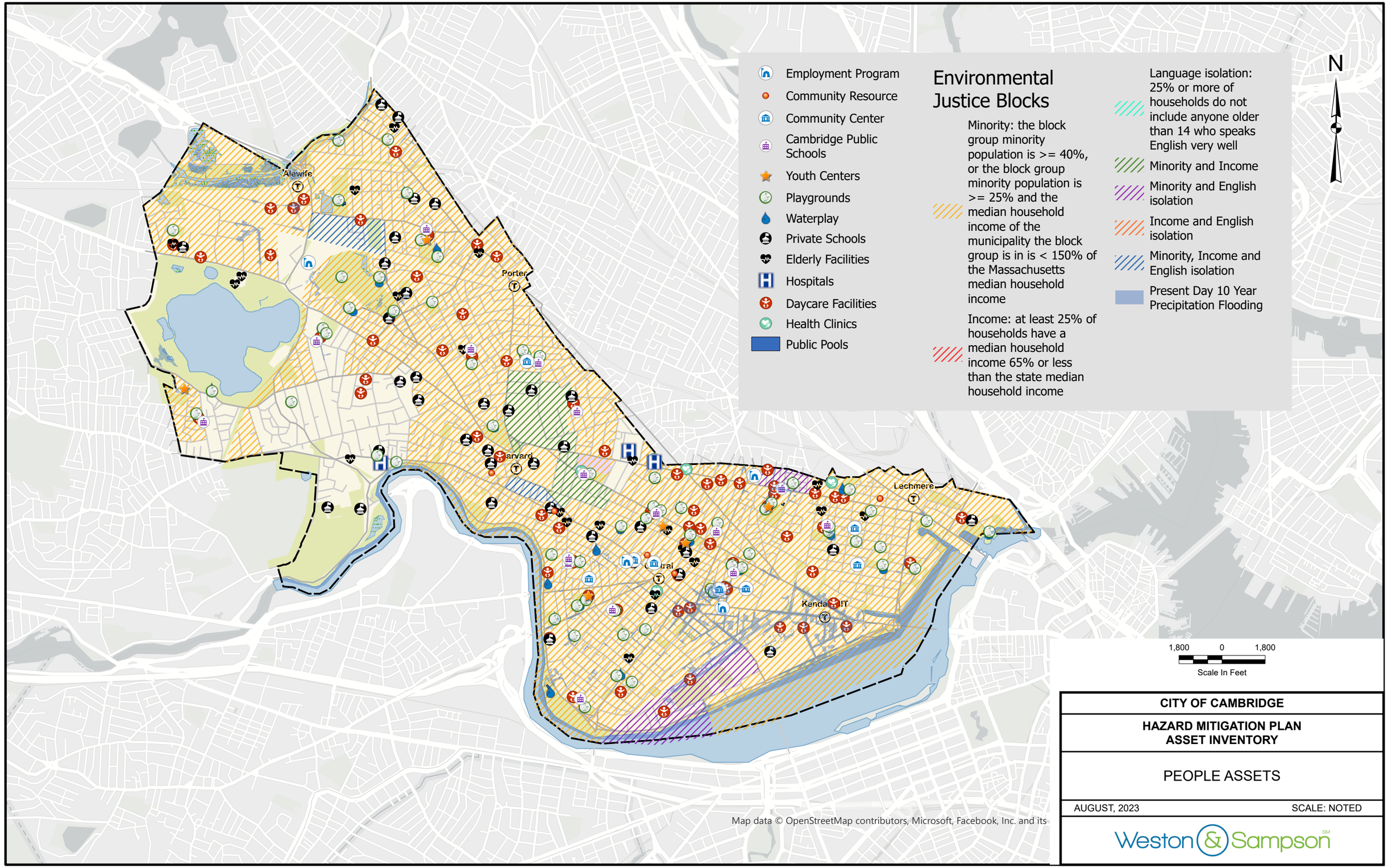

CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

PEOPLE ASSETS

AUGUST, 2023 SCALE: NOTED

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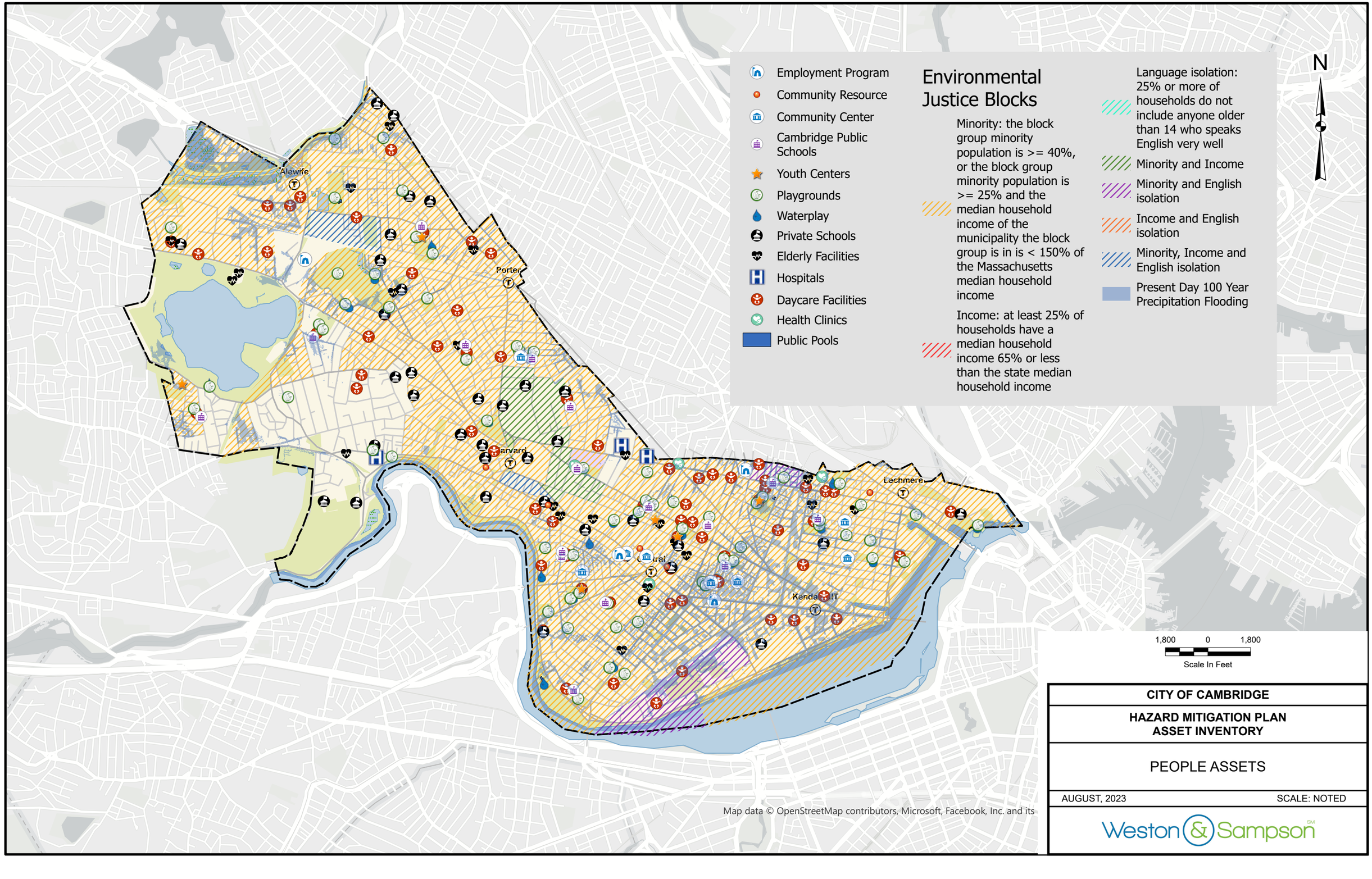

CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

PEOPLE ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson℠

N

Alewife

Porter

Harvard

Central

Kendall/MIT

Lechmere

- Emergency Shelters
- Municipal Parking Lots
- Fire Stations
- Snow Emergency Parking
- Public Libraries
- Post Offices
- Police Stations
- Municipal Buildings
- 2070 10 Year Precipitation Flooding

1,800 0 1,800

Scale In Feet

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CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

STRUCTURES ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson

N

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AUGUST, 2023 SCALE: NOTED

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STRUCTURES ASSETS

AUGUST, 2023 SCALE: NOTED

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CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

STRUCTURES ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson

N

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1,800 0 1,800

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CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

STRUCTURES ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson

N

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Kendall/MIT

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- Police Stations
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- FEMA 500 Year Floodplain

1,800 0 1,800

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CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

STRUCTURES ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson

N

Alewife

Porter

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Kendall/MIT

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1,800 0 1,800

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CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

STRUCTURES ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson

N

Alewife

Porter

Harvard

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Kendall/MIT

Lechmere

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1,800 0 1,800

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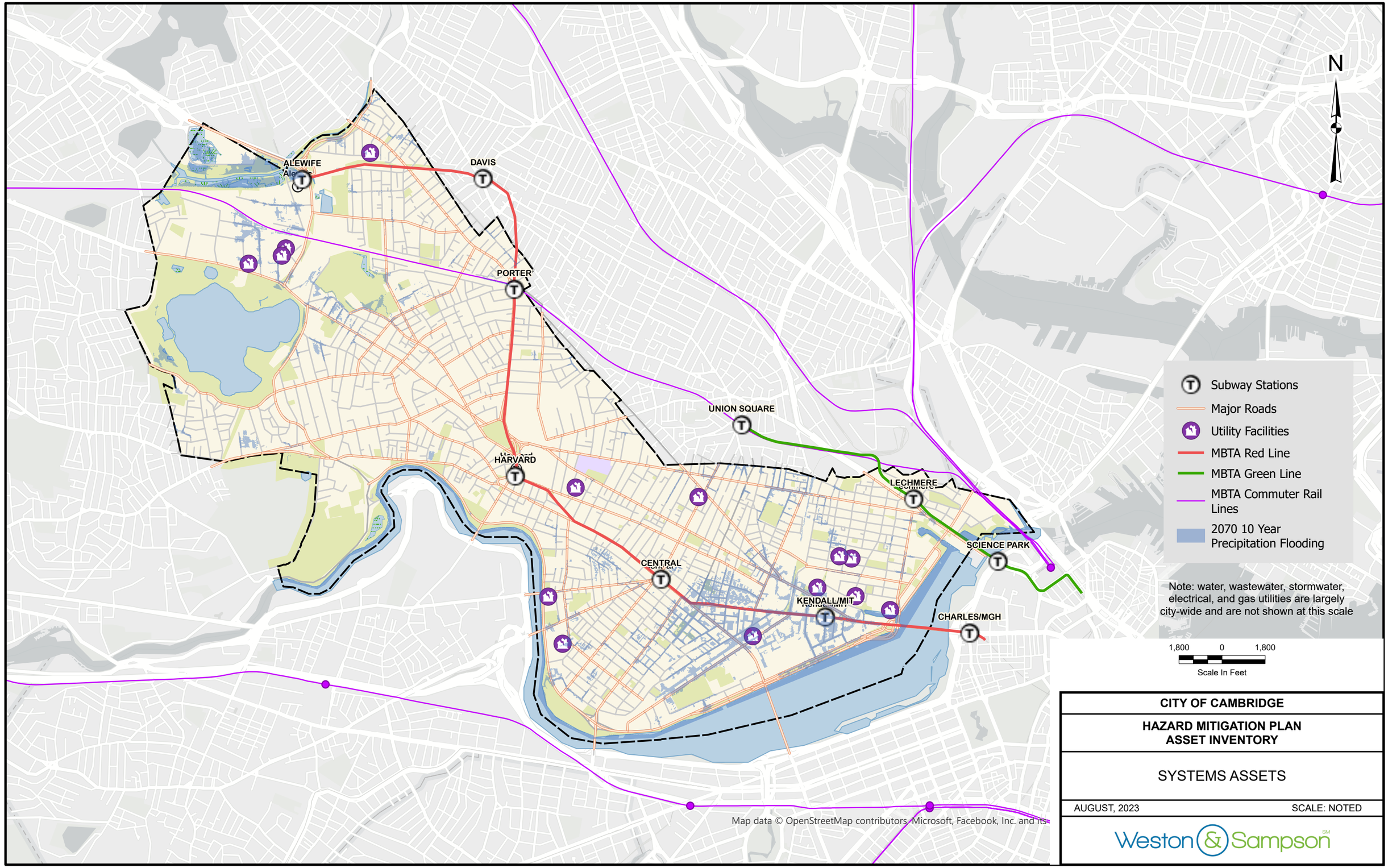
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

STRUCTURES ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

SYSTEMS ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson

ALEWIFE

DAVIS

PORTER

HARVARD

CENTRAL

UNION SQUARE

LECHMERE

SCIENCE PARK

KENDALL/MIT

CHARLES/MGH

N

- Subway Stations
- Major Roads
- Utility Facilities
- MBTA Red Line
- MBTA Green Line
- MBTA Commuter Rail Lines
- 2070 10 Year SLR Storm Surge Flooding

Note: water, wastewater, stormwater, electrical, and gas utilities are largely city-wide and are not shown at this scale

1,800 0 1,800

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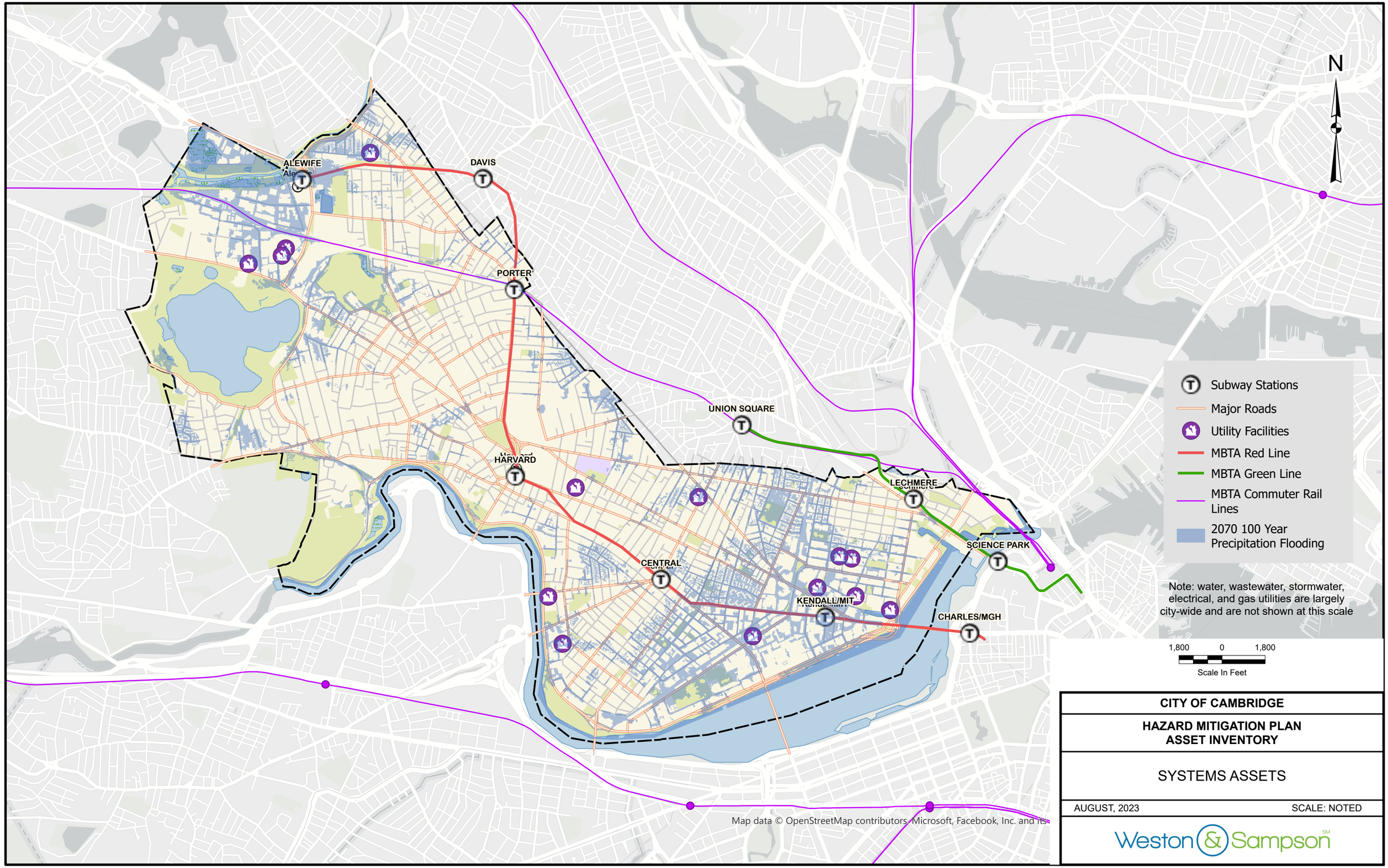
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN ASSET INVENTORY

SYSTEMS ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



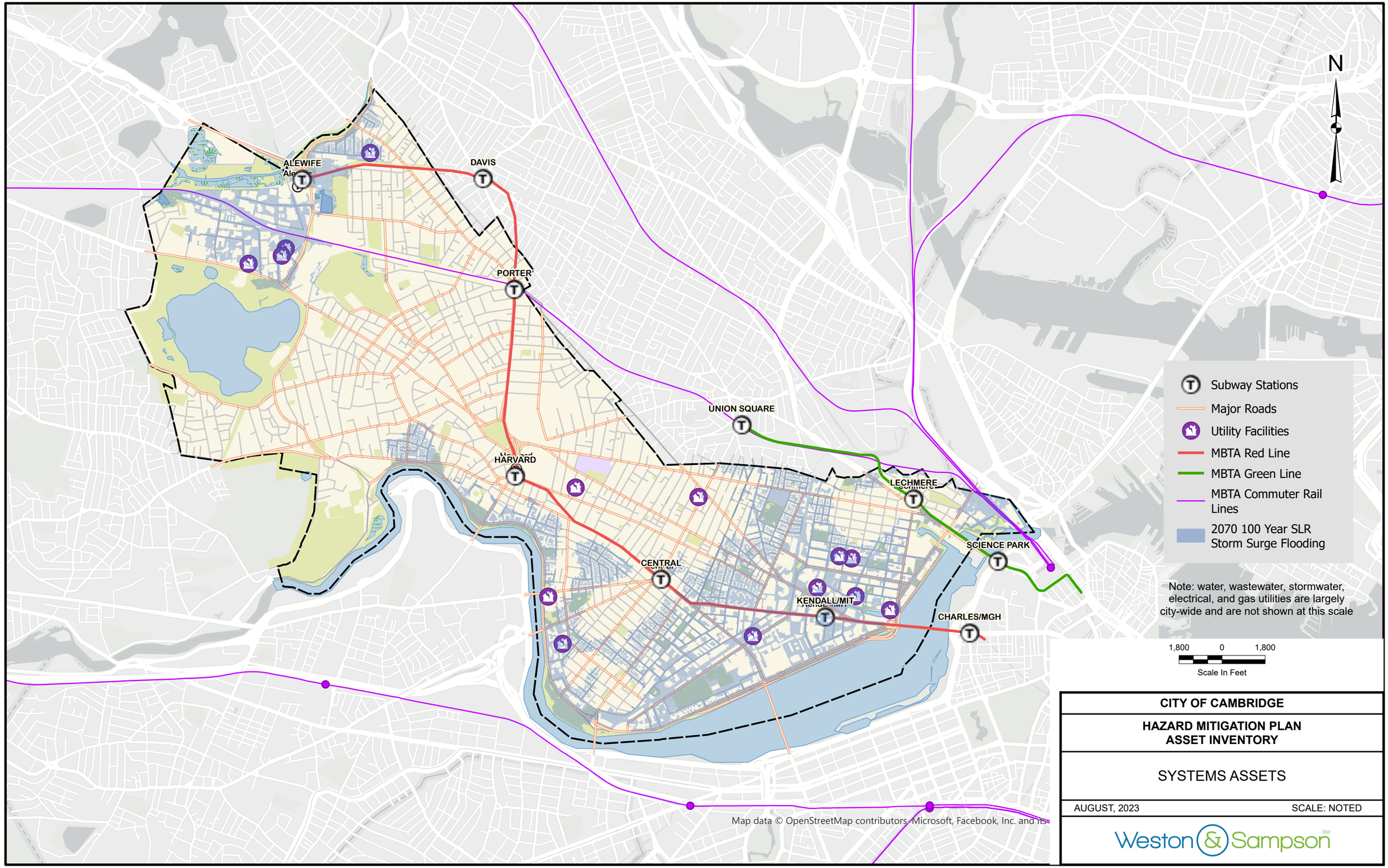
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

SYSTEMS ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



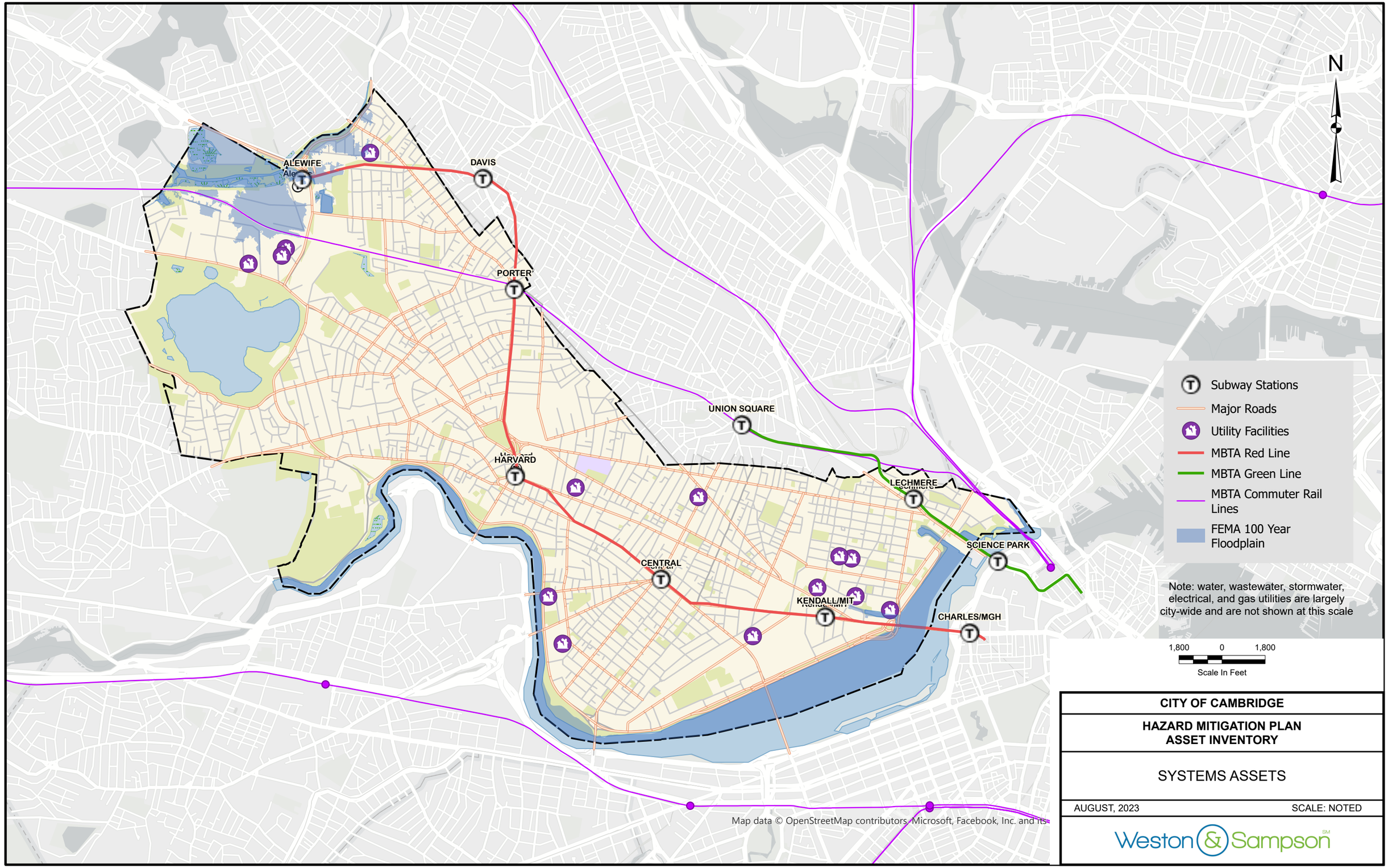
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

SYSTEMS ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



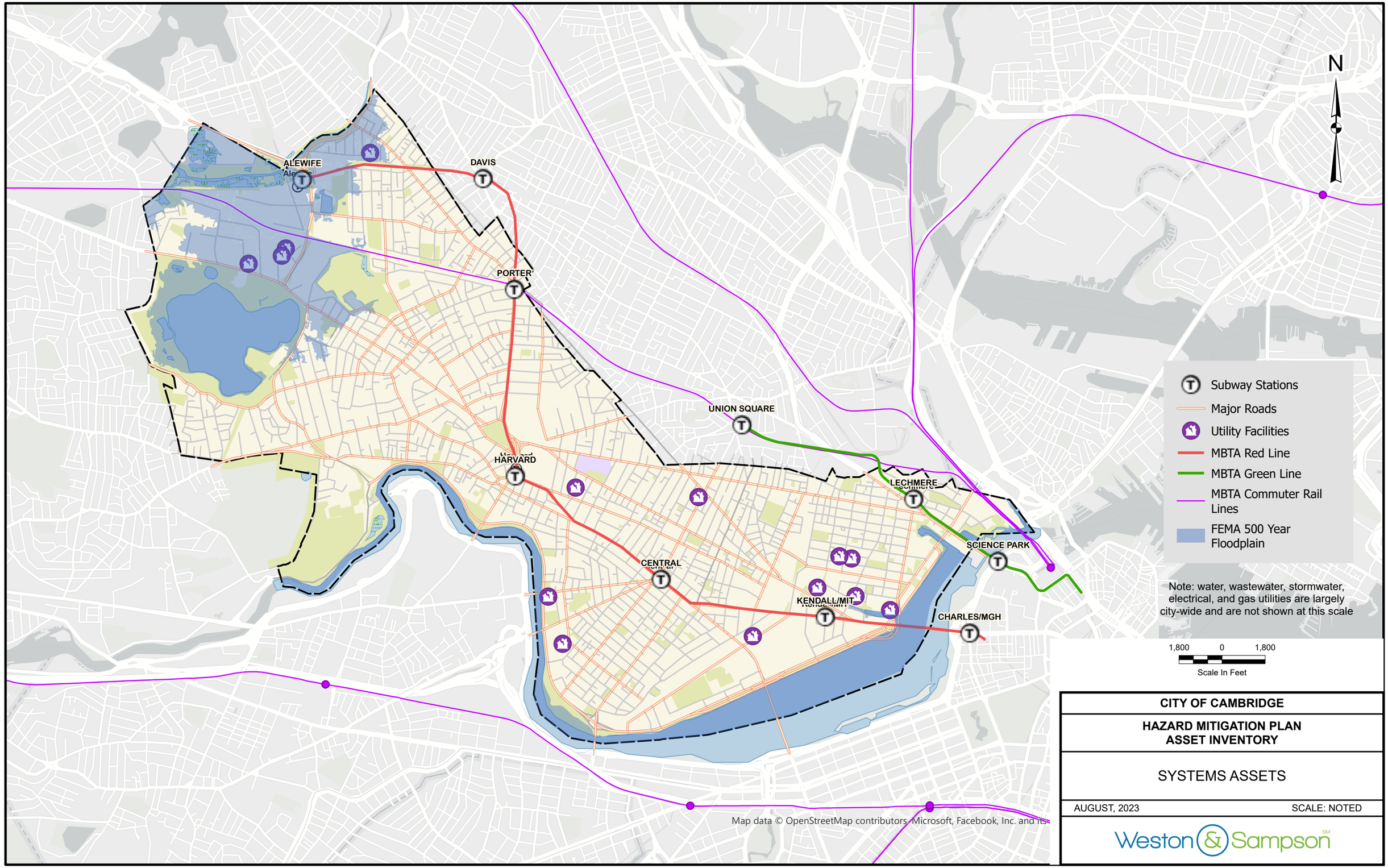
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

SYSTEMS ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



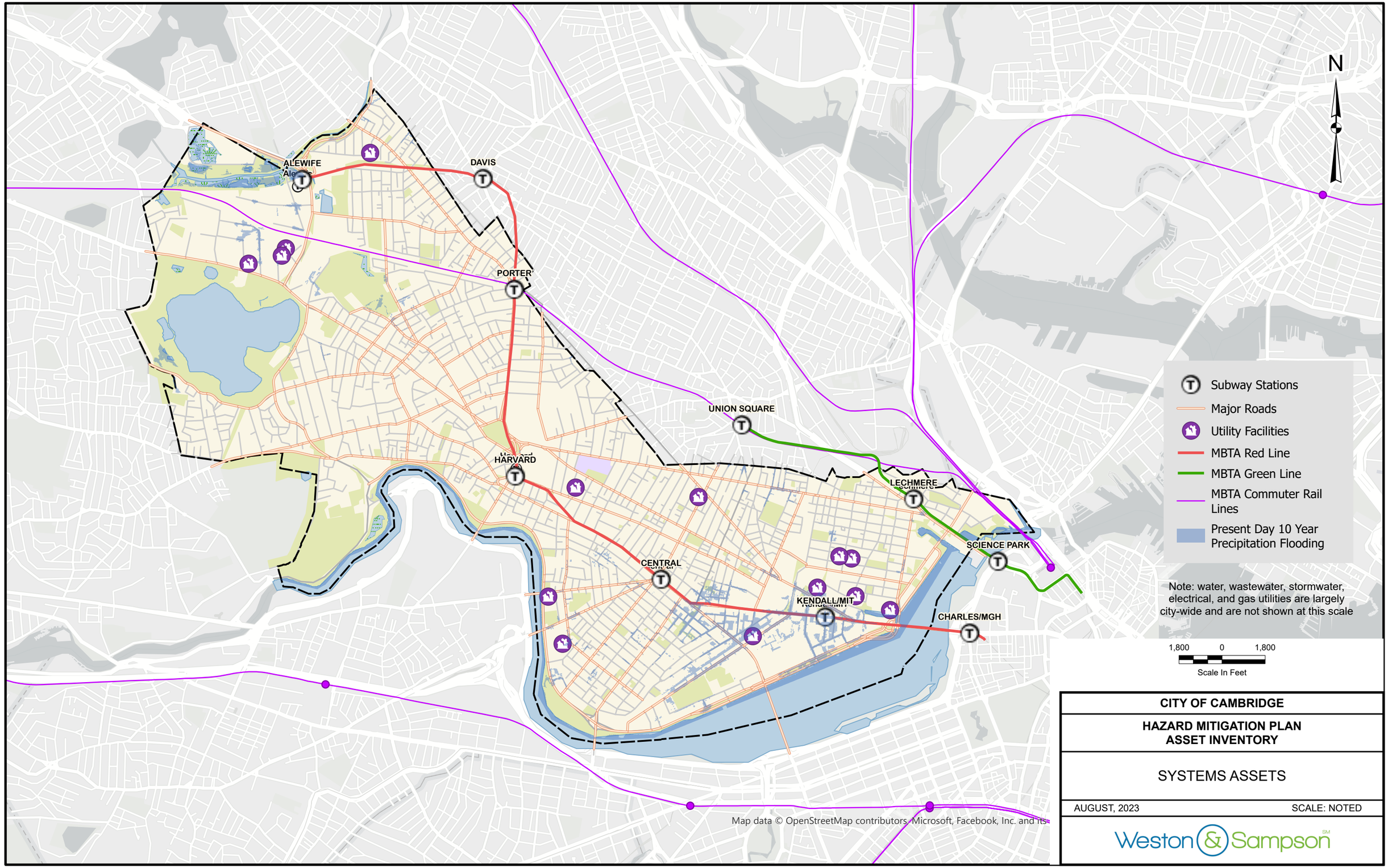
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

SYSTEMS ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



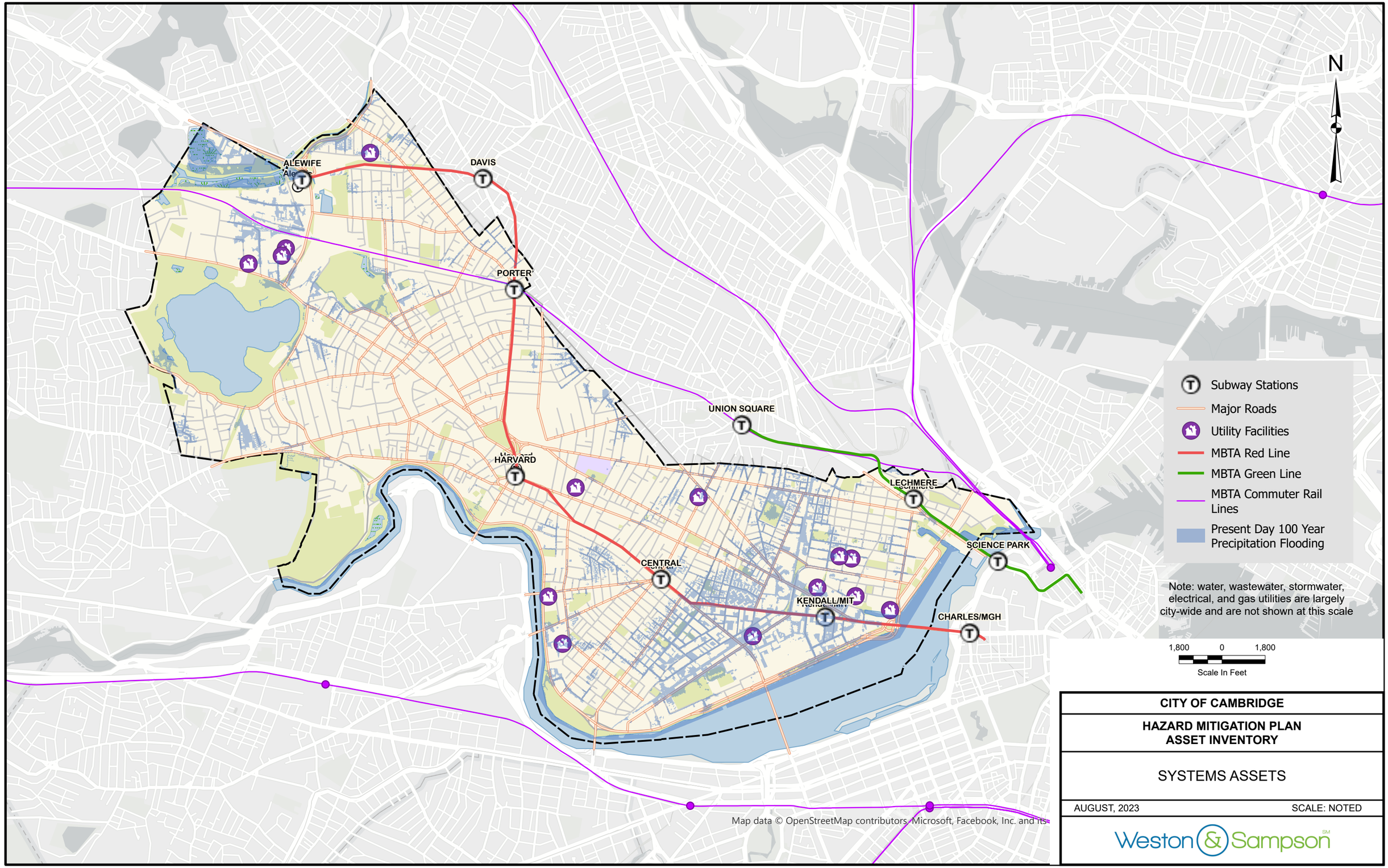
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

SYSTEMS ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

SYSTEMS ASSETS

AUGUST, 2023 SCALE: NOTED

Weston & Sampson

N

Porter

Harvard

Central

Kendall/MIT

Lechmere

- Community Gardens
- Arts & Culture
- Places of Worship
- Historical Markers
- Public Art
- Historic Landmarks and Easements
- Open Space
- Historic Districts
- National Register of Historic Places
- 2070 10 Year Precipitation Flooding

1,800 0 1,800

Scale In Feet

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CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

NATURAL HISTORIC & CULTURAL RESOURCES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson℠

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Porter

Harvard

Central

Kendall/MIT

Lechmere

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1,800 0 1,800

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CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

NATURAL HISTORIC & CULTURAL RESOURCES

AUGUST, 2023 SCALE: NOTED

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Porter

Lechmere

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Community Gardens
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Places of Worship
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1,800 0 1,800
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CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

NATURAL HISTORIC & CULTURAL RESOURCES

AUGUST, 2023 SCALE: NOTED

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1,800 0 1,800

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CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

NATURAL HISTORIC & CULTURAL RESOURCES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson SM

N

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Lechmere

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1,800 0 1,800

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CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

NATURAL HISTORIC & CULTURAL RESOURCES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson SM

N

Porter

Harvard

Central

Kendall/MIT

Lechmere

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1,800 0 1,800

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CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

NATURAL HISTORIC & CULTURAL RESOURCES

AUGUST, 2023 SCALE: NOTED

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Porter

Lechmere

Central

Kendall/MIT

- Community Gardens
- Arts & Culture
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- Historic Districts
- National Register of Historic Places
- Present Day 10 Year Precipitation Flooding

1,800 0 1,800

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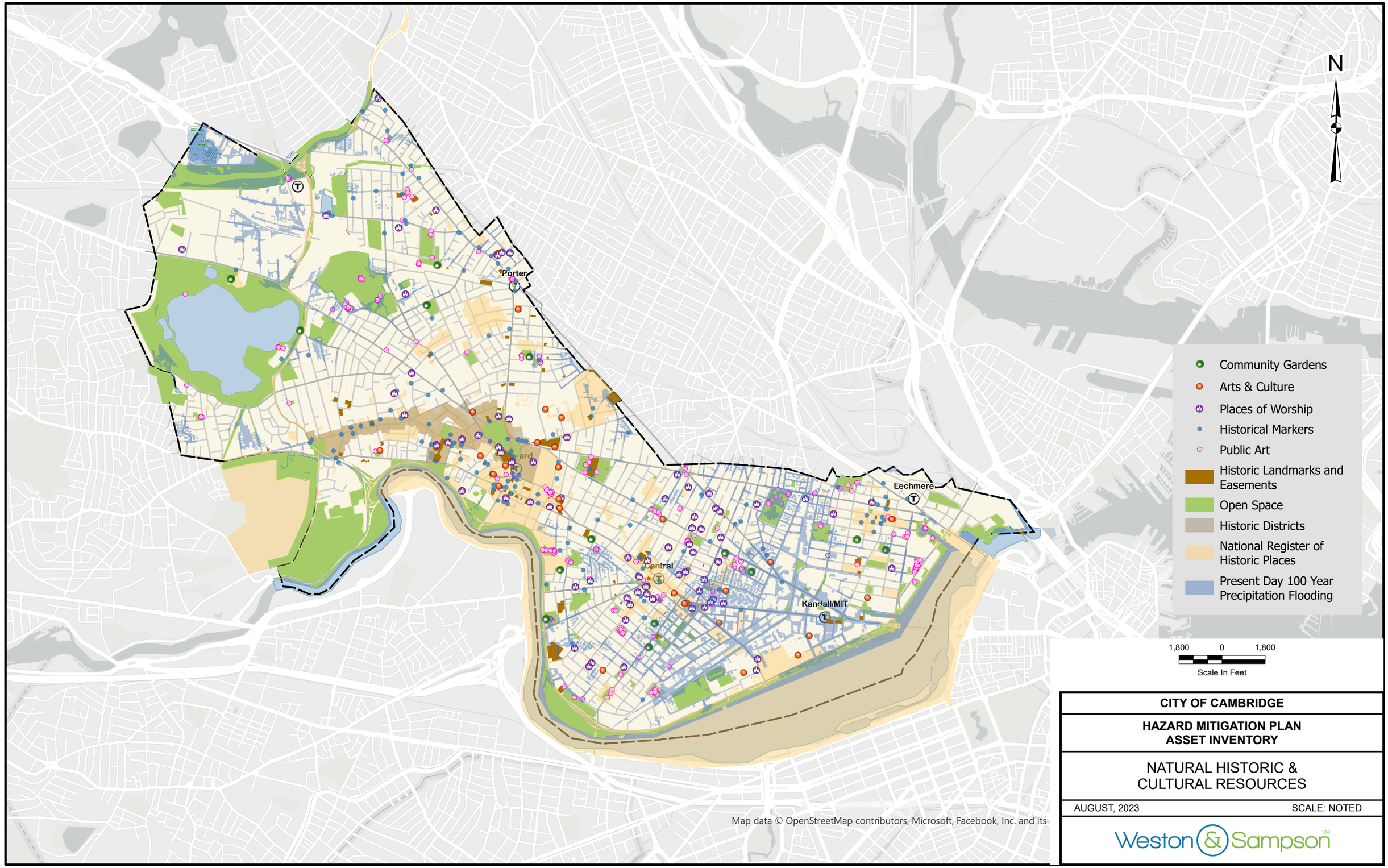
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

NATURAL HISTORIC & CULTURAL RESOURCES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson SM



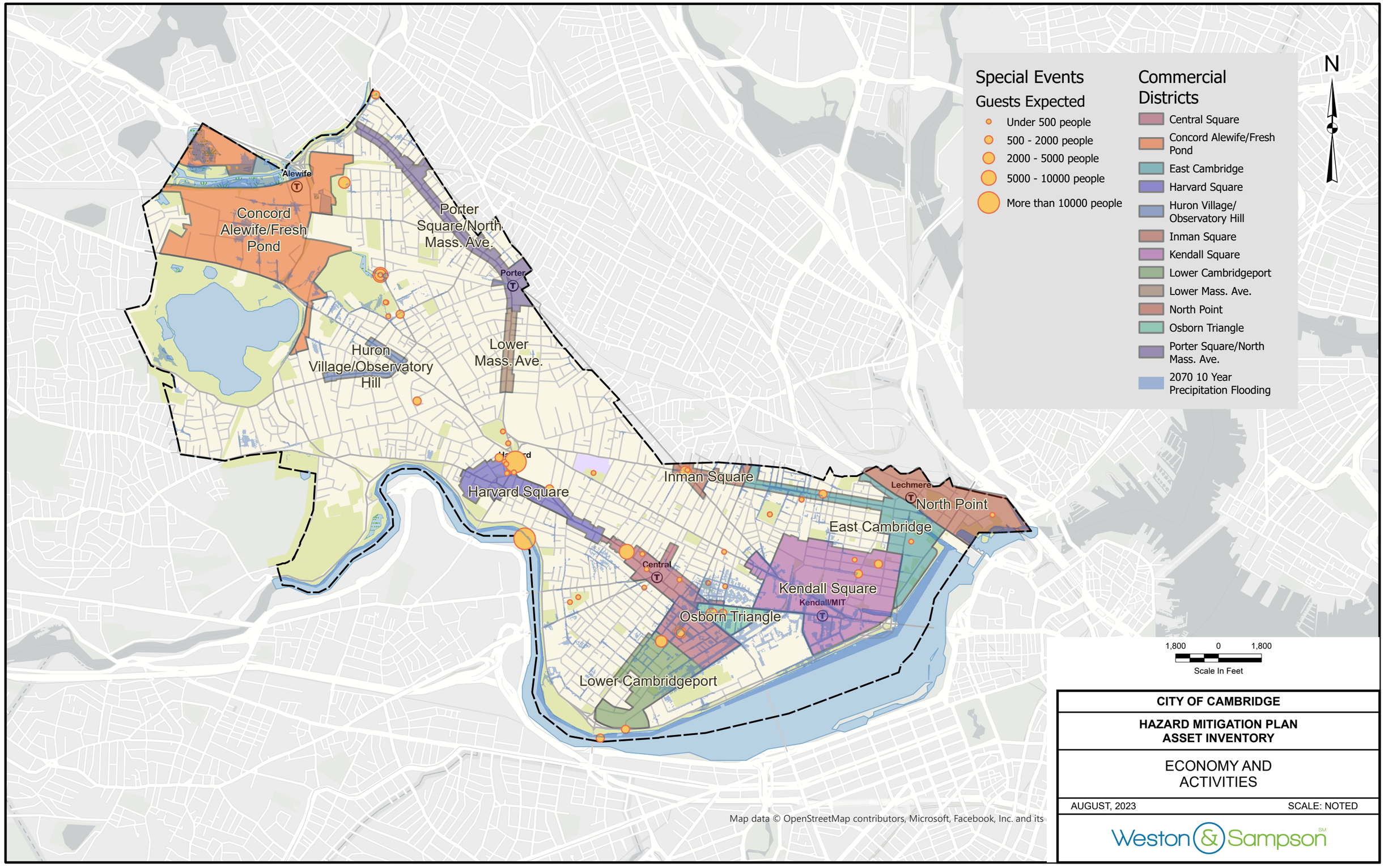
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

NATURAL HISTORIC & CULTURAL RESOURCES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson SM



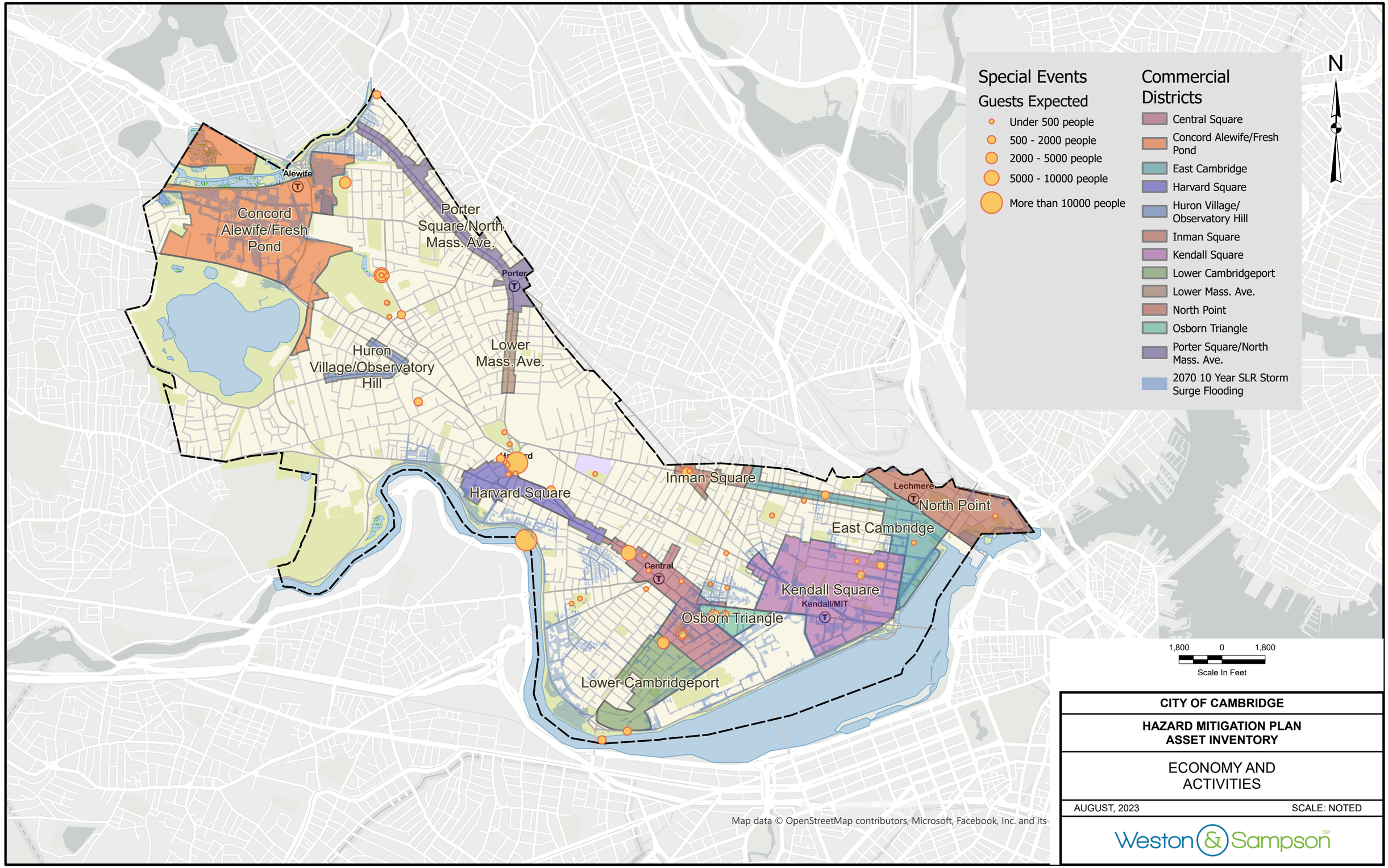
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

ECONOMY AND ACTIVITIES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



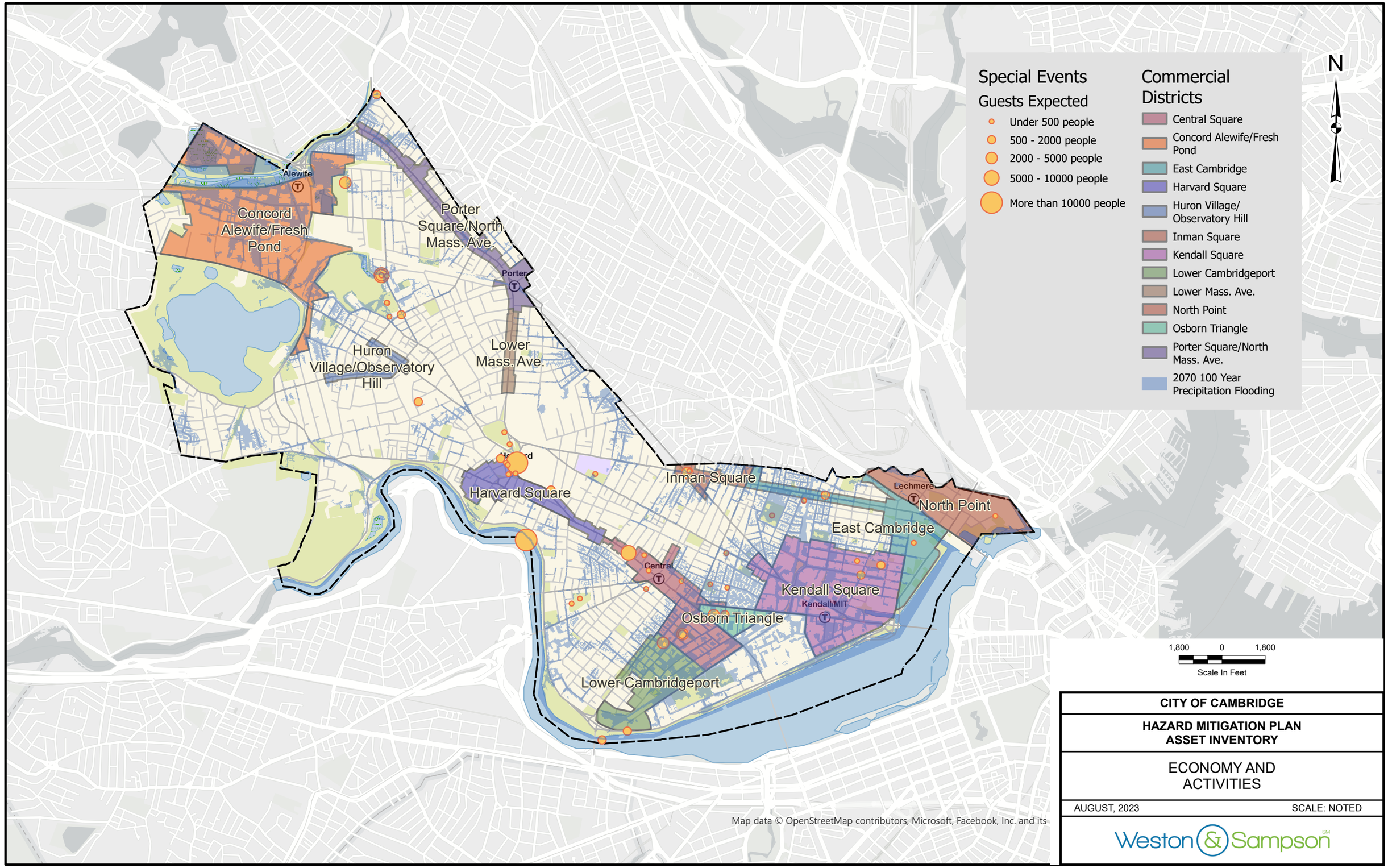
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

ECONOMY AND ACTIVITIES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson℠



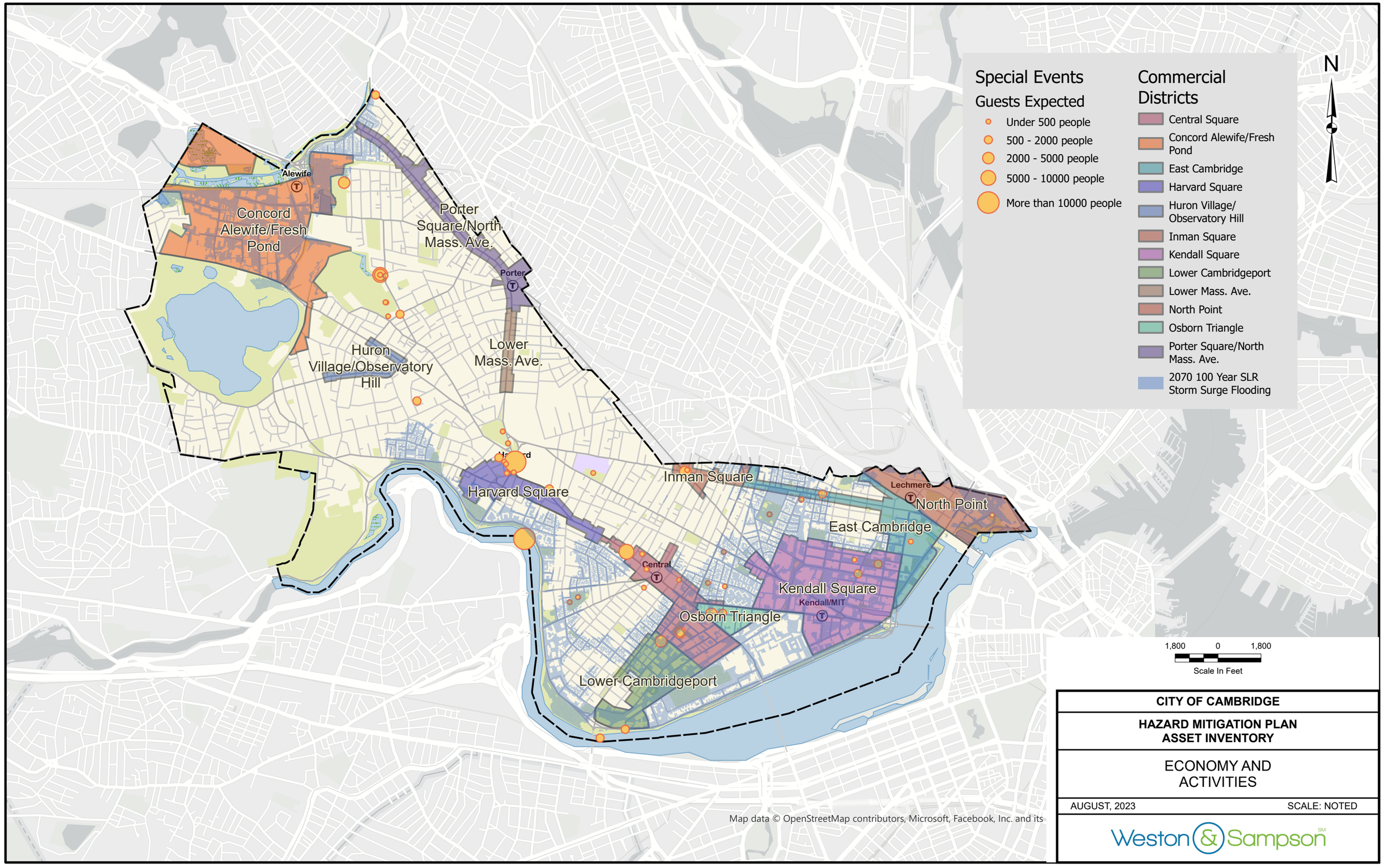
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

ECONOMY AND ACTIVITIES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



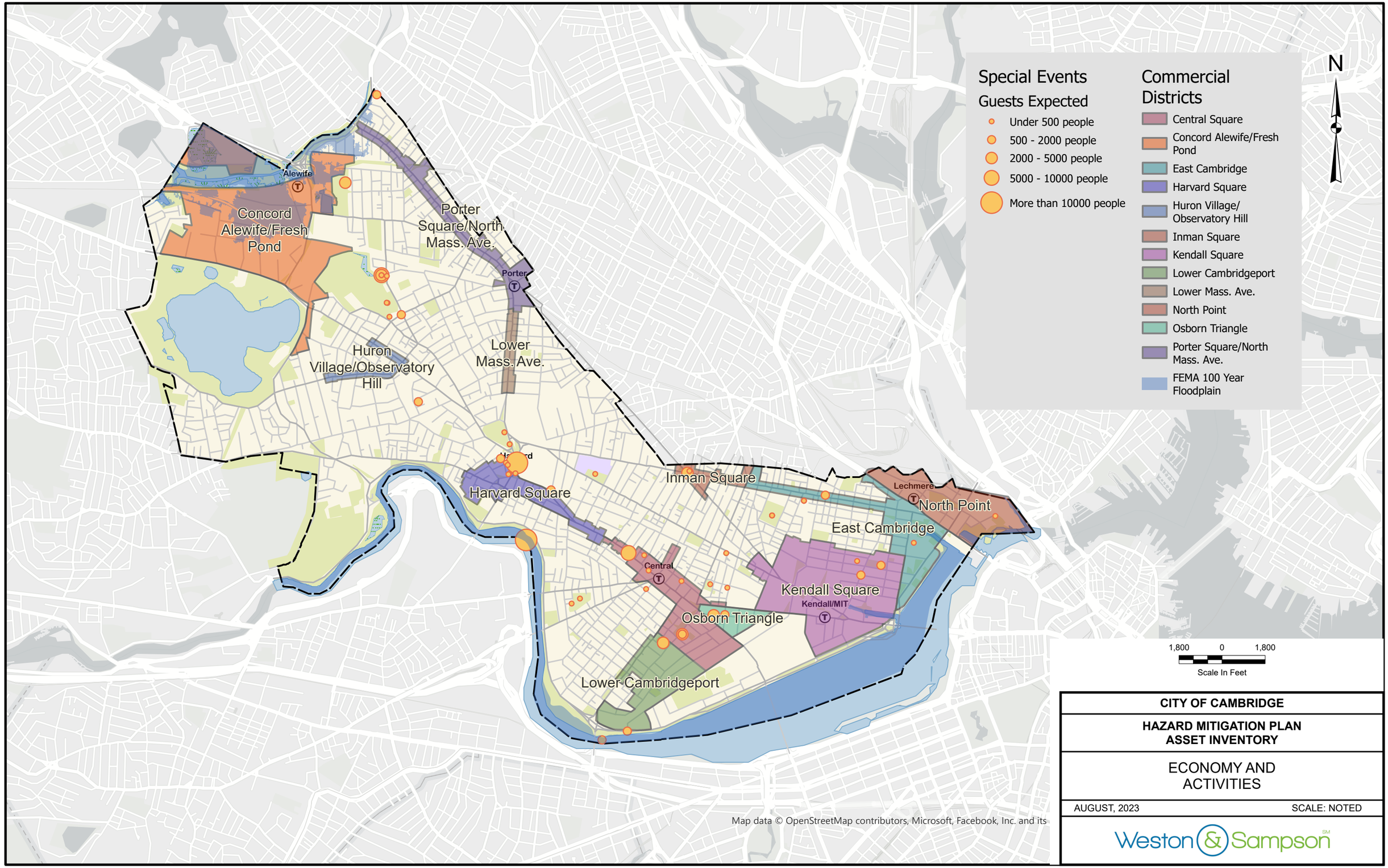
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

ECONOMY AND ACTIVITIES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson



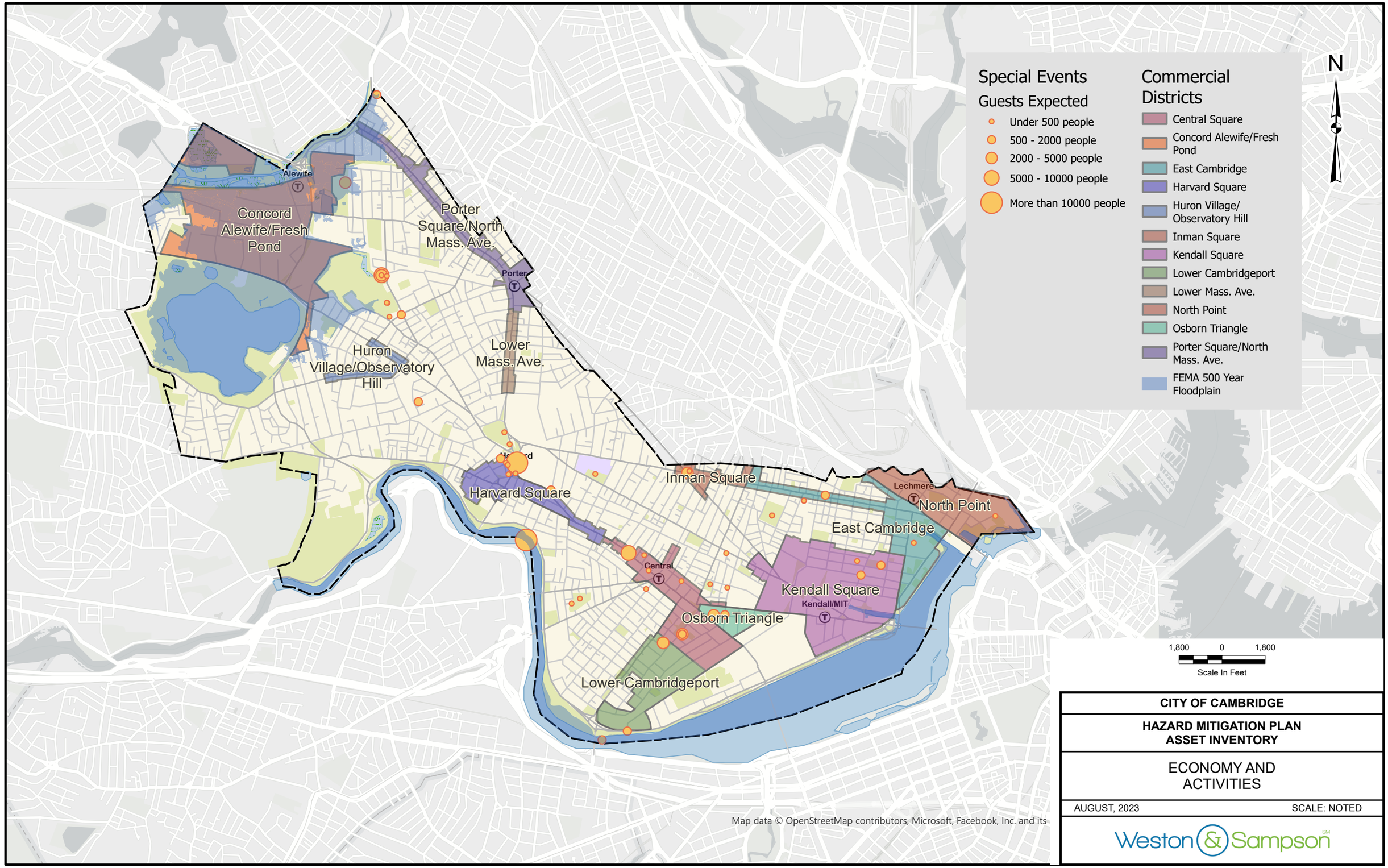
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

ECONOMY AND ACTIVITIES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson℠



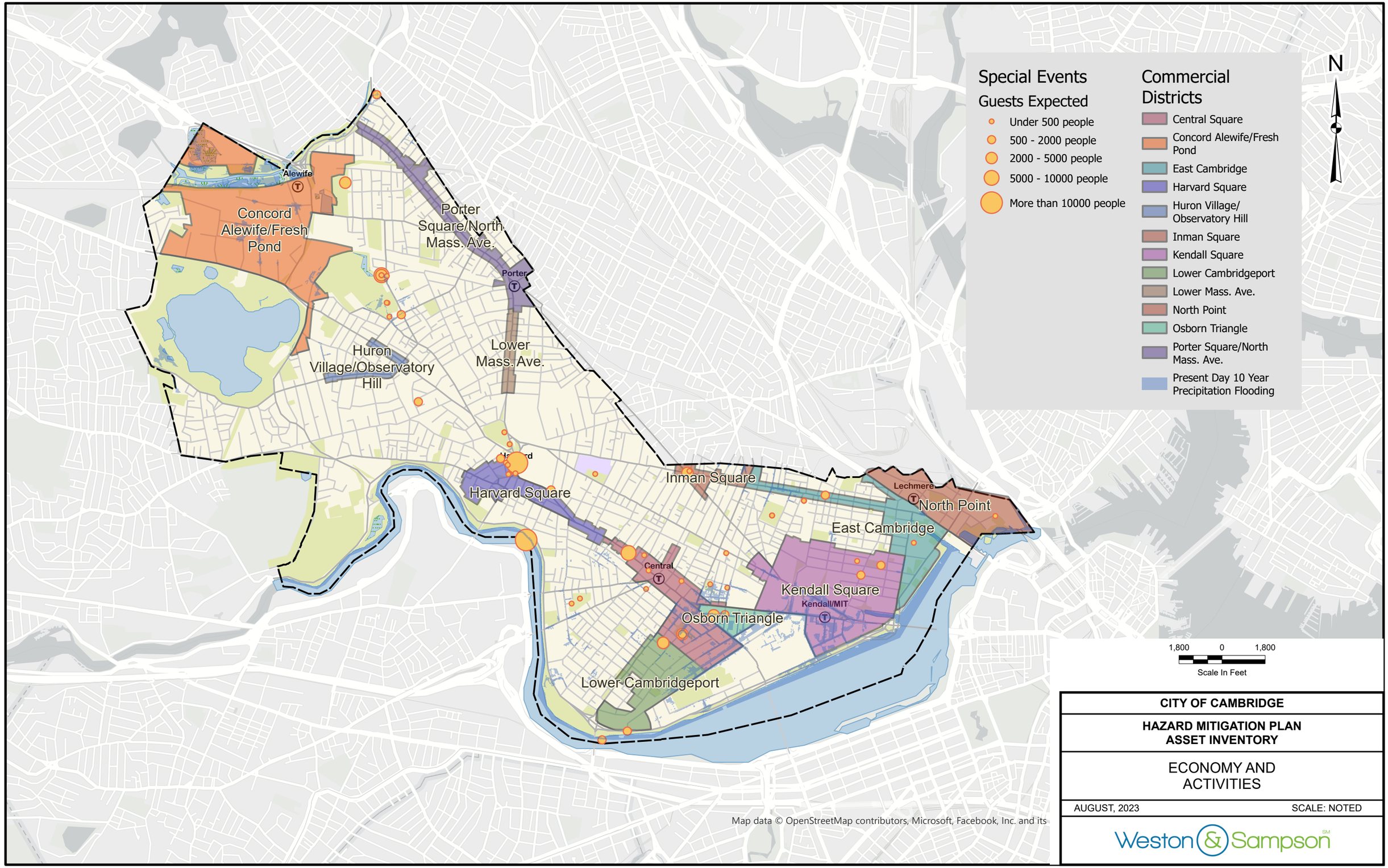
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

ECONOMY AND ACTIVITIES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson℠



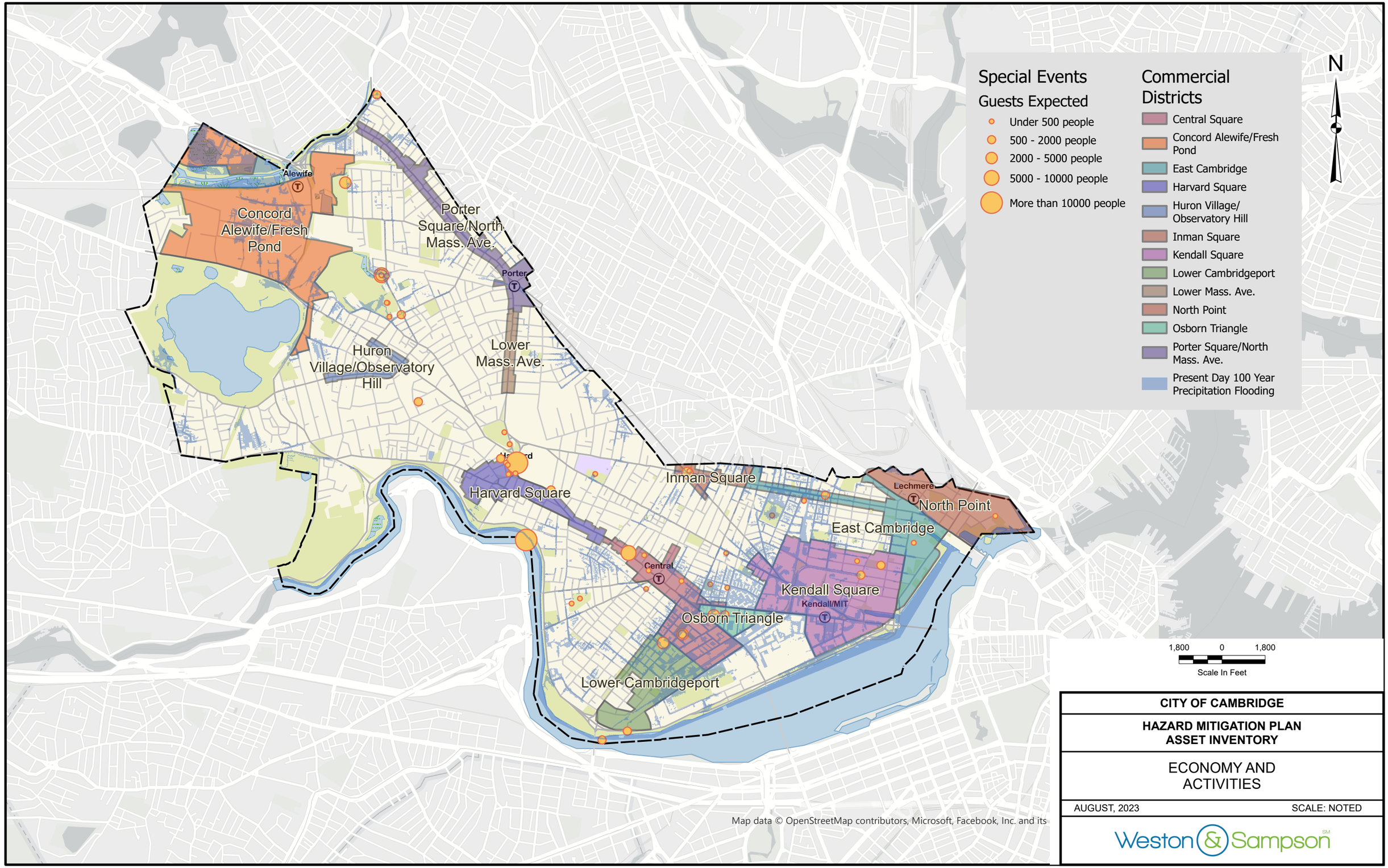
CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

ECONOMY AND ACTIVITIES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson℠



CITY OF CAMBRIDGE

HAZARD MITIGATION PLAN
ASSET INVENTORY

ECONOMY AND ACTIVITIES

AUGUST, 2023 SCALE: NOTED

Weston & Sampson

STONY BROOK
DAM FAILURE SCENARIOS

MAP PANEL INDEX MAP

LEGEND

- Map Panel Extents
- Flood Failure (FF) Floodwater Inundation Extent
- Corporate Limits

Note: The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.
Data Source: MassGIS
Basemap: ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland FIPS 2001 (Feet)
Vertical Datum: NAVD 88 (Feet)

CDM Smith

Miles
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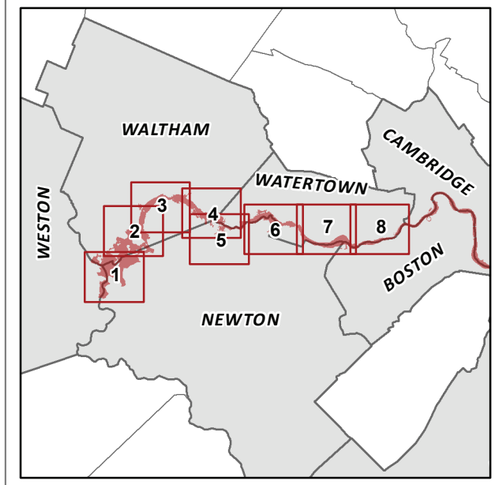
STONY BROOK
DAM FAILURE SCENARIOS

Panel 1 of 8

PANEL LOCATOR



South Street Bridge

D/S Distance to Dam: 0.1 miles
Max Flood Rise: 14 ft (14 ft FF)
Structure Overtop Flood Depth: 6 ft (6 ft FF)
Max Velocity: 15 ft/s (20 ft/s FF)
Flood Wave Arrival Time: 5 mins (5 mins FF)
Peak Flood Wave Arrival Time: 30 mins (25 mins FF)
Overtopping Duration: 2 hrs (> 24 hrs FF)

Cross Section A

D/S Distance to Dam: 0.7 miles
Max Flood Rise: 3 ft (9 ft FF)
Max Velocity: 2 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 10 mins (10 mins FF)
Peak Flood Wave Arrival Time: 1 hrs 10 mins (50 mins FF)

Slow-Moving Backwater up the Charles River

Max Rise Above Ground = 3 ft (8 ft FF)
Flood Wave Arrival Time: 40 mins (30 mins FF)
Peak Flood Wave Arrival Time: 1 hrs 10 mins (1 hrs 10 mins FF)

FF overtops Commonwealth Ave by as much as 2 ft

LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

Note: The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.

Feet
0 250 500 1,000

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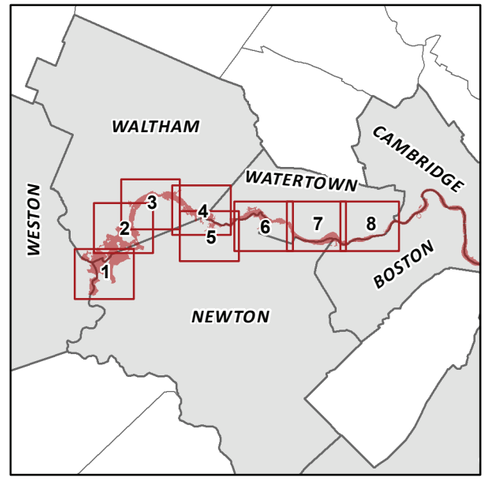
STONY BROOK

DAM FAILURE SCENARIOS

Panel 2 of 8

PANEL LOCATOR



Overtopping of Prospect Street as deep as 2-3 ft (FF Only)

Prospect St Bridge

D/S Distance to Dam: 1.9 miles
Max Flood Rise: 2 ft (7 ft FF)
Structure Overtop Flood Depth: 0 ft (2 ft FF)
Max Velocity: 1 ft/s (5 ft/s FF)
Flood Wave Arrival Time: 15 mins (20 mins FF)
Peak Flood Wave Arrival Time: 2 hrs 10 mins (1 hrs 40 mins FF)
Overtopping Duration: NA (10 hrs FF)

Cross Section B

D/S Distance to Dam: 1.2 miles
Max Flood Rise: 2 ft (8 ft FF)
Max Velocity: 1 ft/s (3 ft/s FF)
Flood Wave Arrival Time: 10 mins (15 mins FF)
Peak Flood Wave Arrival Time: 1 hrs 25 mins (1 hrs 10 mins FF)

Slow-Moving Backwater

Max Rise Above Ground = NA (5 ft FF)
Flood Wave Arrival Time: NA (40 mins FF)
Peak Flood Wave Arrival Time: NA (1 hrs 50 mins FF)

Note: The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.

LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery

Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

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Feet

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STONY BROOK
DAM FAILURE SCENARIOS

Panel 3 of 8

Moody Street Bridge

D/S Distance to Dam: 2.4 miles
Max Flood Rise: 2 ft (6 ft FF)
Structure Overtop Flood Depth: 0 ft (< 1 ft FF)
Max Velocity: 1 ft/s (1 ft/s FF)
Flood Wave Arrival Time: 20 mins (25 mins FF)
Peak Flood Wave Arrival Time: 2 hrs 20 mins (2 hrs FF)
Overtopping Duration: NA (4 hrs 40 mins FF)

Elm Street Bridge

D/S Distance to Dam: 2.6 miles
Max Flood Rise: 5 ft (11 ft FF)
Structure Overtop Flood Depth: 0 ft (4 ft FF)
Max Velocity: 2 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 25 mins (25 mins FF)
Peak Flood Wave Arrival Time: 2 hrs 25 mins (2 hrs FF)
Overtopping Duration: NA (> 24 hrs FF)

Overtopping of Prospect Street as deep as 2-3 ft (FF Only)

Prospect St Bridge

D/S Distance to Dam: 1.9 miles
Max Flood Rise: 2 ft (7 ft FF)
Structure Overtop Flood Depth: 0 ft (2 ft FF)
Max Velocity: 1 ft/s (5 ft/s FF)
Flood Wave Arrival Time: 15 mins (20 mins FF)
Peak Flood Wave Arrival Time: 2 hrs 10 mins (1 hrs 40 mins FF)
Overtopping Duration: NA (10 hrs FF)

Newton Street Bridge

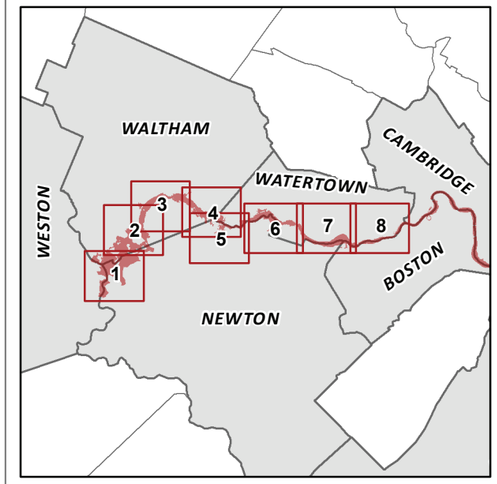
D/S Distance to Dam: 2.9 miles
Max Flood Rise: 4 ft (9 ft FF)
Structure Overtop Flood Depth: 0 ft (3 ft FF)
Max Velocity: 4 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 30 mins (40 mins FF)
Peak Flood Wave Arrival Time: 2 hrs 35 mins (2 hrs 10 mins FF)
Overtopping Duration: NA (> 24 hrs FF)

Moody Street Dam

D/S Distance to Dam: 2.4 miles
Max Flood Rise: 2 ft (5 ft FF)
Max Velocity: 1 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 20 mins (25 mins FF)
Peak Flood Wave Arrival Time: 2 hrs 20 mins (2 hrs FF)

Note: *The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.*

PANEL LOCATOR



LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

Feet
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STONY BROOK

DAM FAILURE SCENARIOS

Panel 4 of 8

Newton Street Bridge

D/S Distance to Dam: 2.9 miles
Max Flood Rise: 4 ft (9 ft FF)
Structure Overtop Flood Depth: 0 ft (3 ft FF)
Max Velocity: 4 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 30 mins (40 mins FF)
Peak Flood Wave Arrival Time: 2 hrs 35 mins (2 hrs 10 mins FF)
Overtopping Duration: NA (> 24 hrs FF)

Bleachery Dam

D/S Distance to Dam: 3.2 miles
Max Flood Rise: 2 ft (8 ft FF)
Max Velocity: 1 ft/s (3 ft/s FF)
Flood Wave Arrival Time: 35 mins (40 mins FF)
Peak Flood Wave Arrival Time: 2 hrs 45 mins (2 hrs 20 mins FF)

Farwell St Bridge

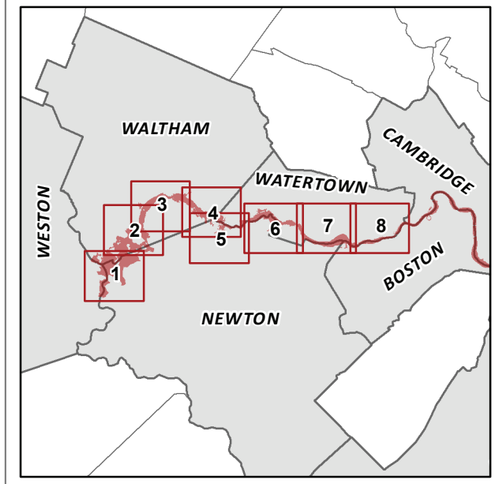
D/S Distance to Dam: 3.5 miles
Max Flood Rise: 5 ft (13 ft FF)
Structure Overtop Flood Depth: 0 ft (3 ft FF)
Max Velocity: 3 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 40 mins (40 mins FF)
Peak Flood Wave Arrival Time: 2 hrs 55 mins (2 hrs 25 mins FF)
Overtopping Duration: NA (> 21 hrs FF)

Slow-Moving Backwater

Max Rise Above Ground = NA (6 - 10 ft FF)
Flood Wave Arrival Time: NA (1 hr FF)
Peak Flood Wave Arrival Time: NA (3 hrs 20 mins FF)

Note: *The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.*

PANEL LOCATOR



LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

Feet
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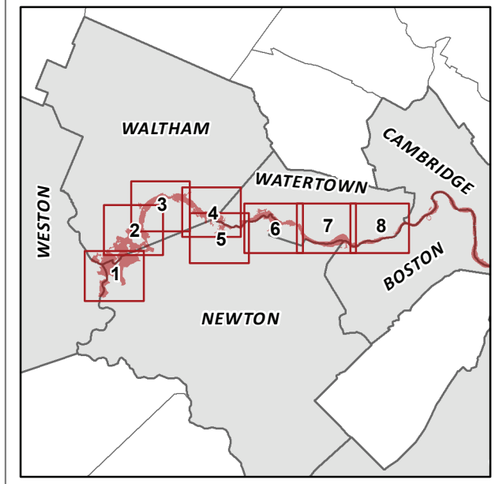
STONY BROOK

DAM FAILURE SCENARIOS

Panel 5 of 8

PANEL LOCATOR



Slow-Moving Backwater

Max Rise Above Ground = NA (6 - 10 ft FF)
Flood Wave Arrival Time: NA (1 hr FF)
Peak Flood Wave Arrival Time: NA (3 hrs 20 mins FF)

Farwell St Bridge

D/S Distance to Dam: 3.5 miles
Max Flood Rise: 5 ft (13 ft FF)
Structure Overtop Flood Depth: 0 ft (3 ft FF)
Max Velocity: 3 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 40 mins (40 mins FF)
Peak Flood Wave Arrival Time: 2 hrs 55 mins (2 hrs 25 mins FF)
Overtopping Duration: NA (> 21 hrs FF)

Bridge St Bridge

D/S Distance to Dam: 4.4 miles
Max Flood Rise: 6 ft (13 ft FF)
Max Velocity: 4 ft/s (8 ft/s FF)
Flood Wave Arrival Time: 55 mins (50 mins FF)
Peak Flood Wave Arrival Time: 3 hrs 20 mins (3 hrs 15 mins FF)

Note: The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.

LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

Feet
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STONY BROOK

DAM FAILURE SCENARIOS

Panel 6 of 8

Watertown Dam

D/S Distance to Dam: 5.3 miles
Max Flood Rise: 2 ft (7 ft FF)
Max Velocity: 2 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 1 hrs 10 mins (1 hrs 5 mins FF)
Peak Flood Wave Arrival Time: 3 hrs 45 mins (3 hrs 55 mins FF)

Slow-Moving Backwater

Max Rise Above Ground = NA (5 ft FF)
Flood Wave Arrival Time: NA (1 hrs 30 mins FF)
Peak Flood Wave Arrival Time: NA (4 hrs 40 mins FF)

Galen St Bridge

D/S Distance to Dam: 5.5 miles
Max Flood Rise: 3 ft (11 ft FF)
Max Velocity: 3 ft/s (6 ft/s FF)
Flood Wave Arrival Time: 1 hrs 15 mins (1 hrs 5 mins FF)
Peak Flood Wave Arrival Time: 3 hrs 45 mins (3 hrs 60 mins FF)

Bridge St Bridge

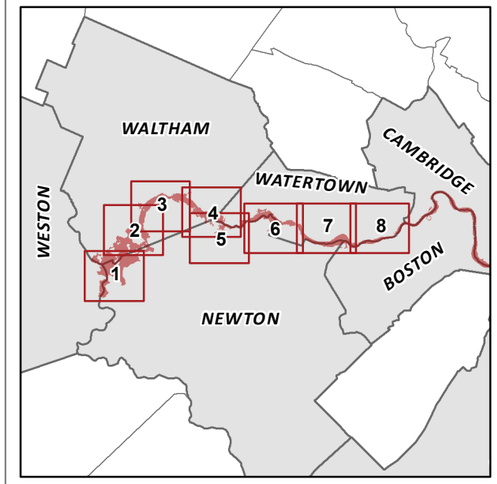
D/S Distance to Dam: 4.4 miles
Max Flood Rise: 6 ft (13 ft FF)
Max Velocity: 4 ft/s (8 ft/s FF)
Flood Wave Arrival Time: 55 mins (50 mins FF)
Peak Flood Wave Arrival Time: 3 hrs 20 mins (3 hrs 15 mins FF)

Charles River

NEWTON

WATERTOWN

PANEL LOCATOR



LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
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- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

Note: The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.

CDM Smith

Feet

0 250 500 1,000

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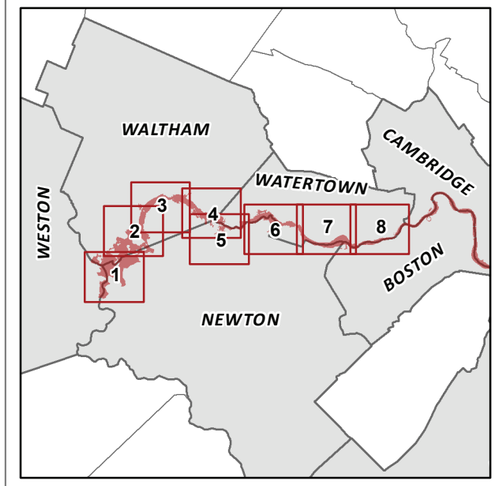
STONY BROOK

DAM FAILURE SCENARIOS

Panel 7 of 8

PANEL LOCATOR



Cross Section C

D/S Distance to Dam: 8.4 miles
Max Flood Rise: 1 ft (2 ft FF)
Max Velocity: 1 ft/s (3 ft/s FF)
Flood Wave Arrival Time: 1 hrs 15 mins (1 hrs 10 mins FF)
Peak Flood Wave Arrival Time: 3 hrs 55 mins (4 hrs 25 mins FF)

LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

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- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery

Coordinate System: NAD 1983 State Plane MA Mainland

Note: The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.

Feet

0 250 500 1,000

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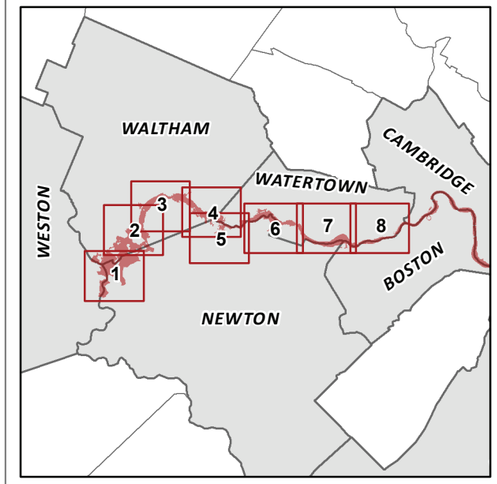
STONY BROOK

DAM FAILURE SCENARIOS

Panel 8 of 8

PANEL LOCATOR



Downstream of map the flood impact dissipates to less than 1 ft rise along the banks of the Charles River Basin.

Arsenal St Bridge

D/S Distance to Dam: 7.8 miles
Max Flood Rise: < 1 ft (4 ft FF)
Max Velocity: 1 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 1 hrs 25 mins (1 hrs 25 mins FF)
Peak Flood Wave Arrival Time: 4 hrs 20 mins (5 hrs 5 mins FF)

N Beacon St Bridge

D/S Distance to Dam: 7 miles
Max Flood Rise: 1 ft (7 ft FF)
Max Velocity: 1 ft/s (3 ft/s FF)
Flood Wave Arrival Time: 1 hrs 20 mins (1 hrs 15 mins FF)
Peak Flood Wave Arrival Time: 4 hrs 15 mins (5 hrs 5 mins FF)

LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

Note: *The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.*

CDM Smith

Feet

0 250 500 1,000

N

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CAMBRIDGE RESERVOIR
DAM FAILURE SCENARIOS

MAP PANEL INDEX MAP

LEGEND

- Map Panel Extents
- Flood Failure (FF) Floodwater Inundation Extent
- Corporate Limits

Note: The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.
Data Source: MassGIS
Basemap: ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland FIPS 2001 (Feet)
Vertical Datum: NAVD 88 (Feet)

CDM Smith

N

Miles

0 1 2

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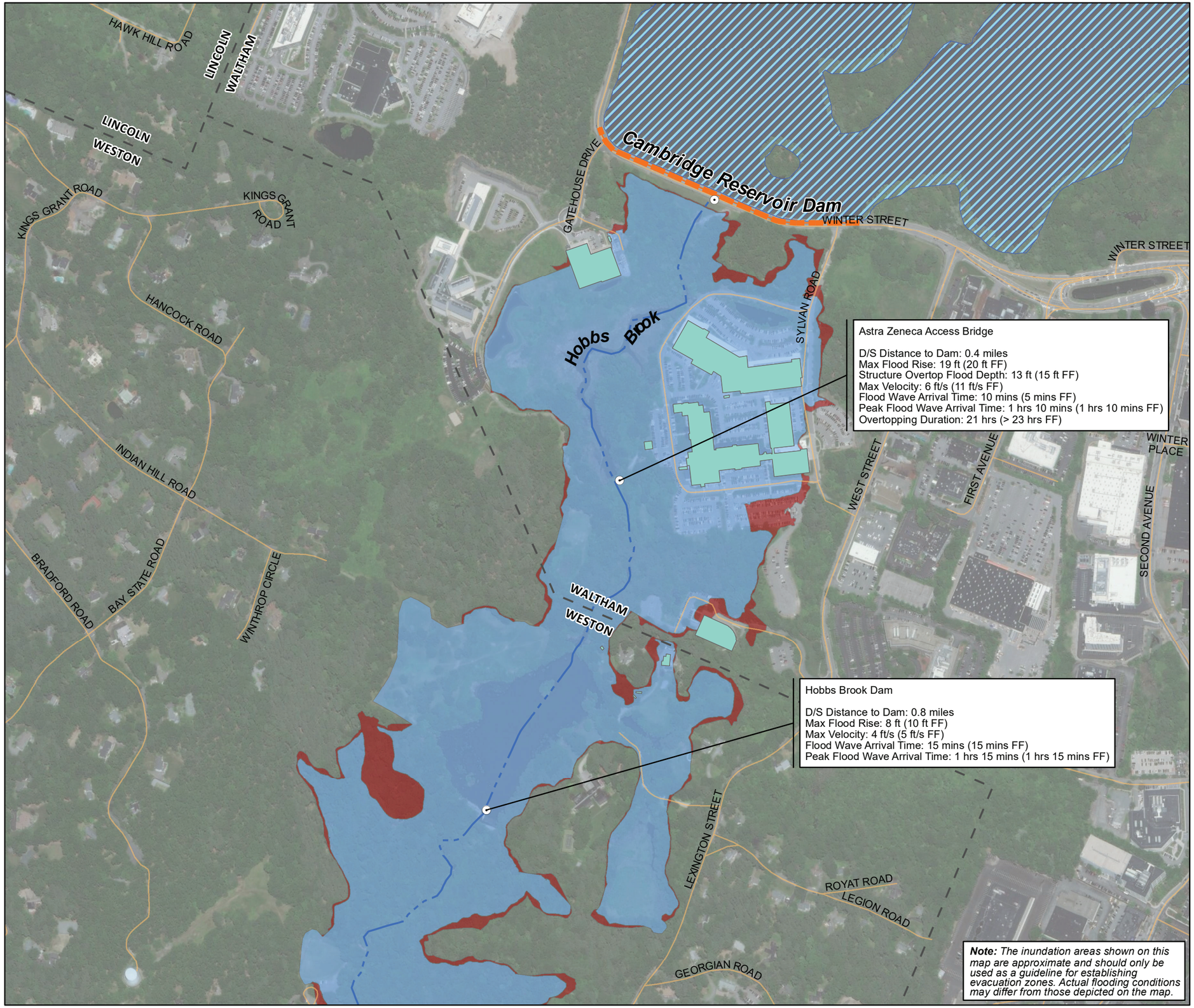
CAMBRIDGE RESERVOIR

DAM FAILURE SCENARIOS

Panel 1 of 16



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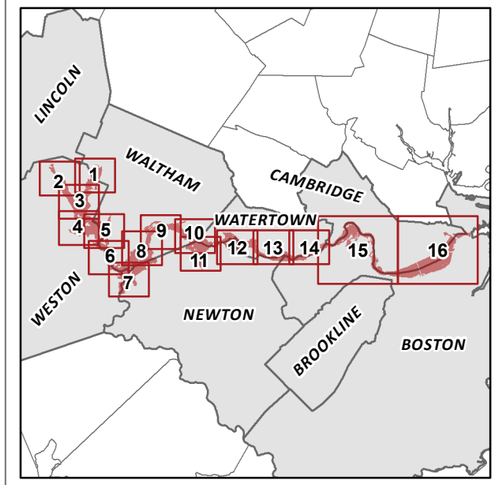

LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery

Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

Feet

0 250 500 1,000

N

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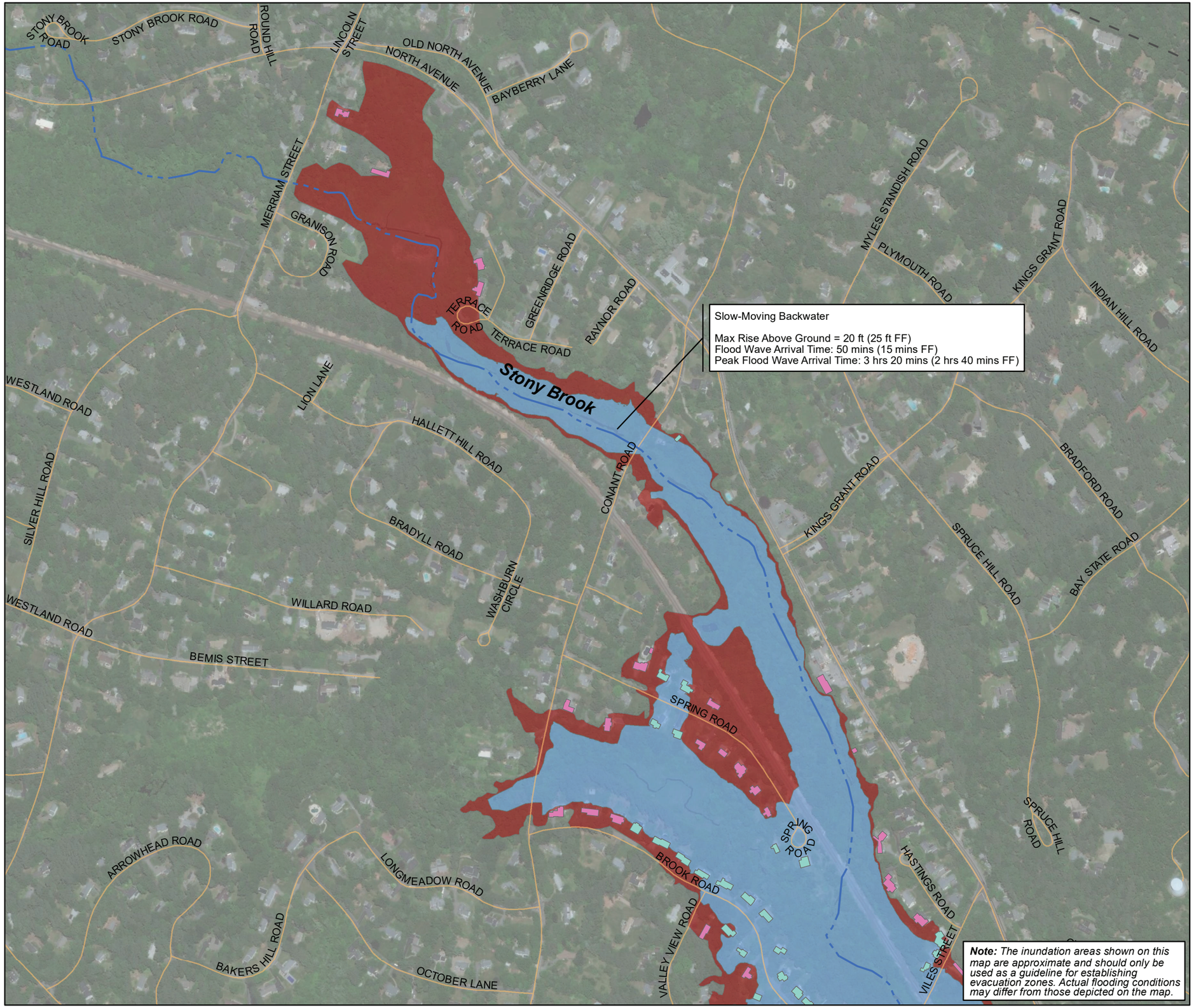
CAMBRIDGE RESERVOIR

DAM FAILURE SCENARIOS

Panel 2 of 16



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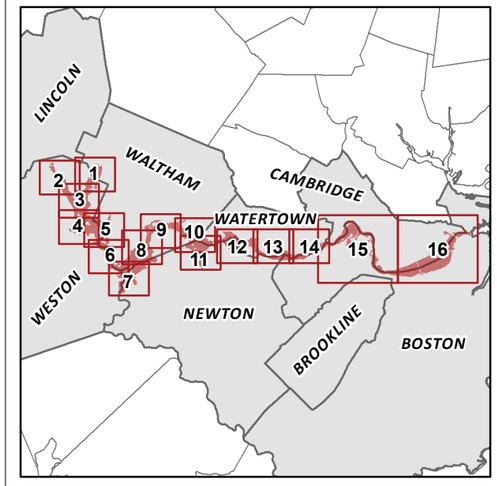

LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery

Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

Feet

0 250 500 1,000

N

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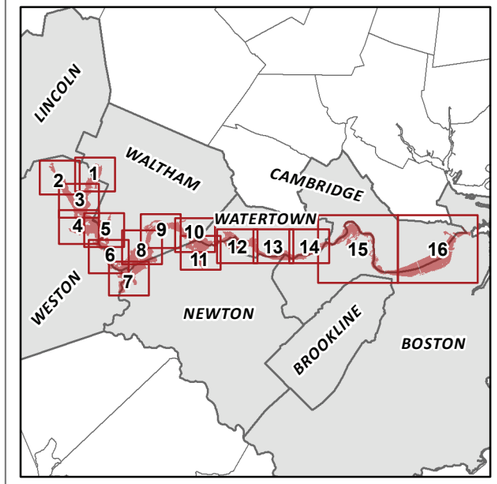
CAMBRIDGE RESERVOIR

DAM FAILURE SCENARIOS

Panel 3 of 16

PANEL LOCATOR



Hobbs Brook Dam

D/S Distance to Dam: 0.8 miles
Max Flood Rise: 8 ft (10 ft FF)
Max Velocity: 4 ft/s (5 ft/s FF)
Flood Wave Arrival Time: 15 mins (15 mins FF)
Peak Flood Wave Arrival Time: 1 hrs 15 mins (1 hrs 15 mins FF)

Slow-Moving Backwater

Max Rise Above Ground = 20 ft (25 ft FF)
Flood Wave Arrival Time: 50 mins (15 mins FF)
Peak Flood Wave Arrival Time: 3 hrs 20 mins (2 hrs 40 mins FF)

North Ave Bridge

D/S Distance to Dam: 1.6 miles
Max Flood Rise: 23 ft (28 ft FF)
Structure Overtop Flood Depth: 8 ft (13 ft FF)
Max Velocity: 3 ft/s (3 ft/s FF)
Flood Wave Arrival Time: 35 mins (20 mins FF)
Peak Flood Wave Arrival Time: 1 hrs 25 mins (1 hrs 25 mins FF)
Overtopping Duration: 17 hrs 30 mins (> 24 hrs FF)

Commuter Railroad #1

D/S Distance to Dam: 1.8 miles
Max Flood Rise: 28 ft (33 ft FF)
Structure Overtop Flood Depth: 17 ft (22 ft FF)
Max Velocity: 1 ft/s (1 ft/s FF)
Flood Wave Arrival Time: 40 mins (20 mins FF)
Peak Flood Wave Arrival Time: 1 hrs 25 mins (1 hrs 25 mins FF)
Overtopping Duration: 22 hrs 10 mins (> 24 hrs FF)

Note: The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.

LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

Feet

0 250 500 1,000

N

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CAMBRIDGE RESERVOIR
DAM FAILURE SCENARIOS

Panel 4 of 16

Commuter Railroad #1

D/S Distance to Dam: 1.8 miles
Max Flood Rise: 28 ft (33 ft FF)
Structure Overtop Flood Depth: 17 ft (22 ft FF)
Max Velocity: 1 ft/s (1 ft/s FF)
Flood Wave Arrival Time: 40 mins (20 mins FF)
Peak Flood Wave Arrival Time: 1 hrs 25 mins (1 hrs 25 mins FF)
Overtopping Duration: 22 hrs 10 mins (> 24 hrs FF)

Abandoned Railroad/Bike Path

D/S Distance to Dam: 2 miles
Max Flood Rise: 32 ft (37 ft FF)
Structure Overtop Flood Depth: 3 ft (8 ft FF)
Max Velocity: 4 ft/s (6 ft/s FF)
Flood Wave Arrival Time: 40 mins (30 mins FF)
Peak Flood Wave Arrival Time: 3 hrs 20 mins (1 hrs 40 mins FF)
Overtopping Duration: 9 hrs 30 mins (15 hrs 40 mins FF)

Slow-Moving Backwater N of Abandoned Railroad

Max Rise Above Ground = 20 ft (25 ft FF)
Flood Wave Arrival Time: 1 hrs 10 mins (20 mins FF)
Peak Flood Wave Arrival Time: 3 hrs 20 mins (2 hrs 40 mins FF)

Slow-Moving Backwater at Weston Station Pond

Max Rise Above Ground = 12 ft (20 ft FF)
Flood Wave Arrival Time: 2 hrs 50 mins (35 mins FF)
Peak Flood Wave Arrival Time: 6 hrs 10 mins (2 hrs 40 mins FF)

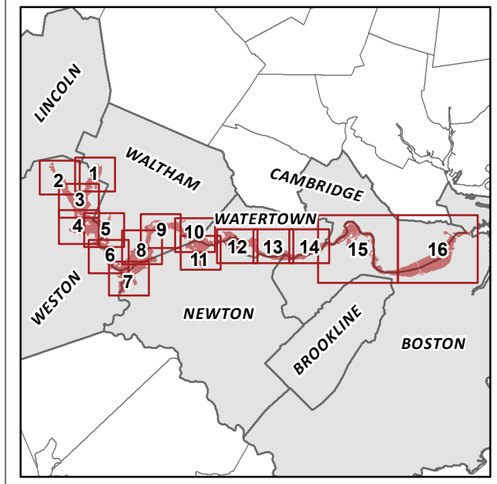
Commuter Railroad #3

D/S Distance to Dam: 2.2 miles
Max Flood Rise: 26 ft (34 ft FF)
Structure Overtop Flood Depth: 11 ft (20 ft FF)
Max Velocity: 0 ft/s (1 ft/s FF)
Flood Wave Arrival Time: 45 mins (30 mins FF)
Peak Flood Wave Arrival Time: 3 hrs 30 mins (2 hrs 5 mins FF)
Overtopping Duration: 17 hrs 45 mins (> 23 hrs FF)

Hobbs Brook
Stony Brook
FAIRVIEW ROAD
BRIDLE PATH
FOREST RIDGE ROAD
NORTH AVENUE
MAIN STREET
HOBBS BROOK ROAD
HITCHING POST LANE
GYPSY TRAIL
WEBSTER ROAD
CHURCH STREET
WESTON
WALTHAM
JONES ROAD
COBURN ROAD
CARROLL CIRCLE
OLD ROAD
LANES END
PIGEON HILL ROAD
CHURCH STREET EXTENSION
HILLCREST ROAD
CRESCENT STREET
BIRCH LANE
HEMLOCK ROAD
BOSTON POST ROAD
BOSTON POST ROAD BYPASS
WINSOR WAY
SKATING POND ROAD
DERBY LANE
ROLLING LANE
WELLESLEY STREET
SCHOOL STREET

***Note:** The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.*

PANEL LOCATOR



LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

Feet
0 250 500 1,000

N

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CAMBRIDGE RESERVOIR
DAM FAILURE SCENARIOS

Panel 5 of 16

Abandoned Railroad/Bike Path

D/S Distance to Dam: 2 miles
Max Flood Rise: 32 ft (37 ft FF)
Structure Overtop Flood Depth: 3 ft (8 ft FF)
Max Velocity: 4 ft/s (6 ft/s FF)
Flood Wave Arrival Time: 40 mins (30 mins FF)
Peak Flood Wave Arrival Time: 3 hrs 20 mins (1 hrs 40 mins FF)
Overtopping Duration: 9 hrs 30 mins (15 hrs 40 mins FF)

Slow-Moving Backwater at I-95 / Route 128

Max Rise Above Ground = 6 ft (15 ft FF)
Flood Wave Arrival Time: 1 hrs 20 mins (35 mins FF)
Peak Flood Wave Arrival Time: 6 hrs 10 mins (1 hrs 50 mins FF)

Commuter Railroad #3

D/S Distance to Dam: 2.2 miles
Max Flood Rise: 26 ft (34 ft FF)
Structure Overtop Flood Depth: 11 ft (20 ft FF)
Max Velocity: 1 ft/s (1 ft/s FF)
Flood Wave Arrival Time: 45 mins (30 mins FF)
Peak Flood Wave Arrival Time: 3 hrs 30 mins (2 hrs 5 mins FF)
Overtopping Duration: 17 hrs 45 mins (> 23 hrs FF)

Slow-Moving Backwater at Weston Station Pond

Max Rise Above Ground = 12 ft (20 ft FF)
Flood Wave Arrival Time: 2 hrs 50 mins (35 mins FF)
Peak Flood Wave Arrival Time: 6 hrs 10 mins (2 hrs 40 mins FF)

Rte 20 Interchange

D/S Distance to Dam: 2.6 miles
Max Flood Rise: 28 ft (37 ft FF)
Structure Overtop Flood Depth: 0 ft (2 ft FF)
Max Velocity: 3 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 50 mins (30 mins FF)
Peak Flood Wave Arrival Time: 5 hrs 40 mins (2 hrs 45 mins FF)
Overtopping Duration: NA (7 hrs 40 mins FF)

I-95 /Rte 128 overtopping as much as 2 ft and velocities as high as 2 ft/s

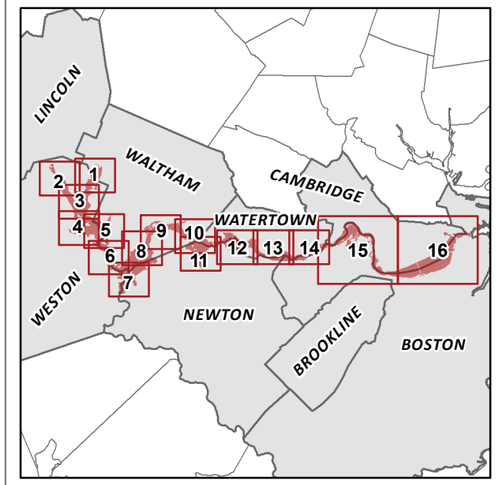
Commuter Railroad #4

D/S Distance to Dam: 2.8 miles
Max Flood Rise: 19 ft (27 ft FF)
Structure Overtop Flood Depth: 3 ft (11 ft FF)
Max Velocity: 9 ft/s (8 ft/s FF)
Flood Wave Arrival Time: 55 mins (35 mins FF)
Peak Flood Wave Arrival Time: 5 hrs 50 mins (2 hrs 50 mins FF)
Overtopping Duration: 10 hrs 25 mins (19 hrs FF)

Floodwater flows underneath I-95 / Rte 128 Bridge at Commuter Railroad

Note: *The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.*

PANEL LOCATOR



LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

N

Feet

0 250 500 1,000

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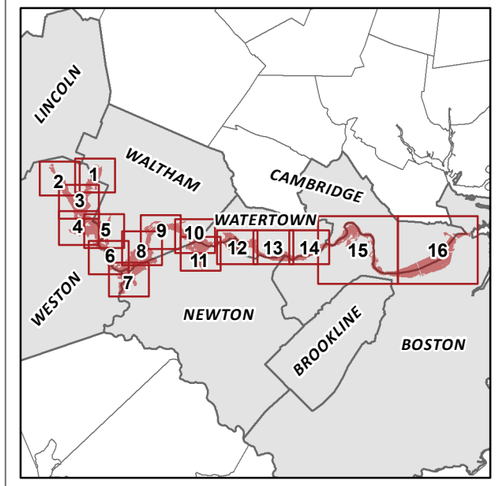
CAMBRIDGE RESERVOIR

DAM FAILURE SCENARIOS

Panel 6 of 16

PANEL LOCATOR



Rte 128 Culvert

D/S Distance to Dam: 3.3 miles
Max Flood Rise: 23 ft (33 ft FF)
Structure Overtop Flood Depth: 0 ft (6 ft FF)
Max Velocity: 2 ft/s (5 ft/s FF)
Flood Wave Arrival Time: 1 hr (40 mins FF)
Peak Flood Wave Arrival Time: 6 hrs 40 mins (2 hrs 55 mins FF)
Overtopping Duration: NA (11 hrs 30 mins FF)

Stony Brook Reservoir Dam

D/S Distance to Dam: 3.9 miles
Flood Wave Arrival Time: 1 hrs 30 mins (45 mins FF)
Peak Flood Wave Arrival Time: 6 hrs 50 mins (3 hrs 10 mins FF)

South Street Bridge

D/S Distance to Dam: 4 miles
Max Flood Rise: 14 ft (19 ft FF)
Structure Overtop Flood Depth: 6 ft (11 ft FF)
Max Velocity: 5 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 1 hrs 30 mins (45 mins FF)
Peak Flood Wave Arrival Time: 6 hrs 55 mins (3 hrs 10 mins FF)
Overtopping Duration: > 19 hrs (> 24 hrs FF)

Note: The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.

LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

Feet

0 250 500 1,000

N

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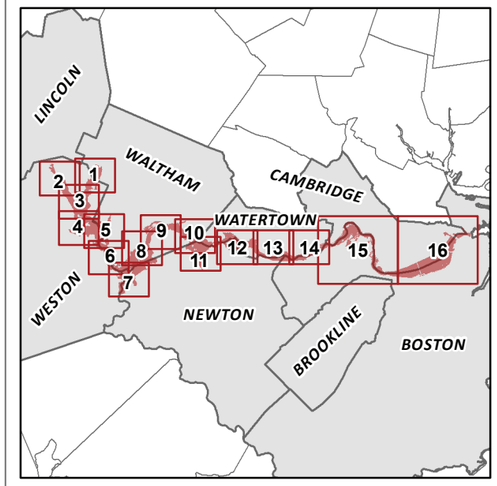
CAMBRIDGE RESERVOIR

DAM FAILURE SCENARIOS

Panel 7 of 16

PANEL LOCATOR



Stony Brook Reservoir Dam

D/S Distance to Dam: 3.9 miles
Flood Wave Arrival Time: 1 hrs 30 mins (45 mins FF)
Peak Flood Wave Arrival Time: 6 hrs 50 mins (3 hrs 10 mins FF)

Cross Section A

D/S Distance to Dam: 4.6 miles
Max Flood Rise: 6 ft (15 ft FF)
Max Velocity: 3 ft/s (5 ft/s FF)
Flood Wave Arrival Time: 1 hrs 30 mins (1 hrs 10 mins FF)
Peak Flood Wave Arrival Time: 7 hrs 15 mins (3 hrs 55 mins FF)

South Street Bridge

D/S Distance to Dam: 4 miles
Max Flood Rise: 14 ft (19 ft FF)
Structure Overtop Flood Depth: 6 ft (11 ft FF)
Max Velocity: 5 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 1 hrs 30 mins (45 mins FF)
Peak Flood Wave Arrival Time: 6 hrs 55 mins (3 hrs 10 mins FF)
Overtopping Duration: > 19 hrs (> 24 hrs FF)

Slow-Moving Backwater up the Charles River

Max Rise Above Ground = 8 ft (17 ft FF)
Flood Wave Arrival Time: 3 hrs 10 mins (55 mins FF)
Peak Flood Wave Arrival Time: 6 hrs 20 mins (4 hrs 50 mins FF)

Note: *The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.*

LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
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- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

Feet

0 250 500 1,000

N

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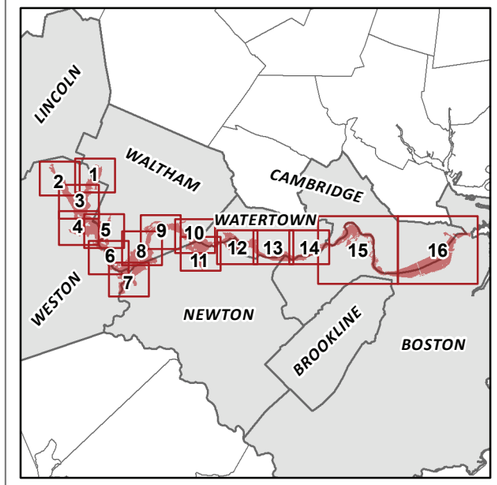
CAMBRIDGE RESERVOIR
DAM FAILURE SCENARIOS

Panel 8 of 16

PANEL LOCATOR



Overtopping of Prospect Street as deep as 5 ft FF

Cross Section B

D/S Distance to Dam: 5.1 miles
Max Flood Rise: 5 ft (14 ft FF)
Max Velocity: 2 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 1 hrs 35 mins (1 hrs 20 mins FF)
Peak Flood Wave Arrival Time: 7 hrs 30 mins (4 hrs 45 mins FF)

Prospect St Bridge

D/S Distance to Dam: 5.8 miles
Max Flood Rise: 5 ft (13 ft FF)
Structure Overtop Flood Depth: 0 ft (3 ft FF)
Max Velocity: 3 ft/s (5 ft/s FF)
Flood Wave Arrival Time: 1 hrs 40 mins (1 hrs 30 mins FF)
Peak Flood Wave Arrival Time: 8 hrs 40 mins (5 hrs FF)
Overtopping Duration: NA (5 hrs 20 mins FF)

Slow-Moving Backwater

Max Rise Above Ground = NA (5 ft FF)
Flood Wave Arrival Time: NA (1 hrs 30 mins FF)
Peak Flood Wave Arrival Time: NA (5 hrs FF)

Charles River

THORNTON ROAD
PLEASANT AVENUE
HIGHLAND STREET
DREW STREET
SHARON STREET
BELLEVUE STREET
PROSPECT STREET
WALNUT STREET
CHESTNUT STREET
MAPLE STREET
MAPLE TERRACE
CHERRY STREET
ALDER STREET
ASH STREET
MYRTLE STREET
SHAKESPEARE ROAD
MORRIS STREET
WHEELOCK ROAD
HOPE AVENUE
LOOP ROAD
SOUTH STREET
OLD SOUTH STREET
SAWYER ROAD
CRESCENT STREET
ROBBINS STREET
ORANGE STREET
ADAMS STREET
CHESTER AVENUE
WADSWORTH AVENUE
WASHINGTON AVENUE
MOODY STREET
DEXTER STREET
DERBY STREET
UNDERWOOD PARK
NORUMBEGA TERRACE
COVE STREET
WOERD AVENUE
DENNISON STREET
MARTYN STREET
RANDALL STREET
PARK STREET
RIVERVIEW AVENUE
RUMFORD AVENUE
MILTON AVENUE
WHITLOWE ROAD
LEXINGTON STREET
JAMES STREET
BUTTRICK STREET
FOREST GROVE ROAD
WABASSO STREET
ANGLESIDE ROAD
CHARLES RIVER ROAD
EDGEWATER DRIVE
KNOLLWOOD DRIVE
RIVERSIDE DRIVE
WALTHAM
NEWTON

LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

N

Feet
0 250 500 1,000

Note: *The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.*

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CAMBRIDGE RESERVOIR
DAM FAILURE SCENARIOS

Panel 9 of 16

Moody Street Bridge

D/S Distance to Dam: 6.3 miles
Max Flood Rise: 4 ft (9 ft FF)
Structure Overtop Flood Depth: 0 ft (3 ft FF)
Max Velocity: 2 ft/s (5 ft/s FF)
Flood Wave Arrival Time: 2 hrs 5 mins (1 hrs 35 mins FF)
Peak Flood Wave Arrival Time: 8 hrs 55 mins (5 hrs 10 mins FF)
Overtopping Duration: NA (11 hrs 10 mins FF)

Elm Street Bridge

D/S Distance to Dam: 6.6 miles
Max Flood Rise: 9 ft (15 ft FF)
Structure Overtop Flood Depth: 2 ft (9 ft FF)
Max Velocity: 3 ft/s (5 ft/s FF)
Flood Wave Arrival Time: 2 hrs 10 mins (1 hrs 40 mins FF)
Peak Flood Wave Arrival Time: 8 hrs 60 mins (5 hrs 10 mins FF)
Overtopping Duration: 8 hrs 30 mins (> 24 hrs FF)

Overtopping of Prospect Street as deep as 5 ft FF

Newton Street Bridge

D/S Distance to Dam: 6.8 miles
Max Flood Rise: 8 ft (14 ft FF)
Structure Overtop Flood Depth: 2 ft (8 ft FF)
Max Velocity: 3 ft/s (3 ft/s FF)
Flood Wave Arrival Time: 2 hrs 20 mins (1 hrs 45 mins FF)
Peak Flood Wave Arrival Time: 9 hrs 5 mins (5 hrs 15 mins FF)
Overtopping Duration: 16 hrs 30 mins (> 24 hrs FF)

Prospect St Bridge

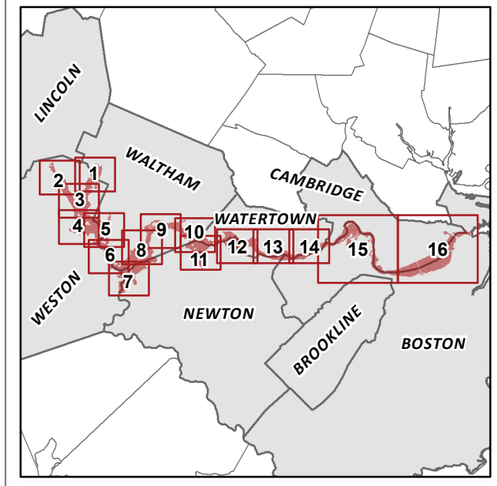
D/S Distance to Dam: 5.8 miles
Max Flood Rise: 5 ft (13 ft FF)
Structure Overtop Flood Depth: 0 ft (3 ft FF)
Max Velocity: 3 ft/s (5 ft/s FF)
Flood Wave Arrival Time: 1 hrs 40 mins (1 hrs 30 mins FF)
Peak Flood Wave Arrival Time: 8 hrs 40 mins (5 hrs FF)
Overtopping Duration: NA (5 hrs 20 mins FF)

Moody Street Dam

D/S Distance to Dam: 6.3 miles
Max Flood Rise: 4 ft (8 ft FF)
Max Velocity: 3 ft/s (8 ft/s FF)
Flood Wave Arrival Time: 2 hrs 10 mins (1 hrs 40 mins FF)
Peak Flood Wave Arrival Time: 8 hrs 55 mins (5 hrs 10 mins FF)

Note: *The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.*

PANEL LOCATOR



LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

N

Feet
0 250 500 1,000

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CAMBRIDGE RESERVOIR

DAM FAILURE SCENARIOS

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Newton Street Bridge

D/S Distance to Dam: 6.8 miles
Max Flood Rise: 8 ft (14 ft FF)
Structure Overtop Flood Depth: 2 ft (8 ft FF)
Max Velocity: 3 ft/s (3 ft/s FF)
Flood Wave Arrival Time: 2 hrs 20 mins (1 hrs 45 mins FF)
Peak Flood Wave Arrival Time: 9 hrs 5 mins (5 hrs 15 mins FF)
Overtopping Duration: 16 hrs 30 mins (> 24 hrs FF)

Bleachery Dam

D/S Distance to Dam: 7.2 miles
Max Flood Rise: 5 ft (13 ft FF)
Max Velocity: 3 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 2 hrs 35 mins (1 hrs 55 mins FF)
Peak Flood Wave Arrival Time: 9 hrs 20 mins (5 hrs 15 mins FF)

Farwell St Bridge

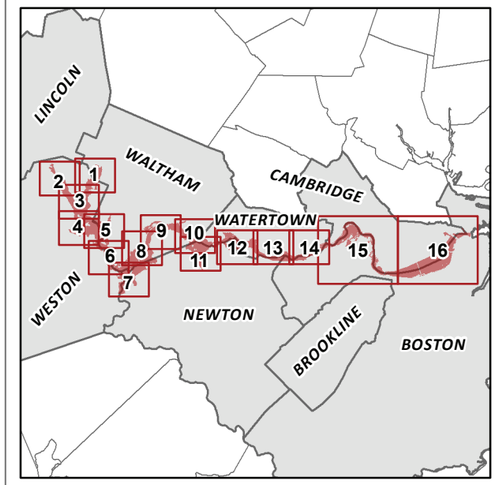
D/S Distance to Dam: 7.5 miles
Max Flood Rise: 10 ft (19 ft FF)
Structure Overtop Flood Depth: <1 ft (9 ft FF)
Max Velocity: 2 ft/s (2 ft/s FF)
Flood Wave Arrival Time: 2 hrs 40 mins (2 hrs FF)
Peak Flood Wave Arrival Time: 9 hrs 35 mins (5 hrs 25 mins FF)
Overtopping Duration: 10 mins (> 8 hrs 30 mins FF)

Slow-Moving Backwater

Max Rise Above Ground = NA (6 - 10 ft FF)
Flood Wave Arrival Time: NA (2 hrs 10 mins FF)
Peak Flood Wave Arrival Time: NA (6 hrs 30 mins FF)

Note: *The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.*

PANEL LOCATOR



LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
- "Max Flood Rise" is relative to the channel water surface associated with the simulated normal flow condition.
- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

Feet
0 250 500 1,000

N

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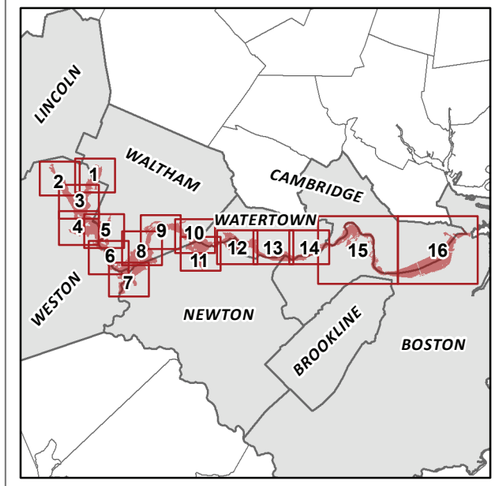
CAMBRIDGE RESERVOIR

DAM FAILURE SCENARIOS

Panel 11 of 16

PANEL LOCATOR



Slow-Moving Backwater

Max Rise Above Ground = NA (6 - 10 ft FF)
Flood Wave Arrival Time: NA (2 hrs 10 mins FF)
Peak Flood Wave Arrival Time: NA (6 hrs 30 mins FF)

Farwell St Bridge

D/S Distance to Dam: 7.5 miles
Max Flood Rise: 10 ft (19 ft FF)
Structure Overtop Flood Depth: <1 ft (9 ft FF)
Max Velocity: 2 ft/s (2 ft/s FF)
Flood Wave Arrival Time: 2 hrs 40 mins (2 hrs FF)
Peak Flood Wave Arrival Time: 9 hrs 35 mins (5 hrs 25 mins FF)
Overtopping Duration: 10 mins (> 8 hrs 30 mins FF)

Bridge St Bridge

D/S Distance to Dam: 8.3 miles
Max Flood Rise: 10 ft (23 ft FF)
Structure Overtop Flood Depth: 0 ft (5 ft FF)
Max Velocity: 6 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 3 hrs 10 mins (2 hrs 15 mins FF)
Peak Flood Wave Arrival Time: 10 hrs 5 mins (6 hrs 30 mins FF)
Overtopping Duration: NA (6 hrs FF)

Note: *The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.*

LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
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- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

Feet
0 250 500 1,000

N

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CAMBRIDGE RESERVOIR
DAM FAILURE SCENARIOS

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Watertown Dam

D/S Distance to Dam: 9.2 miles
Max Flood Rise: 5 ft (13 ft FF)
Max Velocity: 4 ft/s (5 ft/s FF)
Flood Wave Arrival Time: 3 hrs 40 mins (2 hrs 30 mins FF)
Peak Flood Wave Arrival Time: 10 hrs 35 mins (6 hrs 60 mins FF)

Bridge St Bridge

D/S Distance to Dam: 8.3 miles
Max Flood Rise: 10 ft (23 ft FF)
Structure Overtop Flood Depth: 0 ft (5 ft FF)
Max Velocity: 6 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 3 hrs 10 mins (2 hrs 15 mins FF)
Peak Flood Wave Arrival Time: 10 hrs 5 mins (6 hrs 30 mins FF)
Overtopping Duration: NA (6 hrs FF)

Slow-Moving Backwater

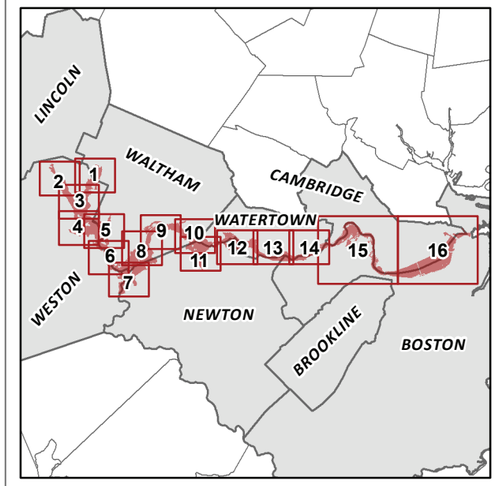
Max Rise Above Ground = NA (5 ft FF)
Flood Wave Arrival Time: NA (2 hrs 30 mins FF)
Peak Flood Wave Arrival Time: NA (6 hrs 30 mins FF)

Galen St Bridge

D/S Distance to Dam: 9.4 miles
Max Flood Rise: 8 ft (18 ft FF)
Structure Overtop Flood Depth: 0 ft (3 ft FF)
Max Velocity: 5 ft/s (6 ft/s FF)
Flood Wave Arrival Time: 3 hrs 40 mins (2 hrs 35 mins FF)
Peak Flood Wave Arrival Time: 10 hrs 40 mins (7 hrs 5 mins FF)
Overtopping Duration: NA (5 hrs FF)

Note: The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.

PANEL LOCATOR



LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
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- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

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- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

Feet
0 250 500 1,000

N

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CAMBRIDGE RESERVOIR

DAM FAILURE SCENARIOS

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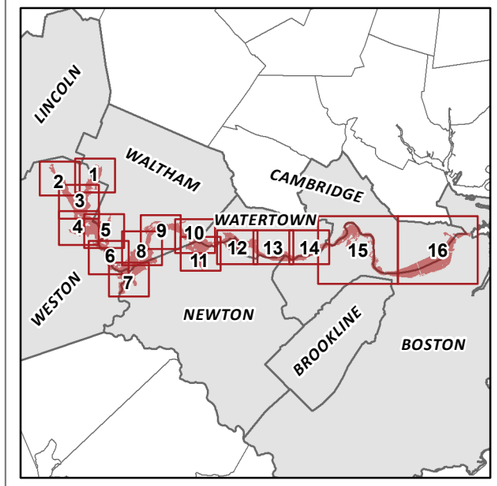
Cross Section C

D/S Distance to Dam: 12.3 miles
Max Flood Rise: 4 ft (5 ft FF)
Max Velocity: 2 ft/s (4 ft/s FF)
Flood Wave Arrival Time: 3 hrs 45 mins (2 hrs 45 mins FF)
Peak Flood Wave Arrival Time: 10 hrs 60 mins (7 hrs 20 mins FF)

Charles River

WATERTOWN
NEWTON
BOSTON

PANEL LOCATOR



LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
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- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

- Values refer to FWF unless otherwise labeled "FF"
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- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery

Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

Feet

0 250 500 1,000

N

Note: *The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.*

CAMBRIDGE RESERVOIR

DAM FAILURE SCENARIOS

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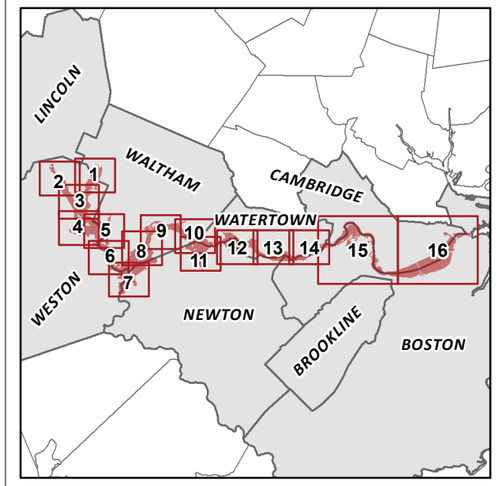
PANEL LOCATOR



Arsenal St Bridge

D/S Distance to Dam: 11.7 miles
Max Flood Rise: 2 ft (8 ft FF)
Structure Overtop Flood Depth: 0 ft (1 ft FF)
Max Velocity: 3 ft/s (6 ft/s FF)
Flood Wave Arrival Time: 4 hrs (2 hrs 55 mins FF)
Peak Flood Wave Arrival Time: 11 hrs 35 mins (8 hrs FF)
Overtopping Duration: NA (5 hrs 20 mins FF)

N Beacon St Bridge

D/S Distance to Dam: 10.9 miles
Max Flood Rise: 4 ft (12 ft FF)
Structure Overtop Flood Depth: 0 ft (3 ft FF)
Max Velocity: 2 ft/s (5 ft/s FF)
Flood Wave Arrival Time: 3 hrs 50 mins (2 hrs 50 mins FF)
Peak Flood Wave Arrival Time: 11 hrs 25 mins (7 hrs 50 mins FF)
Overtopping Duration: NA (7 hrs 20 mins FF)

LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
- Roads
- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

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- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

CDM Smith

N

Feet

0 250 500 1,000

Note: *The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.*

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CAMBRIDGE RESERVOIR

DAM FAILURE SCENARIOS

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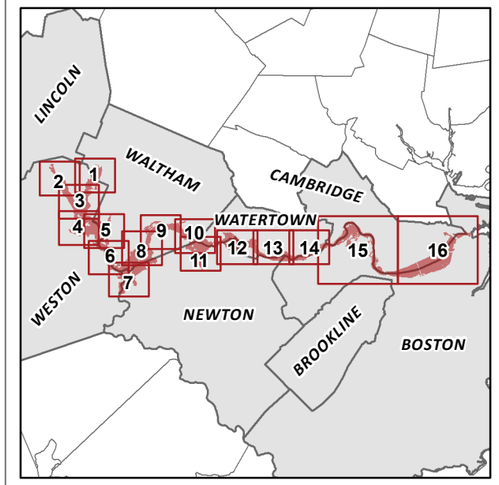
Arsenal St Bridge

D/S Distance to Dam: 11.7 miles
Max Flood Rise: 2 ft (8 ft FF)
Structure Overtop Flood Depth: 0 ft (1 ft FF)
Max Velocity: 3 ft/s (6 ft/s FF)
Flood Wave Arrival Time: 4 hrs (2 hrs 55 mins FF)
Peak Flood Wave Arrival Time: 11 hrs 35 mins (8 hrs FF)
Overtopping Duration: NA (5 hrs 20 mins FF)

Charles River Basin FWF: 1.2 ft rise
Charles River Basin FF: 5.7 ft rise

PANEL LOCATOR



LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
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- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

NOTES ON FLOOD WAVE CALL-OUTS

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- "Structure Overtop Flood Depth" is relative to the deck elevation of the crossing.
- Section 4.1 and Appendix G provide more information on the flood scenario assumptions.

Data Source: MassGIS; ESRI World Imagery
Coordinate System: NAD 1983 State Plane MA Mainland

Note: The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.

Feet
0 500 1,000 2,000

N

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CAMBRIDGE RESERVOIR

DAM FAILURE SCENARIOS

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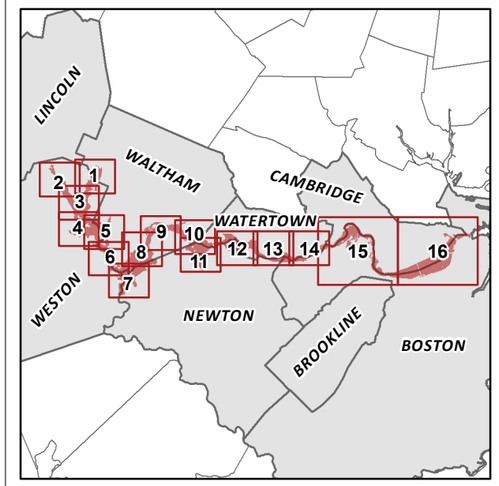
Charles River Basin FWF: 1.2 ft rise
Charles River Basin FF: 5.7 ft rise

PANEL LOCATOR



LEGEND

- Flood Failure (FF) Floodwater Inundation Extent
- Fair Weather Failure (FWF) Floodwater Inundation Extent
- Inundated Structures (FWF & FF)
- Inundated Structures (FF Only)
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- Corporate Limits
- Dam
- Lake/Reservoir
- Key Locations

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Data Source: MassGIS; ESRI World Imagery

Coordinate System: NAD 1983 State Plane MA Mainland

Note: The inundation areas shown on this map are approximate and should only be used as a guideline for establishing evacuation zones. Actual flooding conditions may differ from those depicted on the map.

Feet

0 500 1,000 2,000

N

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Appendix G

FEMA Local Mitigation Plan Review Tool

Local Mitigation Plan Review Tool

Cover Page

The Local Mitigation Plan Review Tool (PRT) demonstrates how the local mitigation plan meets the regulation in 44 CFR § 201.6 and offers states and FEMA Mitigation Planners an opportunity to provide feedback to the local governments, including special districts.

1. The Multi-Jurisdictional Summary Sheet is a worksheet that is used to document how each jurisdiction met the requirements of the plan elements (Planning Process; Risk Assessment; Mitigation Strategy; Plan Maintenance; Plan Update; and Plan Adoption).
2. The Plan Review Checklist summarizes FEMA's evaluation of whether the plan has addressed all requirements.

For greater clarification of the elements in the Plan Review Checklist, please see Section 4 of this guide. Definitions of the terms and phrases used in the PRT can be found in Appendix E of this guide.

Plan Information	
Jurisdiction(s)	City of Cambridge, Massachusetts
Title of Plan	Natural Hazard Mitigation Plan 2023 Update
New Plan or Update	Update
Single- or Multi-Jurisdiction	Single
Date of Plan	November 29, 2023
Local Point of Contact	
Title	Deputy City Manager
Agency	City Manager's Office
Address	795 Massachusetts Avenue, Cambridge, MA 02139
Phone Number	617-349-4300
Email	ooriordan@cambridgema.gov

Additional Point of Contact	
Title	Director of Environmental and Transportation Planning
Agency	Cambridge Community Development Department
Address	344 Broadway, Cambridge, MA 02139
Phone Number	617-349-4600
Email	srasmussen@cambridgema.gov or cddat344@cambridgema.gov

Review Information	
State Review	
State Reviewer(s) and Title	Jeffrey Zukowski
State Review Date	February 5, 2024
FEMA Review	
FEMA Reviewer(s) and Title	
Date Received in FEMA Region	
Plan Not Approved	
Plan Approvable Pending Adoption	
Plan Approved	

Multi-Jurisdictional Summary Sheet

#	Jurisdiction Name	Requirements Met (Y/N)						
		A. Planning Process	B. Risk Assessment	C. Mitigation Strategy	D. Plan Maintenance	E. Plan Update	F. Plan Adoption	G. State Requirements
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Plan Review Checklist

The Plan Review Checklist is completed by FEMA. States and local governments are encouraged, but not required, to use the PRT as a checklist to ensure all requirements have been met prior to submitting the plan for review and approval. The purpose of the checklist is to identify the location of relevant or applicable content in the plan by element/sub-element and to determine if each requirement has been "met" or "not met." FEMA completes the "required revisions" summary at the bottom of each element to clearly explain the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is "not met." Sub-elements in each summary should be referenced using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each element and sub-element are described in detail in Section 4: Local Plan Requirements of this guide.

Plan updates must include information from the current planning process.

If some elements of the plan do not require an update, due to minimal or no changes between updates, the plan must document the reasons for that.

Multi-jurisdictional elements must cover information unique to all participating jurisdictions.

Element A: Planning Process

Element A Requirements	Location in Plan (section and/or page number)	Met / Not Met
A1. Does the plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement 44 CFR § 201.6(c)(1))		
A1-a. Does the plan document how the plan was prepared, including the schedule or time frame and activities that made up the plan's development, as well as who was involved?	Acknowledgements Chapter 2 Schedule: Figure 2-1 Activities: Chapter 2 Who was involved: Chapter, 2.2, 2.3, 2.4, 2.5 Appendix A, B, C, and D provide supporting materials.	Met
A1-b. Does the plan list the jurisdiction(s) participating in the plan that seek approval, and describe how they participated in the planning process?	Chapter 2 and Appendix A and B	Met

Element A Requirements	Location in Plan (section and/or page number)	Met / Not Met
A2. Does the plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development as well as businesses, academia, and other private and non-profit interests to be involved in the planning process? (Requirement 44 CFR § 201.6(b)(2))		
A2-a. Does the plan identify all stakeholders involved or given an opportunity to be involved in the planning process, and how each stakeholder was presented with this opportunity?	Chapter 2.4 and Appendix B	Met
A3. Does the plan document how the public was involved in the planning process during the drafting stage and prior to plan approval? (Requirement 44 CFR § 201.6(b)(1))		
A3-a. Does the plan document how the public was given the opportunity to be involved in the planning process and how their feedback was included in the plan?	Chapter 2.2, 2.5 Appendix C and D	Met
A4. Does the plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement 44 CFR § 201.6(b)(3))		
A4-a. Does the plan document what existing plans, studies, reports and technical information were reviewed for the development of the plan, as well as how they were incorporated into the document?	Chapter 2.6 and 2.7	Met
ELEMENT A REQUIRED REVISIONS		
Required Revision: Click or tap here to enter text.		

Element B: Risk Assessment

Element B Requirements	Location in Plan (section and/or page number)	Met / Not Met
B1. Does the plan include a description of the type, location, and extent of all natural hazards that can affect the jurisdiction? Does the plan also include information on previous occurrences of hazard events and on the probability of future hazard events? (Requirement 44 CFR § 201.6(c)(2)(i))		
B1-a. Does the plan describe all natural hazards that can affect the jurisdiction(s) in the planning area, and does it provide the rationale if omitting any natural hazards that are commonly recognized to affect the jurisdiction(s) in the planning area?	Chapter 3 N/A for omitting	Met

Element B Requirements	Location in Plan (section and/or page number)	Met / Not Met
B1-b. Does the plan include information on the location of each identified hazard?	Chapter 3	Met
B1-c. Does the plan describe the extent for each identified hazard?	Chapter 3	Met
B1-d. Does the plan include the history of previous hazard events for each identified hazard?	Chapter 3	Met
B1-e. Does the plan include the probability of future events for each identified hazard? Does the plan describe the effects of future conditions, including climate change (e.g., long-term weather patterns, average temperature and sea levels), on the type, location and range of anticipated intensities of identified hazards?	Chapter 3	Met
B1-f. For participating jurisdictions in a multi-jurisdictional plan, does the plan describe any hazards that are unique to and/or vary from those affecting the overall planning area?	N/A	Met
B2. Does the plan include a summary of the jurisdiction's vulnerability and the impacts on the community from the identified hazards? Does this summary also address NFIP-insured structures that have been repetitively damaged by floods? (Requirement 44 CFR § 201.6(c)(2)(ii))		
B2-a. Does the plan provide an overall summary of each jurisdiction's vulnerability to the identified hazards?	Chapter 4 Chapter 5	Met
B2-b. For each participating jurisdiction, does the plan describe the potential impacts of each of the identified hazards on each participating jurisdiction?	Chapter 5	Met
B2-c. Does the plan address NFIP-insured structures within each jurisdiction that have been repetitively damaged by floods?	Chapter 3.1.2.3 Chapter 6.1.4	Met
ELEMENT B REQUIRED REVISIONS		
Required Revision: Click or tap here to enter text.		

Element C: Mitigation Strategy

Element C Requirements	Location in Plan (section and/or page number)	Met / Not Met
C1. Does the plan document each participant's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement 44 CFR § 201.6(c)(3))		
C1-a. Does the plan describe how the existing capabilities of each participant are available to support the mitigation strategy? Does this include a discussion of the existing building codes and land use and development ordinances or regulations?	Chapter 6 Chapter 6.2.1	Met
C1-b. Does the plan describe each participant's ability to expand and improve the identified capabilities to achieve mitigation?	Chapter 6 "Capability Gaps"	Met
C2. Does the plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement 44 CFR § 201.6(c)(3)(ii))		
C2-a. Does the plan contain a narrative description or a table/list of their participation activities?	Chapter 6.1	Met
C3. Does the plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement 44 CFR § 201.6(c)(3)(i))		
C3-a. Does the plan include goals to reduce the risk from the hazards identified in the plan?	Chapter 1.4	Met
C4. Does the plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement 44 CFR § 201.6(c)(3)(ii))		
C4-a. Does the plan include an analysis of a comprehensive range of actions/projects that each jurisdiction considered to reduce the impacts of hazards identified in the risk assessment?	Chapter 2.4 and Appendix B Chapter 7	Met
C4-b. Does the plan include one or more action(s) per jurisdiction for each of the hazards as identified within the plan's risk assessment?	Table 7.2	Met
C5. Does the plan contain an action plan that describes how the actions identified will be prioritized (including a cost-benefit review), implemented, and administered by each jurisdiction? (Requirement 44 CFR § 201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))		
C5-a. Does the plan describe the criteria used for prioritizing actions?	Chapter 7.3.2	Met

Element C Requirements	Location in Plan (section and/or page number)	Met / Not Met
C5-b. Does the plan provide the position, office, department or agency responsible for implementing/administrating the identified mitigation actions, as well as potential funding sources and expected time frame?	Table 7.2 Chapter 7.3.3	Met
ELEMENT C REQUIRED REVISIONS		
Required Revision: Click or tap here to enter text.		

Element D: Plan Maintenance

Element D Requirements	Location in Plan (section and/or page number)	Met / Not Met
D1. Is there discussion of how each community will continue public participation in the plan maintenance process? (Requirement 44 CFR § 201.6(c)(4)(iii))		
D1-a. Does the plan describe how communities will continue to seek future public participation after the plan has been approved?	Chapter 8.5	Met
D2. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a five-year cycle)? (Requirement 44 CFR § 201.6(c)(4)(i))		
D2-a. Does the plan describe the process that will be followed to track the progress/status of the mitigation actions identified within the Mitigation Strategy, along with when this process will occur and who will be responsible for the process?	Chapter 8.1 and 8.5	Met
D2-b. Does the plan describe the process that will be followed to evaluate the plan for effectiveness? This process must identify the criteria that will be used to evaluate the information in the plan, along with when this process will occur and who will be responsible.	Chapter 8.2	Met
D2-c. Does the plan describe the process that will be followed to update the plan, along with when this process will occur and who will be responsible for the process?	Chapter 8.3	Met

Element D Requirements	Location in Plan (section and/or page number)	Met / Not Met
D3. Does the plan describe a process by which each community will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement 44 CFR § 201.6(c)(4)(ii))		
D3-a. Does the plan describe the process the community will follow to integrate the ideas, information and strategy of the mitigation plan into other planning mechanisms?	Chapter 8.4	Met
D3-b. Does the plan identify the planning mechanisms for each plan participant into which the ideas, information and strategy from the mitigation plan may be integrated?	Chapter 8.4	Met
D3-c. For multi-jurisdictional plans, does the plan describe each participant's individual process for integrating information from the mitigation strategy into their identified planning mechanisms?	N/A	Met
ELEMENT D REQUIRED REVISIONS		
Required Revision: Click or tap here to enter text.		

Element E: Plan Update

Element E Requirements	Location in Plan (section and/or page number)	Met / Not Met
E1. Was the plan revised to reflect changes in development? (Requirement 44 CFR § 201.6(d)(3))		
E1-a. Does the plan describe the changes in development that have occurred in hazard-prone areas that have increased or decreased each community's vulnerability since the previous plan was approved?	Chapter 4.2.3.1	Met
E2. Was the plan revised to reflect changes in priorities and progress in local mitigation efforts? (Requirement 44 CFR § 201.6(d)(3))		
E2-a. Does the plan describe how it was revised due to changes in community priorities?	Chapter 2.1	Met
E2-b. Does the plan include a status update for all mitigation actions identified in the previous mitigation plan?	Chapter 7 Table 7.1	Met

Element E Requirements	Location in Plan (section and/or page number)	Met / Not Met
E2-c. Does the plan describe how jurisdictions integrated the mitigation plan, when appropriate, into other planning mechanisms?	Chapter 2.6 Chapter 8.4	Met
ELEMENT E REQUIRED REVISIONS		
Required Revision: Click or tap here to enter text.		

Element F: Plan Adoption

Element F Requirements	Location in Plan (section and/or page number)	Met / Not Met
F1. For single-jurisdictional plans, has the governing body of the jurisdiction formally adopted the plan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))		
F1-a. Does the participant include documentation of adoption?	Chapter 9	Met
F2. For multi-jurisdictional plans, has the governing body of each jurisdiction officially adopted the plan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))		
F2-a. Did each participant adopt the plan and provide documentation of that adoption?	Chapter 9	Met
ELEMENT F REQUIRED REVISIONS		
Required Revision: Click or tap here to enter text.		

Element G: High Hazard Potential Dams

HHPD Requirements	Location in Plan (section and/or page number)	Met / Not Met
HHPD1. Did the plan describe the incorporation of existing plans, studies, reports and technical information for HHPDs?		
HHPD1-a. Does the plan describe how the local government worked with local dam owners and/or the state dam safety agency?	Chapter 2.4 and Appendix B Chapter 4.2.3.3	Met
HHPD1-b. Does the plan incorporate information shared by the state and/or local dam owners?	Chapter 4.2.3.3	Met
HHPD2. Did the plan address HHPDs in the risk assessment?		
HHPD2-a. Does the plan describe the risks and vulnerabilities to and from HHPDs?	Chapter 3.3	Met
HHPD2-b. Does the plan document the limitations and describe how to address deficiencies?	Chapter 3.3 Table 7.2	Met
HHPD3. Did the plan include mitigation goals to reduce long-term vulnerabilities from HHPDs?		
HHPD3-a. Does the plan address how to reduce vulnerabilities to and from HHPDs as part of its own goals or with other long-term strategies?	Chapter 3.3 Chapter 4.2.3.3 Table 7.2	Met
HHPD3-b. Does the plan link proposed actions to reducing long-term vulnerabilities that are consistent with its goals?	Table 7.2	Met
HHPD4-a. Did the plan include actions that address HHPDs and prioritize mitigation actions to reduce vulnerabilities from HHPDs?		
HHPD4-a. Does the plan describe specific actions to address HHPDs?	Table 7.2	Met
HHPD4-b. Does the plan describe the criteria used to prioritize actions related to HHPDs?	Chapter 7.3.2	Met

HHPD Requirements	Location in Plan (section and/or page number)	Met / Not Met
HHPD4-c. Does the plan identify the position, office, department or agency responsible for implementing and administering the action to mitigate hazards to or from HHPDs?	Chapter 3.3 Chapter 4.2.3.3 Table 7.2	Met
HHPD Required Revisions		
Required Revision: Click or tap here to enter text.		

Element H: Additional State Requirements (Optional)

Element H Requirements	Location in Plan (section and/or page number)	Met / Not Met
This space is for the State to include additional requirements		
Click or tap here to enter text.	Click or tap here to enter text.	Choose an item.

Plan Assessment

These comments can be used to help guide your annual/regularly scheduled updates and the next plan update.

Element A. Planning Process

Strengths

- Participation in plan development by a wide range of city staff in many departments.
- Broad stakeholder group available for support of plan development
- Cambridge has in-house staff dedicated applying equitable access who heavily participated in plan development.
- Cambridge has developed numerous plans, studies, reports, and prepared technical information that facilitated plan development,

Opportunities for Improvement

- Improved advertisement of opportunities to provide input on the plan.

Element B. Risk Assessment

Strengths

- Cambridge has some of the most advanced climate resilience planning work in the region that supported plan development.

Opportunities for Improvement

- Cambridge could take next steps to improve its Community Rating System class ranking from a 9 to an 8.

Element C. Mitigation Strategy

Strengths

- Cambridge streamlined the goals and objectives of hazard mitigation planning that facilitate rapid understanding but decision makers and the public.
- The city has identified funding to implement many of the high priority mitigation actions.
- Mitigation actions address all natural hazards.
- There are a variety of departments who were actively involved in development of the plan who have agreed to champion mitigation actions.

Opportunities for Improvement

- The number of actions may be challenging to implement in 5 years. In the next update, the city should evaluate whether reduction in the number of actions results in a more streamlined and effective HMP.

Element D. Plan Maintenance

Strengths

- City pursuing single role for managing all hazard mitigation and climate resilience actions across various plans and department city-wide.

Opportunities for Improvement

- Identifying how to better engage the community as the plan is maintained.

Element E. Plan Update

Strengths

- Strong local regulations related to mitigating impacts from flooding, heat, and other natural hazards are applied to redevelopment projects.
- Diversity, equity, and inclusion was a priority for this plan and will continue to be integrated into actions undertaken to reduce risk from natural hazards and climate change.

Opportunities for Improvement

- The City is currently working on regional projects to provide resilience from coastal flooding. The results of this work should be integrated in the next HMP.

Element G. HHPD Requirements (Optional)

Strengths

- Cambridge actively is coordinating with the Charles River and Amelia Earhart dam owners on evaluation and upgrades to further protect the city from coastal flooding.
- Cambridge addresses state requirements for the two dams owned and operated by the city for their public water supply.

Opportunities for Improvement

- During the next HMP update, Weston & Waltham should be engaged in discussions about the city's owned/operated dams during plan development.

Element H. Additional State Requirements (Optional)

Strengths

- [insert comments]

Opportunities for Improvement

- [insert comments]